



HPOIL GAS PRIVATE LIMITED

(A Joint Venture of HPCL & OIL)

**TENDER FOR ANNUAL RATE CONTRACT FOR EXECUTION OF
COMPOSITE WORKS (MECHANICAL & ELECTRICAL) FOR CNG
STATIONS AT KOLHAPUR GA**

COMMERCIAL VOLUME

TENDER NO. HOGPL/2025-26/C&P/030

DATE: 26.12.2025

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Tender No.....



SCOPE OF WORK – MECHANICAL

**HPOIL GAS PRIVATE LIMITED
(HOGPL)**

**CITY GAS DISTRIBUTION PROJECT AT
KOLHAPUR GA**

**SCOPE OF WORK FOR COMPOSITE WORKS FOR
CNG STATIONS**

Rev	Date	Description	Prepared By	Checked By	Approved By



SCOPE OF WORK FOR COMPOSITE WORKS FOR CNG STATIONS

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SCOPE OF WORK FOR COMPOSITE WORKS FOR CNG STATIONS

1.0 INTRODUCTION

Hindustan Petroleum Corporation Limited (HPCL) is a Central Public Sector with a Navratna Status, and a Forbes 2000 and Global Fortune 500 company incorporated in 1974 engaged in refining and marketing of petroleum products with its headquarter in Mumbai, Maharashtra.

Oil India Limited (OIL) is a premier Indian National Oil Company engaged in the business of exploration, development and production of crude oil and natural gas, transportation of crude oil and production of LPG founded in 1959 with its headquarters in Duliajan, Assam.

A JVC has been incorporated in the name of HPOIL GAS PRIVATE LIMITED, which has received the authorization from PNGRB vide letter PNGRB/CGD/BID/8/2018/GA/Ambala-Kurukshetra District dated 22/02/2018 to Lay, Build and Operate City Gas Distribution networks in Ambala & Kurukshetra and vide letter PNGRB/CGD/BID/8/2017/BEC/GA-Kolhapur dated 06/03/2018 to Lay, Build and Operate City Gas Distribution networks in Kolhapur District.

2.0 BRIEF DESCRIPTION OF PROJECT

The present project is the supply of natural gas as Piped Natural Gas (PNG) to Domestic, Commercial and Industrial consumers and Compressed Natural Gas (CNG) to automobile consumers at Kolhapur GA. It is proposed to execute the Composite work for CNG stations involving Supply, Erection, Installation and Commissioning of Electrical & Mechanical works as per details furnished in this Bid document.

3.0 OVERALL, SCOPE OF COMPOSITE WORK FOR CNG STATION

The scope of work includes composite works (Electrical & Mechanical works) for CNG stations at Kolhapur GA on Annual Rate Contract (ARC) basis:

Part-A Kolhapur		
DBS STATION (In Nos.)	ONLINE STATION (In Nos.)	DBS Stations to On-Line Stations (In Nos.)
3	1	1

All materials and consumables (e.g., Valves, Fittings, Flanges, Assorted Pipes etc.) of below 2 inches required for satisfactory completion of the job shall be in the scope of the Contractor except free issue material provided by Owner. It shall include Supply, Erection, Testing and safely commissioning of all items required for completion of all the jobs mentioned in scope of work including inspection of all supply items but not



SCOPE OF WORK FOR COMPOSITE WORKS FOR CNG STATIONS

limited to above. Wherever it is mentioned in the Specifications or Scope of Work that the Contractor shall perform certain work or provide certain facilities, contractor shall execute the work without any extra charges.

Free Issue materials:

- Compressor
- Cascade
- Dispenser

3.1 Scope – Mechanical work

This document covers the details of supply and installation of mechanical equipment at Kolhapur GA include installation of Cascades, and supply and installation of Fire extinguisher and trailer panel etc. All works and clauses of this document shall be applicable unless specifically mentioned otherwise. The scope of work for electrical is covered in other parts of tender.

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

4.0 SCOPE OF SUPPLY

The detail scope of work given below: -

4.1 ONLINE STATION

- 3000/4500 WL Capacity Stationary cascade
- Supply and installation of 09 KG DCP near Compressor
- Supply and installation of 09 KG DCP near Dispenser
- Supply and installation of 09 KG DCP near Mobile Cascade
- Supply and installation of 09 KG DCP near Stationary Cascade
- Supply and installation of 2 KG CO₂ Fire Extinguisher
- Supply and installation of 4.5 KG CO₂ Fire Extinguisher
- Supply and installation of 6.5 KG CO₂ Fire Extinguisher
- Supply and Installation of LCV Filling facility (Trailer Panel) with mass flow meter, flow range (0 to 100 kg/min) along with associated fittings & consumables - 1 Nos at each station.
- Supply, erection, laying, testing and safely commissioning of SS tubing, fittings and valves and necessary adaptors, clamps, brackets etc., as required from compressor priority panel to mobile cascade, stationary cascade and dispenser of Online stations as per the tentative quantities mentioned in the SOR, Standard technical specifications of the SS tube and Fittings.
- Supply, erection, laying, testing and safely commissioning of CS Piping, fittings and valves and necessary adaptors, clamps, brackets, CS Piping Supports etc., as required from compressor priority panel to mobile cascade, stationary cascade and dispenser of Online stations as per the tentative quantities mentioned in the SOR, Standard technical specifications of the CS Piping and Fittings

4.2 DAUGHTER BOOSTER STATION (DBS)

- Supply and installation of 09 KG DCP near Compressor
- Supply and installation of 75 KG DCP near Compressor



SCOPE OF WORK FOR COMPOSITE WORKS FOR CNG STATIONS

- Supply and installation of 09 KG DCP near Dispenser
- Supply and installation of 09 KG DCP near Mobile Cascade
- Supply and installation of 09 KG DCP near Stationary Cascade
- Supply and installation of 2 KG CO₂ Fire Extinguisher
- Supply and installation of 4.5 KG CO₂ Fire Extinguisher
- Supply and installation of 6.5 KG CO₂ Fire Extinguisher
- Supply, erection, laying, testing and safely commissioning of SS tubing, fittings and valves and necessary adaptors, clamps, brackets etc., as required from compressor priority panel to mobile cascade, stationary cascade and dispenser of Daughter Booster stations as per the tentative quantities mentioned in the SOR, Standard technical specifications of the SS tube and Fittings.
- Supply and Installation of LCV Filling facility (Trailer Panel) with mass flow meter, flow range (0 to 100 kg/min) along with associated fittings & consumables - 1 Nos at each station.

4.3 **CONVERSION OF DAUGHTER BOOSTER STATIONS TO ON-LINE STATIONS** **(DBS TO OLS)**

- Supply and installation of 09 KG DCP near Compressor
- Supply and installation of 09 KG DCP near Dispenser
- Supply and installation of 09 KG DCP near Mobile Cascade
- Supply and installation of 09 KG DCP near Stationary Cascade
- Supply and installation of 2 KG CO₂ Fire Extinguisher
- Supply and installation of 4.5 KG CO₂ Fire Extinguisher
- Supply and installation of 6.5 KG CO₂ Fire Extinguisher
- Supply and Installation of LCV Filling facility (Trailer Panel) with mass flow meter, flow range (0 to 100 kg/min) along with associated fittings & consumables - 1 Nos at each station.
- Supply, erection, laying, testing and safely commissioning of SS tubing, fittings and valves and necessary adaptors, clamps, brackets etc., as required from compressor priority panel to mobile cascade, stationary cascade and dispenser of Online stations as per the tentative quantities mentioned in the SOR, Standard technical specifications of the SS tube and Fittings.
- Supply, erection, laying, testing and safely commissioning of CS Piping, fittings and valves and necessary adaptors, clamps, brackets, CS Piping Supports etc., as required from compressor priority panel to mobile cascade, stationary cascade and dispenser of Online stations as per the tentative quantities mentioned in the SOR, Standard technical specifications of the CS Piping and Fittings
- DISMANTLING/RECONNECTING/MODIFICATION OF SS TUBING & FITTINGS.

5.0 EXCLUSIONS



SCOPE OF WORK FOR COMPOSITE WORKS FOR CNG STATIONS

The following are excluded from the scope of the bidder:

- All civil works and foundation design, however the bidder shall furnish all the relevant data for design of any pedestal if required.
- Supply and Installation of CNG Booster Compressor
- Supply and Installation of Car Dispenser
- Installation of incoming main power cable to starter cum local control panel.

6.0 BASIS OF WORK

- 6.1 The design, construction, manufacture, supply, testing and other general requirements of the Fire Extinguisher shall be strictly in accordance with the applicable OISD codes, technical specification, approved drawing./document and shall comply fully with relevant National/ International standards, Indian Electricity Act, Indian Electricity Rules, regulations of Insurance Association of India and Factories Act while carrying out work as per this specification.
- 6.2 Any modification suggested by the statutory bodies either during drawing approval or during inspection, if any, shall be carried out by the Bidder without any additional cost and delivery implications.
- 6.3 Following codes, standards and regulations & all their subsequent amendments to be considered:
- OISD-179
 - OISD-226
 - PNGRB-T4S-CGD
 - PETROLEUM RULES-2002
 - GAS CYLINDER RULES-2004/2016 (GOVT. OF INDIA)
 - GUIDELINES OF CHIEF CONTROLLER OF EXPLOSIVES.

7.0 STORAGE OF MATERIALS

- 7.1 All materials shall be preserved against deterioration and corrosion due to poor or improper storage while under the custody of the Contractor.



SCOPE OF WORK FOR COMPOSITE WORKS FOR CNG STATIONS

- 7.2 All materials shall be duly protected by the Contractor at his own cost with the appropriate preservatives like primer, lacquer, coating, grease etc. and shall be covered with suitable material to prevent them from direct exposure to sun, rain, wind and dust.
- 7.3 The Contractor shall check that equipment's, pipes, specials etc. are not subjected to corrosion from hydrostatic test water. Any such condition when detected should be brought to the notice of Engineer-in-Charge and remedial measures taken as directed.
- 7.4 All machined surface shall be properly greased and should be maintained and protected from damages.

8.0 AS-BUILT DOCUMENTS

- 8.1 Three sets of hard copies of following documents shall be submitted by Contractor:
- (i) Updated as-built drawings (made earlier) of Piping GAD's.
 - (ii) Project Records
 - (iii) Isometrics
- 8.2 In addition, the above documents shall also be submitted in electronic media i.e., CD ROM diskettes. Software used for the presentation of these documents shall be as follows:

Type of document	Software
Reports	MS Word/ Excel
Drawings	AutoCAD

- 8.3 For the purpose of preparation of as-built drawings, Contractor shall update the "Issued for Construction" (IFC) drawings approved by the Company. Contractor shall be provided with electronic file of all „IFC“ drawings/ alignment sheets. Contractor shall update all the drawings issued by the Company. As-built drawings shall be prepared on AutoCAD.

9.0 DOCUMENTS TO BE SUBMITTED AT THE TIME OF BIDDING

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

10.0 GENERAL

In case of conflict between the requirements given in this document and the requirements of other specifications enclosed with the tender document, the requirements specified in Scope of Work document shall govern.

Should there be conflict, discrepancy, inconsistency or dispute between the various documents, they shall be referred in the order of priority as given below:

- a. Scope of work.
- b. Schedule of Rates.
- c. P&ID's
- d. IFC drawings
- e. Specifications
- f. Standards

11.0 AS BUILT DOCUMENT



SCOPE OF WORK FOR COMPOSITE WORKS FOR CNG STATIONS

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

- a. All inspection & testing documents.
- b. All purchase specification & procurement documents.
- c. All piping GA drawings and supports at terminals.
- d. Installation and testing reports.
- e. All purchase specification and procurement documents.
- f. All Inspection, Testing and NDT records. Radiographs/ UT of all weld joints.
- g. All inspection & testing documents.
- h. All purchase specification & procurement documents.



SCOPE OF WORK – ELECTRICAL

**HPOIL GAS PRIVATE LIMITED
(HOGPL)**

CITY GAS DISTRIBUTION PROJECT AT KOLHAPUR GA

**SCOPE OF WORK FOR COMPOSITE WORKS FOR
CNG STATIONS-ELECTRICAL**



SCOPE OF WORK FOR COMPOSITE WORKS FOR CNG STATIONS

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SCOPE OF WORK FOR COMPOSITE WORKS FOR CNG STATIONS

1.0 INTRODUCTION

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Oil India Limited (OIL) is a premier Indian National Oil Company engaged in the business of exploration, development and production of crude oil and natural gas, transportation of crude oil and production of LPG founded in 1959 with its headquarters in Duliajan, Assam.

A JVC has been incorporated in the name of HPOIL GAS PRIVATE LIMITED, which has received the authorization from PNGRB vide letter PNGRB/CGD/BID/8/2018/GA/Ambala-Kurukshetra District dated 22/02/2018 to Lay, Build and Operate City Gas Distribution networks in Ambala & Kurukshetra and vide letter PNGRB/CGD/BID/8/2017/BEC/GA-Kolhapur dated 06/03/2018 to Lay, Build and Operate City Gas Distribution networks in Ambala-Kurukshetra District.

2.0 BRIEF DESCRIPTION OF PROJECT

The present project is the supply of natural gas as Piped Natural Gas (PNG) to Domestic, Commercial and Industrial consumers and Compressed Natural Gas (CNG) to automobile consumers in Kolhapur GA. It is proposed to execute the Composite work for CNG stations involving Supply, Erection, Installation and Commissioning of Electrical & Mechanical works as per details furnished in this Bid document.

3.0 OVERALL SCOPE OF COMPOSITE WORK FOR CNG STATION

The scope of work includes composite works (Electrical & Mechanical works) for CNG stations at Kolhapur GA on Annual Rate Contract (ARC) basis:

Part-A Kolhapur		
DBS STATION (In Nos.)	ONLINE STATION (In Nos.)	DBS Stations to On-Line Stations (In Nos.)
3	1	1

3.1 Scope – Electrical Work

This document covers the details of supply and installation of Electrical equipment at Kolhapur GA. The scope includes supply and installation of all electrical items. All works and clauses of this document shall be applicable unless specifically mentioned otherwise. The scope of work for Mechanical is covered in other parts of tender.



SCOPE OF WORK FOR COMPOSITE WORKS FOR CNG STATIONS

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

4.0 SCOPE OF SUPPLY & SCOPE OF WORK

The Scope of electrical works shall include **supply installation/erection testing and commissioning** of the items listed below but shall not be limited to the following.

1. Various types of LV switchboards, junction boxes etc. as per single line diagram and SOR/specifications.
2. Dual redundant UPS system with battery (sealed maintenance free lead acid battery) backup of four / two hours and AC DB as per SOR/specifications.
3. Outdoor flameproof lighting fixtures complete with LED lamps and poles as per SOR/specifications.
4. Indoor lighting fixtures as per SOR/specifications.
5. Sub Energy meter 0.2 class for LV three phase system as per specifications and SOR.
6. Supply of various LV power cables, Instrumentation cables and communication cables complete with cable glands and lugs and ferrules as per SOR/specifications.
7. Supply of various GI/PVC/HDPE conduit pipes as per SOR/specifications.
8. Supply of cable trench markers and cable tags at both ends and at intermediate locations.
9. Supply of conventional GI/Copper plate / maintenance free earthing systems and accessories like inspection chambers, earthing strips, GI wire/rope, flange jumpers as per as per SOR/specifications.
10. Supply of cable trays of various sizes as per SOR/specifications.
11. Supply of miscellaneous items like Caution boards (Danger, High Voltage), Shock hazard charts, Insulating Mats 11 KV grade, Single Line Diagram complete in glass frame Single as per SOR.
12. Any other item required for completion of the work and satisfactory operation of the CNG facilities.
13. PG test for APFC panel & UPS also in scope of bidder on site as per instructions of engineer in charge.
14. DISCONNECTING/RECONNECTING/MODIFICATION ALL ELECTRICAL CONNECTIONS

5.0 EXCLUSIONS

The following are excluded from the scope of the bidder:

- All civil works and foundation design, however the bidder shall furnish all the relevant data for design of any pedestal if required.
- Supply and Installation of CNG Booster Compressor
- Supply and Installation of Car Dispenser
- Supply of CNG Cascade



SCOPE OF WORK FOR COMPOSITE WORKS FOR CNG STATIONS

6.0 BASIS OF WORK

- 6.1** The design, construction, manufacture, supply, testing and other general requirements of the Fire Extinguisher shall be strictly in accordance with the applicable OISD codes, Technical specification, approved drawing. /document and shall comply fully with relevant National/ International standards, Indian Electricity Act, Indian Electricity Rules, regulations of Insurance Association of India and Factories Act while carrying out work as per this specification.
- 6.2** Any modification suggested by the statutory bodies either during drawing approval or during inspection, if any, shall be carried out by the Bidder without any additional cost and delivery implications.
- 6.3** Following codes, standards and regulations & all their subsequent amendments to be considered:
- OISD-179
 - OISD-226
 - PNGRB-T4S-CGD
 - PETROLEUM RULES-2002
 - GAS CYLINDER RULES-2004/2016 (GOVT. OF INDIA)
 - GUIDELINES OF CHIEF CONTROLLER OF EXPLOSIVES.

7.0 STORAGE OF MATERIALS

- 7.1** All materials shall be preserved against deterioration and corrosion due to poor or improper storage while under the custody of the Contractor.
- 7.2** All materials shall be duly protected by the Contractor at his own cost with the appropriate preservatives like primer, lacquer, coating, grease etc. and shall be covered with suitable material to prevent them from direct exposure to sun, rain, wind and dust.
- 7.3** The Contractor shall check that equipment"s, pipes, specials etc. are not subjected to corrosion from hydrostatic test water. Any such condition when detected should be brought to the notice of Engineer-in-Charge and remedial measures taken as directed.
- 7.4** All machined surface shall be properly greased and should be maintained and protected from damages.

8.0 DOCUMENTS TO BE SUBMITTED AT THE TIME OF BIDDING

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

9.0 GENERAL

In case of conflict between the requirements given in this document and the requirements of other specifications enclosed with the tender document, the requirements specified in Scope of Work document shall govern.

Should there be conflict, discrepancy, inconsistency or dispute between the various documents, they shall be referred in the order of priority as given below:

- a. Scope of work.
- b. Schedule of Rates.



SCOPE OF WORK FOR COMPOSITE WORKS FOR CNG STATIONS

- c. P&ID's
- d. IFC drawings
- e. Specifications
- f. Standards

10.0 AS BUILT DOCUMENT

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

- a. All inspection & testing documents.
- b. All purchase specification & procurement documents.
- c. All piping GA drawings and supports at terminals.
- d. Installation and testing reports.
- e. All purchase specification and procurement documents.
- f. All Inspection, Testing and NDT records. Radiographs/ UT of all weld joints.
- g. All inspection & testing documents.
- h. All purchase specification & procurement documents.

Software used for the presentation of these documents shall be as follows:

Type of document	Software
Reports	MS Word/ Excel
Drawings	AutoCAD

For the purpose of preparation of as-built drawings, Contractor shall update the "Issued for Construction" (IFC) drawings approved by the Company. Contractor shall be provided with electronic file of all „IFC“ drawings/ alignment sheets. Contractor shall update all the drawings issued by the Company. As-built drawings shall be prepared on AutoCAD.

STANDARD SPECIFIC

Digitally signed by BIVEK
KUMAR SINGH
Date: 2025.12.26 15:03:44 IST

Approved By

**STANDARD SPECIFICATION
FOR FABRICATION AND ERECTION
OF PIPING**

ABBREVIATIONS:

NACE	National Association of Corrosion Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing of Materials
BHN	Brinell hardness number
MSS-SP	Manufacturers Standardization Society - Standard Practice
LTCS	Low temperature Carbon Steel AS Alloy Steel

**STANDARD SPECIFICATION
FOR FABRICATION AND ERECTION
OF PIPING**

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**STANDARD SPECIFICATION
FOR FABRICATION AND ERECTION
OF PIPING**

1.0 SCOPE

This specification sets out the basic requirements for fabrication and erection/ installation of above ground and trench piping systems at site. This specification covers the scope of work, basis of work to be carried out by the contractor and standards, specifications, normal practice which shall apply to all piping installed by or pre-fabricated for installation by contractor.

2.0 REFERENCE DOCUMENTS

Reference has also been made in this specification to the latest edition (edition enforce at the time of issue of enquiry unless specified otherwise) of the following codes, standards and specification.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

B 31.3 : Process Piping.

B 31.4 : Pipeline Transportation System for liquid Hydrocarbon and other liquids.

B 31.8 : Gas Transmission and Distribution Piping Systems.

3.0 SCOPE OF WORK OF CONTRACTOR

Scope of work of contractor shall include the following else otherwise specified:

3.1 Transportation of required piping materials (as described in Cl. 2.1.1), pipe supports materials (as described in Cl. 2.3) and all other necessary piping materials from owner's storage areas or contractor's storage point (in case of contractor's scope of supply) to work site/ shop including raising store requisitions for issue of materials in the prescribed format and maintaining an account of the materials received from owner's stores.

3.1.1 Piping materials include the following but not limited to the same.

- a) Pipes (All sizes and schedule).
- b) Fittings (All sizes, types & schedule).
- c) Flanges (All sizes, types & Pressure ratings).
- d) Valves & Gaskets (All sizes, types & Ratings).
- e) Bolts, Nuts or M/C Bolts (All types), Studs and Expansion joint/ bellows (All sizes).
- f) Specialty items like online Filters, Scrubber, Scraper, Pumps, Compressors, Strainers and Air traps etc.
- g) Online instruments like control valves, orifice flange, rotameter, safety valves etc.

3.2 Shop and field fabrication and erection of piping in accordance with documents listed under Cl.3.0 including erection of all piping materials listed above.

3.3 Fabrication and erection of pipe supports like shoe, saddle, guide, stops, anchors, clips, cradles, hangers, turn buckles, supporting fixtures, brackets cantilevers, struts, tee posts, including erection of spring supports and sway braces.

3.4 Fabrication of plain and threaded nipples from pipes as required during erection.

3.5 Fabrication of swage nipples as and when required.

**STANDARD SPECIFICATION
FOR FABRICATION AND ERECTION
OF PIPING**

- 3.6** Fabrication of odd angle elbow like 60°, 30° or any other angle from 90/ 45° elbows as and when required.
- 3.7** Fabrication of flange, reducing flange, blind flange, spectacle blinds as and when required.
- 3.8** Fabrication of stub-in connection with or without reinforcement.
- 3.9** Grinding of edges of pipes, fittings, flanges etc. to match mating edges of uneven/ different thickness wherever required.
- 3.10** Modifications like providing additional cleats, extension of stem of valve, locking arrangement of valves etc. as and when required.
- 3.11** Preparation of isometrics, bill of materials, supporting details upto 2-1/2" within the unit battery limit and get subsequent approval from Company Representative as and when called for.
- 3.12** Obtaining approval for drawings prepared by contractor from statutory authority, if required.
- 3.13** Spun concrete lining at inside of pipes 3" NB and above including fittings and flanges as required in accordance with specification.
- 3.14** Rubber lining inside pipes, fittings, flanges as and when required, in accordance with specification.
- 3.15** Radiography, stress relieving, dye penetration, magnetic particle test etc. as required in specification.
- 3.16** Casting of concrete pedestals and fabrication and erection of small structures for pipe supports including supply of necessary materials.
- 3.17** Providing insert plates from concrete structures and repair of platform gratings around pipe openings.
- 3.18** Making material reconciliation statement and return of owner's supply left over materials to owner's storage.
- 3.19** Flushing and testing of all piping systems as per standard specification for inspection, flushing and testing of piping systems.
- 3.20** Pickling (as and when applicable) as per standard specification for chemical cleaning of C.S. suction piping of compressors.
- 3.21** Submission of job execution procedure for review and approval of Company Representative covering all above activities.

4.0 BASIS FOR WORK

- 4.1** The complete piping work shall be carried out in accordance with the following:
 - 4.1.1** "Approved for construction" drawings and sketches issued by vcs to the Contractor, Plan and/ or Isometrics.
 - 4.1.2** "Approved for construction" drawings and sketches issued by Turn-key bidders to the Contractor, Plan and/ or Isometrics.

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4.1.3 Approved process licensor's standards and specifications.

4.1.4 Drawing, sketches and documents prepared by contractor duly approved by Company.

4.1.5 Approved construction job procedures prepared by contractor as stipulated in 2.20.

4.1.6 VCS specifications/ documents as below:

- a) Process and Instrument Diagram.
- b) Piping materials specification.
- c) Piping support standards.
- d) Line list
- e) Piping support indices (only in offsite), if support are not shown in plan.
- f) Standard specification of non-destructive requirement of piping.
- g) Welding specification charts for piping classes.
- h) Standard specification for pressure testing of erected piping system.
- i) Welding specification for fabrication of piping.
- j) Any other VCS or Other specifications attached with piping material specification or special condition of contract.

4.1.7 Following codes, standards and regulations:

- a) ASME B 31.8 : Gas Transmission and Distribution piping systems.
ASME B 31.4 : Pipeline Transportation systems for Liquid Hydrocarbons and Other Liquids.
- b) ASME B 31.3 : Process Piping.
- c) ASME Sec. VII : Code for unfired pressure vessel.
- d) IS: 823 : Code for procedure for manual metal arc welding of mild steel
(For structural steel).
- e) NACE Std. : Code for sour services material requirements MR-01-75.

Note: All codes referred shall be of latest edition, at the time of award of contract.

4.2 DEVIATIONS

Where a deviation from the "Basis of Work" and approved job procedure described above is required or where the basis of work does not cover a particular situation, the matter shall be brought to the notice of Company Representative and the work carried out only after obtaining written approval from him in each case.

5.0 FABRICATION

5.1 PIPING MATERIAL

Pipe, pipe fittings, flanges, valves, gaskets, studs bolts etc. used in a given piping system shall be strictly as per the "Piping material specification" for the "Pipe class" specified for that system. To ensure the above requirement, all piping material supplied by the owner/ contractor shall have proper identification marks as per relevant standards/ VCS specifications/ Licensors specification. Contractor shall provide identification marks on left over pipe lengths wherever marked up pipe lengths have been fabricated/ erected. Material traceability is to be maintained for A.S., S.S., NACE, LTCS, material for hydrogen

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service and other exotic materials by way of transferring heat number, etc. (hard punching) as per approved procedure. This shall be in addition to color coding for all piping materials to avoid mix-up.

For the purpose of common understanding of construction job procedure, to be submitted by the contractor, shall include proposal for

- a) Maximizing prefabrication, inspection and testing at fabrication shop with minimum field joints.
- b) Positive material identification, handling, storage and preservation (if required).

5.2 DIMENSIONAL TOLERANCES

Dimensional tolerances for piping fabrication shall be as per Company Standard. The contractor shall be responsible for working to the dimensions shown on the drawings. However the contractor shall bear in mind that there may be variations between the dimensions shown in the drawing and those actually existing at site due to minor variations in the location of equipments, inserts structures etc. To take care of these variations "Field Welds" shall be provided during piping fabrication. An extra pipe length of 100 mm over and above the dimensions indicated in the drawing may be left on one side of the pipe at each of the field welds. During erection, the pipe end with extra length at each field weld shall be cut to obtain the actual dimension occurring at site. Isometrics, if supplied may have the field welds marked on them. However it is the responsibility of the contractor to provide adequate number of field welds. In any case no extra claim will be entertained from the contractor on this account. Wherever errors/ omissions occur in drawings and Bills of Materials it shall be the contractor's responsibility to notify the Company Representative prior to fabrication.

5.3 PIPE JOINTS

The piping class of each line specifies the type of pipe joints to be adopted. In general, joining of lines 2" and above in process and utility piping shall be accomplished by butt welds. Joining of lines 1-1/2" and below shall be by socket welding/ threaded joints as specified in "Piping material specifications". However, in piping 1 1/2" and below where socket welding/ threaded joints are specified, butt weld may be used with the approval of Company Representative for pipe to pipe joint in long run of piping. This is only application for non-galvanized piping without lining.

Flange joints shall be used at connections to vessels, equipment's, valves and where required for ease of erection and maintenance as indicated in drawings.

5.4 BUTT WELDED AND SOCKET WELDED PIPING

End preparation, alignment and fit-up of pipe pieces to be welded, welding, pre-heating, post-heating and heat treatment shall be as described in the welding specification and NDT specification.

5.5 SCREWED PIPING

In general, galvanized piping shall have threads as per IS: 554 or ANSI B2.1 NPT as required matching threads on fitting, valves etc. All other piping shall have threads as per ANSI B2.1, tapered unless specified otherwise.

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Threads shall be clean cut, without any burrs or stripping and the ends shall be reamed. Threading of pipes shall be done preferably after bending, forging or heat treating operations. If it is not possible, threads shall be gauge checked and chased after welding heat treatment etc.

During assembly of threads joints, all threads of pipes and fittings shall be thoroughly cleaned of cuttings, dirt, oil or any other foreign matter. The male threads shall be coated with thread sealant and the joint tightened sufficiently for the threads to seize and give a leak proof joint.

Threaded joint to be seal-welded shall be cleaned of all foreign matter, including sealant and make up to full thread engagement before seal welding.

5.6 FLANGES CONNECTIONS

All flanges facings shall be true and perpendicular to the axis of pipe to which they are attached. Flanged bolt holes shall straddle the normal centerlines unless different orientation is shown in the drawing. All bolts shall be equally tightened.

Wherever a spectacle blind is to be provided, drilling and the jack screws in the flange shall be done welding it to the pipe.

5.7 BRANCH CONNECTIONS

Branch connections shall be as indicated in the piping material specifications. For end preparation, alignment, spacing, fit-up and welding of branch connections refer welding specifications. Templates shall be used wherever required to ensure cutting and proper fit-up.

For all branch connections accomplished either by pipe to pipe connections or by using forged tees the rates quoted for piping shall be inclusive of this work.

Reinforcement pads shall be provided whether indicated in drawings/ specifications etc.

5.8 BENDING

Bending shall be as per ASME B31.3 except that corrugated or creased bends shall not be used.

Cold bends for lines 1-1/2" and below, with a bend radius of 6 times the nominal diameter shall be used as required in place of elbow wherever allowed by piping specifications. Bending of pipe 2" and above may be required in some cases like that for headers around heaters, reactors etc.

The completed bend shall have a smooth surface, free from cracks, buckles, wrinkles, bulges, flat spots and other serious defects. They shall be true to dimensions. The flattening of a bend, as measured by the difference between the maximum and minimum diameters at any cross-section, shall not exceed 8% and 3% of the normal outside diameter, for internal and external pressure respectively.

5.9 MITRE BENDS AND FABRICATED REDUCERS

The specific application of welded miter bends and fabricated reducers shall be governed by the piping material specifications. Generally all 90° mitres shall be 4-

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piece 3-weld type and 45° mitres shall be 3-piece 2-weld type as per standard unless otherwise specified. Reducers shall be fabricated as per directions of Company Representative. The radiographic requirements shall be as per material specifications for process and utility systems.

5.10 CUTTING AND TRIMMING OF STANDARD FITTING AND PIPES

Components like pipes, elbows, couplings, half-couplings etc. shall be cut/ trimmed/ edge prepared whether required to meet fabrication and erection requirements, as per drawings and instructions of Company Representative. Nipples as required shall be prepared from straight length piping.

5.11 GALVANISED PIPING

Galvanised carbon steel piping shall be completely cold worked, so as not to damage galvanized surfaces. This piping involves only threaded joints and additional external threading on pipes may be required to be done as per requirement.

5.12 JACKETED PIPING

The jacketing shall be done in accordance with specification or Licensors specification as suggested in material specification or special condition of contract.

Pre-assembly of jacketed elements to the maximum extent possible shall be accomplished at shop by contractor. Position of jump over and nozzles on the jacket pipes, fittings etc. shall be marked according to pipe disposition and those shall be prefabricated to avoid damaging of inner pipe and obstruction of jacket space. However valves, flow glasses, in line instruments or even fittings shall be supplied as jacketed.

5.13 SHOP FABRICATION/ PREFABRICATION

The purpose of shop fabrication or pre-fabrication is to minimize work during erection to the extent possible. Piping spool, after fabrication, shall be stacked with proper identification marks, so as facilitate their withdrawal at any time during erection. During this period all flange (gasket contact faces) and threads shall be adequately fabricated by coating with removable rust preventive. Care shall also be avoiding any physical damage to flange faces and threads.

5.14 FORGING AND FORMING

Forging and forming of small bore fittings, like reducing nipples for piping 1 ½" and below, shall be as per ASME B 31.3.

5.15 MISCELLANEOUS

5.15.1 Contractor shall fabricate miscellaneous elements like flash pot, seal pot, sample cooler, supporting elements like turn buckles, extension of spindles and interlocking arrangement of valves, operating platforms as required by Company Representative.

5.15.2 Span Concrete Lining

The work of inside spun concrete lining of pipes and specials of diameter 3" and above shall be done as per material specifications and special condition contract.

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5.15.3 Fabrication of pipes from plate

Pipes shall be fabricated at site as and when required as per the specifications attached with contract document and the actual piping material specification.

6.0 ERECTION

6.1 CLEANING OF PIPING

On completion of fabrication, all pipes and fittings shall be cleaned inside and outside by suitable means (mechanical cleaning tool, wire brush, etc.) before erection to ensure that assembly is free from all loose foreign material such as scale, sand, weld spatter particles, cutting chips etc.

All field-fabricated piping shall also be cleaned at the completion of the fabrication. All burrs, welding circles and weld spatter shall be removed by suitable means (mechanical tools, wire brush etc.)

Special cleaning requirements for some services, if any shall be as specified in the piping material specification or isometric or line list. S.S. jacketed piping requiring pickling shall be pickled to remove oxidation and discoloring due to welding.

6.2 PIPING ROUTING

No deviations from the piping route indicated in drawings shall be permitted without the consent of Company Representative.

Pipe to pipe to structure/ equipments distances/ clearances as shown in the drawings shall be strictly followed as these clearances may be required for the free expansion of piping/ equipment. No deviations from these clearances shall be permissible without the approval of Company Representative.

In case of fouling of a line with other piping, structure, equipment etc. the matter shall be brought to the notice of Company Representative and corrective action shall be taken as per his instructions.

6.3 SLOPES

Slopes specified for various lines in the drawings/ P&ID shall be maintained by the contractor. Corrective action shall be taken by the contractor in consultation with Company Representative wherever the contractor is not able to maintain the specified slope.

6.4 VENTS AND DRAINS

High point vents and low point drains shall be provided as per the instructions of Company Representative, even if these are not shown in the drawings. The details of vents and drains shall be as per piping material specifications/ job standards.

6.5 VALVES

Valves shall be installed with spindle/ actuator orientation/ position as shown in the layout drawings. In case of any difficulty in doing this or if the spindle orientation/ position is not shown in the drawings, the Company Representative shall be consulted and work done as per his instructions. Care shall be exercised to ensure that globe valves, check valves and

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other uni-directional valves are installed with the "flow direction arrow" on the valve body pointing in the correct direction. If the direction of arrow is not marked on such valves, this shall be done in the presence of Company Representative before installation.

Fabrication of stem extensions, locking arrangements and interlocking arrangements of valves (if called for), shall be carried out as per drawings/ instructions of Company Representative.

6.6 INSTRUMENTS

Installation of in-line instruments such as restriction orifices, control valves, safety valves, relief valves, Rota meters, orifice flange assembly, venturimeters, flow meters etc. shall form a part of piping erection work.

Fabrication and erection of piping up to first block valve/ nozzle/ flange for installation of offline instruments for measurement of level, pressure, temperature; flow etc. shall also form part of piping construction work. The limits of piping and instrumentation work will be shown in drawing/ standards/ specifications. Orientations/ locations of take-offs for temperature, pressure, flow, level connections etc. shown in drawings shall be maintained.

Flushing and testing of piping systems which include instruments mentioned above and the precautions to be taken are covered in flushing, testing and inspection of piping Specification. Care shall be exercised and adequate precautions taken to avoid damage and entry foreign matter into instruments during transportation, installation, testing etc.

6.7 LINE MOUNTED EQUIPMENTS/ ITEMS

Installation of line mounted items line filters, strainers, steam traps, air traps, desuperheaters, ejectors, sample coolers, mixers, flame arrestors, sight glasses etc. Including their supporting arrangements shall form part of piping erection work.

6.8 BOLTS AND NUTS

The contractor shall apply moly coat grease mixed with graphite powder (unless otherwise specified in the piping class) on all bolts and nuts during storage, after erection and wherever flange connection are broken and made-up for any purpose whatsoever. The grease and graphite powder shall be supplied by the contractor within the rates for piping work.

6.9 PIPE SUPPORTS

Pipe supports are designed and located to effectively sustain the weight and thermal effects of the piping system and to prevent its vibrations. Location and design of pipe supports will be shown in drawings for lines 3"NB and above for line below 3"NB contractor shall locate and design pipe supports in line with VCS standards and obtain approval of Company Representative on drawings prepared by contractor, before erection. However any extra support designed by Company Representative shall also be installed.

No pipe shoe/ cradle shall be offset unless specifically shown in the drawings.

Hanger rod shall be installed in a direction opposite to the direction in which the pipe moves during expansion.

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Preset pins of all spring supports shall be removed only after only after hydrostatic testing and insulation is over. Springs shall be checked for range of movement and adjusted if necessary to obtain the correct position in cold condition. These shall be subsequently adjusted to hot setting in operating condition. The following points shall be checked after installation, with Company Representative and necessary confirmation in written obtained certifying that:

- a) All restraints have been installed correctly.
- b) Clearances have been maintained as per support drawings.
- c) Insulation does not restrict thermal expansion.
- d) All temporary tack welds provided during erection have been fully removed.
- e) All welded supports have been fully welded.

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FOR SS MULTI TUBES FOR CNG
STATION**

ABBREVIATIONS:

ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
API	American Petroleum Institute
BHN	Brinell Hardness Number
HAZ	Heat Affected Zone
MSS-SP	Manufacturers Standardization Society - Standard Practice
SSPC	Steel Structures Painting Council

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1.0 INTRODUCTION

The Concept of Stainless-Steel Bundle Tubes / Multi tubes is to be used for construction of CNG Station. The Proposal is to replace the conventional method of connecting between Compressor Priority panels to Dispenser with SS tubes of 6-meter length and having connection with Ferrule fitting of two adjacent SS tubes and many other open joints with valves and fittings. As these tubes are connected with multiple joints, these tubes have to be installed within the Concrete duct which is kept open to atmosphere. All this leads to compromise the safety of tubes, and CNG station. It is also observed that over the time, the possibility of open SS fittings get damage is more, which lead for gas leakage. The leakage within SS fittings also leads for commercial losses due to shut down of CNG Station.

2.0 SCOPE

This document is prepared to define the technical requirement of Stainless-Steel Bundle / Multi flexible tubes with PE protection. This document also provides the Installation guidelines for contractor.

3.0 ADVANTAGES OF BUNDLE / MULTIFLEXIABLE TUBES

- a) The Bundle Tube length is available for more than 2000 Meters, so No joints between compressors to Dispenser tubes.
- b) Can install underground which neglect the damage or corrosion of tubes avoiding further the gas leakage.
- c) Cost saving due to not requirement of concrete duct, chambers, SS fittings and etc.
- d) Good Control over LUAG and which can lead to saving of Gas Consumption.
- e) Maintenance free installation.

4.0 TECHNICAL SPECIFICATION FOR PIPING COMPONENTS

a) CODES AND STANDARDS:

EN 10217-7 (metric) ASTM A269 (imperial) AISI 304

ISO 1127

DIN VED 0207 ASTM D1248

b) HYDRAULIC ANALYSIS OF SS TUBES:

Stainless steel (SS 316L / SS 316 Ti) tube for compressor discharge/ storage bank/ priority panel/ dispenser inlet tube design conditions: 330 barg & (-) 100 / 85 deg C) and for daughter station inlet design conditions of 350 barg & 100 deg C.

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Standard Tube Size (mm), (Note-2)	Tube OD (mm)	Tube Thickness (mm)	Remarks
6	6	1	Note -1
10	10	1.5	-
12	12	2	-
16	16	2.5	-
20	20	3	-
25	25	3	-
30	30	4	-
38	30	5	-

Note:

Multi flexible tube bundle containing SS tubes of 10 mm OD each shall be used for Underground portion of daughter station inlet and between priority panel & NGV- ½ Dispensers with deviation (if any) w.r.t. to maximum economic velocity limit for CNG application.

c) TUBE SIZING IN LINE WITH HYDRAULIC ANALYSIS:

As per hydraulics report, size of the compressor final discharge tubing, priority panel tubing and dispenser tubing including the controlling device in the line shall be minimum as shown below.

Station	Line Description	Flow rate (SCMH)	Operating Pressure (barg)	Operating Temp. (deg. C)	Minimum Recommended Line Size	Remark
Mother Station	Individual Compressor Discharge Line & Each Storage Bank (NGV-1) Inlet/Outlet Line	1500	300	40	16 mm OD - SS tube	-
	Storage Bank (NGV-2) Inlet/ Outlet Line	3000	300	40	25 mm OD - SS tube	-

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	NGV-1 Dispenser each inlet tube	250	200	40	10 mm OD - SS tube	-
	NGV-2 Dispenser inlet tube	3000	250	40	25 mm OD - SS tube	Note-2
Online station	Compressor Discharge Line and Each Storage Bank Inlet/ Outlet Line	1000	300	40	16 mm OD-SS tube	-
	NGV-1 Dispenser each inlet tube	250	200	40	10 mm OD-SS tube	-
Daughter Station (Option- 1)	Station Inlet Line	4200	200	10-60	38 mm OD-SS tube	Note-3
	Direct Filling Line to Priority Panel	1000	250	10-60	30 mm OD-SS tube	-
	Compressor Discharge Line and Each Storage Bank Inlet / Outlet line	4200	300	40	25 mm OD- SS tube	-
	NGV-1 Dispenser each inlet tube	250	200	40	10 mm OD -SS tube	-
Daughter Station option-2)	Station Inlet Line & Direct Filling Line to Priority Panel from Trailer	1000	200-250	10-60	30 mm OD-SS tube	Note-4
	Compressor Discharge Line and Each Storage Bank Inlet/ Outlet Line	1000	300	40	16 mm OD - SS tube	-
	NGV-1 Dispenser each inlet tube	250	200	40	10 mm OD - SS tube	-

Notes:

1. Multi core flexible SS tubes of 10 mm OD each shall be used from sequential panel to dispensers in order to use existing provision to route via existing ducts to minimize excavation works. The deviation from economical maximum velocity limit is mutually

accepted for this case of CNG application.

2. Two nos. of multi core flexible SS tubes of 10 mm OD each shall be used for underground portion from decanting pillar to inlet system (up to 38 mm SS tube) inside the compressor enclosure. As maximum size available for the design conditions is 38mm SS tube, 38mm SS tube is considered for further station inlet system up to compressor. The deviation from economical maximum velocity limit is mutually agreed for this case of CNG application.
3. Two nos. of multi core flexible SS tubes of 10 mm OD each shall be used for underground portion from decanting pillar up to 30mm SS tube inside the compressor enclosure. The deviation from economical maximum velocity limit is mutually accepted for this case of CNG application.
4. Material grade for SS tube is SS 316L / SS 316Ti.
5. Line sizing shall be minimum as per specified in document.
6. The venting system shall be designed as per the design recommendation by Vendor. Vents from the compressor package shall be routed to the safe height.
7. Numbers of NGV-1 dispensers indicated are minimum. Actual number depends on company dispensing requirement. Accordingly, number of set of priority valves, tubes from priority valves to inlet of dispenser and valves/instrumentation inside the dispenser etc., shall be considered.

5.0 TUBING AND TUBE FITTINGS

- I. Multi Tube Bundle (3 X 10 mm OD Stainless steel tubes) of following specifications shall be provided between dispensers and priority panel located near compressor enclosure.
- II. Tube material shall be Stainless Steel series –316 L / Ti conforming to ASTM-A269. The process followed is longitudinal welded austenitic steel tubes to maintain the continuous length of tube.
- III. HP Bundle tubes are twisted stainless steel tubes which are coated with a plastic sheathing.
- IV. **Brief Technical Specification of Multi tubes is as follows:**
 - Design Pressure (@ 70 °C): 300 Bar
 - Test Pressure (@ 20 °C): 430 Bar
 - Burst Pressure under Hydraulic testing– 1100 Bar.
 - Filler Sheath (EPDM) thickness: 1 mm Outer Jacket (PE-LD HM2) thickness: 1.8mm
 - Min. bending radius with an automatic bending machine: 125 mm
 - Flame behavior of outer jacket: IEC 332/3 Cat. A/F
 - Operating temperatures of outer jacket :-25°C / +80°C
 - Natural Bending Radius – 10 X diameter of SS tube
 - Multi Core Bundle Tubes will be supplied in coil form packed within Drums as per customer requirement.

- V. Delivery Line: Multi-tube bundle (10 mm OD x 1.2 mm WT, 3 Core), coated with a plastic sheathing.
- VI. Return Line: Single tube (10 mm OD x 1.2 mm WT, 1 Core), coated with a plastic sheathing. (If required)
- VII. All tubes are 100% Eddy current tested acc. to DIN EN 10246 3 after the welding process at the production. The orbital welding is carried out at every 300-meter length to maintain the continuity of tube length as per client requirement.
- VIII. All high-pressure double ferrule fitting & 2 / 3-way ball valves shall be from company approved makes & shall be SS 316L / Ti material.
- IX. All, multi-tube bundles, shall be suitably identified as per applicable codes and practices.
- X. Actual numbers of dispensers depend on the number of dispensers for CNG NGV-1/ cars filling in each station.

6.0 BUNDLE TUBE / MULTI TUBES INSTALLATION PHILOSOPHY

As a minimum, 2 nos. of NGV-1 type dispensers (2 filling hoses / dispenser) and 4 nos. of NGV-2 type dispensers (2 filling hoses / dispenser) have been considered for arriving at the quantity. In short 1 number of Multi tube (3 X 10mm OD tubes) to be proposed to carry gas from Priority panel to each hose of dispenser. The High bank, Medium bank and low bank connection from priority panel will be directly connected inside the dispenser of High, medium and low bank connection of each bank.

Bundle Tube (3 nos. tube, 1 no. from each high, medium and low bank) from Cascade to dispenser shall be used. The Multi tubes can be laid underneath the paved surface in depth of 60-80 cm without using a conduit or also at the outside of buildings. The additional and suitable fittings may be used at priority panel and inside dispenser to make the provision of Multi tube connection.

All tubes are 100% Eddy – current tested acc. To DIN EN 10246-3 after the welding process at the production.

7.0 STORAGE TO DISPENSER TUBING

Storage to dispenser tubing shall mainly comprise of bundled SS tubes (3 nos. tube, 1 no. from each high, medium and low bank), from cascade banks to the dispenser. The Multi tubes can be laid underneath the paved surface outside of buildings.

SS tubes shall be covered with protective sheath for underground application.

8.0 TRAINING

Training for COMPANY personnel shall be planned just before CNG station start-up or commissioning by competent trainers from MANUFACTURER/ VENDOR'S office. The awareness shall be provided to company officers to understand the concept of Multi tube connections.

9.0 APPROVALS

Inspection certificate acc. DIN EN 10204 3.1 issued by TUV Nord – Germany.

10.0 ADDITIONAL CERTIFICATES OF TUBE BUNDLES

1. LRS Type Approval Certificate Extension 98/200 23 (E1).
2. Det Norske Veritas Schweisszulassung ESN-06-5970 Rev 1.
3. Schweißzulassung RW TÜV gemäß AD-2000 Merkblatt HP2/1, EN 288-3.
4. ABS Product Design Assessment Certificate 01-HG2 42690/1-PDA.
5. CCS Certificate of works approval BJW-95010006.
6. DNV Manufacturing survey arrangement R1747.
7. Bureau Veritas SMS.W. II/3567/A.O.
8. Attachments: Typical CNG Station layout for installation of SS Bundle tubes.

**STANDARD SPECIFICATION
FOR
STAINLESS STEEL TUBE LAYING AND TESTING**

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**STANDARD SPECIFICATION
FOR STAINLESS STEEL TUBE
LAYING AND TESTING**

1.0 SCOPE OF WORK AND TECHNICAL SPECIFICATION

This specification covers the minimum requirements for design, manufacture and supply of Stainless-steel tube laying and testing for city gas distribution.

1.1 Laying of SS Tube

Laying, testing and commissioning of SS tubes and fittings complete with all supports. The MS Angle and U-clamps (galvanised) / other fixing arrangement shall be procured and installed by the contractor. Payment shall be at the rate for the work set out in the agreed Schedule of Rates.

Contractor shall engage approved subcontractor for this specialized work.

1.2 Scope of Works: For Laying, Testing & Commissioning of SS Tubing

Generally, the following shall constitute the Contractor's scope of work but not limited to as given herein:

- 1.2.1 SS tubes shall be clamped to the MS Angle at every 1000 mm using P clamps of SWAGELOK make / any other approved make / SS – 308 clamps with EPDM cushion. The practice of flattening tubes for clamping purposes shall not be permitted.
- 1.2.2 MS Angle and U-clamps (galvanised) shall be procured from approved manufacturers and through a QAP including stage inspection and pre dispatch inspection of the materials By VCS (To be isolated by rubber gaskets).
- 1.2.3 Tubes shall be bend using tube benders only and any hot bending will be totally rejected. Tubes shall be cut using pipe cutting device. Hot cutting is not allowed.
- 1.2.4 Carrying out pneumatic testing and purging with nitrogen as per approved procedures; providing all tools, tackles, instruments, manpower and other related accessories for carrying out the testing of tubes.
- 1.2.5 Start-up and commissioning assistance.
- 1.2.6 Handing over the completed works to Client for their operation/ use purposes.
- 1.2.7 Any other work not specifically mentioned herein, but required for the satisfactory completion/ operation/ safety/ statutory/ maintenance of the works shall also be covered under the scope of work and has to be completed by the Contractor within specified schedule at no extra cost to Client.

2.0 INSTALLATION PROCEDURE

2.1 TUBE END PREPARATION

- 2.1.1 Cut the ends square with a hacksaw and a suitable guide. Tube cutters are satisfactory for most tube materials but tend to work harden stainless steel. As such proper care shall be exercised while cutting the SS tubes to avoid the hardening.
- 2.1.2 Burrs must be removed inside and outside for proper entry into fitting to prevent contamination and/ or restricted flow. 'Swagelok' de burring tool shall be used.
- 2.1.3 Remove all fittings, chips, and grit before attachment of fittings.

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FOR STAINLESS STEEL TUBE
LAYING AND TESTING**

2.2 ASSEMBLY

- 2.2.1 Tube line fabrication must be accurate so that the tube end easily enters the fitting in proper alignment. Do not force an improperly fitted tube line into the fittings.
- 2.2.2 Ensure that the tube end is bottomed against the shoulder in the fitting body. This is necessary to prevent movement of the tube while the nut forces the ferrule to grip the tube and to seal through any imperfections that may exist on the outside tube surface.
- 2.2.3 Never permit the fitting body to rotate during tube end make-up, use two wrenches. Assemble port connectors to components first and hold with a wrench while making up the tube joint. All types of union bodies must be held while each of the tube ends is made up.
- 2.2.4 Never attempt to make up by torque.
- 2.2.5 Always turn the nut the prescribed amount regardless of torque required. Fitting end plugs required only 1- ¼ turn from finger tight make up in all sizes.

3.0 REMAKE OF FITTINGS

A disassembled joint can be remade, simply by retightening the nut to the position of the original make up. For maximum number of remakes, mark the fitting and nut before disassembly. Before retightening, make sure the assembly has been inserted into the fitting until the ferrule(s) seats in the fitting. Retighten the nut by hand. Rotate the nut with a wrench to the original position as indicated by the previous marks lining up. (A noticeable increase in mechanical resistance will be felt indicating the ferrule is being re-sprung into sealing position.) Then snug the nut 1/12 turn (1/2 hex flat) past the original position.

4.0 REFERENCE SPECIFICATION, CODES AND STANDARDS

The Contractor shall carry out the work in accordance with this specification, VCS'S Engineering Standards, ASME B 31.8 - Gas Transmission and Distribution Piping Systems, Oil Industry Safety Directorate (OISD) norms. Should the Contractor find any discrepancy, ambiguity or conflict in or between any of the Standards and the contract documents, then this should be promptly referred to the Engineer-in- Charge (EIC) for his decision, which shall be considered binding on the contractor.

5.0 SCOPE OF SUPPLY

In general, the following tubes & fittings shall be supplied:

- i) ¾" OD SS Tube of 0.095 wall thick min.
- ii) ½" OD SS Tube of 0.083 wall thick min.
- iii) Double Compression Ferrule Fittings of sizes ¾", ½", 3/8" & ¼". iv SS Valves of suitable sizes.

1.1.1 Supply by The Contractor at His Own Cost As Part Of This Specification:

The procurement and supply of MS Angle with U- clamps at the appropriate time of all the materials and consumables except for the materials specifically enlisted under Owner's scope of supply, shall be entirely the Contractor's responsibility and its rates of execution shall be inclusive for all these items, as follows but not limited to these:

- i) Bolts and nuts for supports, U-bolts with nuts, P-clamps for tubes, anchor bolts of various sizes for fixing to concrete structure.
- ii) Bitumen paints primer and solvents.
- iii) All material for minor civil works like grouting etc.,
- iv) Minor structural steel for fabrication of tube/ tray supports like MS plates, GI plates, flats, pipe etc., v Pumps, compressor, Corrosion Inhibitor for water used for hydrostatic

**STANDARD SPECIFICATION
FOR STAINLESS STEEL TUBE
LAYING AND TESTING**

testing, including water for testing, inert gas for purging. vi All items not expressly mentioned in the Contract but which are necessary for the satisfactory completion and performance of the Work under this Contract.

Note: Samples of all the consumables items / test certificates required to be approved by EIC.

**STANDARD SPECIFICATION
FOR
SEAMLESS FITTINGS AND FLANGES
{SIZE UPTO DN 400MM (16")}**

**STANDARD SPECIFICATION
FOR SEAMLESS FITTINGS AND
FLANGES {SIZE UPTO DN 400MM (16")}**

ABBREVIATIONS:

ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
API	American Petroleum Institute
BHN	Brinell hardness number
HAZ	Heat Affected Zone
MSS-SP	Manufacturers Standardization Society - Standard Practice
RTJ	Ring Type Joint
SSPC	Steel Structures Painting Council
CE	Carbon Equivalent
LTCS	Low Temperature Carbon Steel
LPG	Liquefied Petroleum Gas

**STANDARD SPECIFICATION
FOR SEAMLESS FITTINGS AND
FLANGES {SIZE UPTO DN 400MM (16")}**

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1.0 SCOPE

This Technical specification specifies the minimum requirements for the design, manufacture and supply of following carbon steel flanges (such as welding neck flanges, blind flanges, spectacle blinds, spacers and blind etc.) and seamless fittings (such as tees, elbows, reducers, caps, outlets etc.) size DN up to 400 mm (16") to be installed in onshore pipeline systems handling non-sour hydrocarbons in liquid or gaseous phase including Liquefied Petroleum Gas (LPG).

2.0 REFERENCE DOCUMENTS

Reference has been made in this specification to the latest edition (edition enforce at the time of issue of enquiry unless specified otherwise) of the following Codes, Standards and Specification.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

B31.4	:	Pipeline Transportation system for liquid Hydrocarbon & other liquids.
B 31.8	:	Gas Transmission and Distribution Piping Systems.
B16.5	:	Pipe Flanges and Flanged Fitting.
B16.9	:	Factory made Wrought Butt Weld Fittings.
B 16.11	:	Forged Steel Fittings, Socket welding and Threaded.
B 16.48	:	Steel Line Blanks.
Section VIII	:	Boiler and Pressure Vessel Code - Rules for Construction of Pressure Vessels.
Section IX	:	Welding and Brazing Qualifications.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A370	:	Standard Test Methods and Definitions for Mechanical Testing of Steel Products.

MANUFACTURERS STANDARDIZATION SOCIETY (MSS)

SP-25	:	Standard Marking System for Valves, Fittings, Flanges and Unions.
SP-97	:	Forged Carbon Steel Branch Outlet Fittings- Socket Welding, Threaded and Butt Welding Ends

In case of conflict between various requirements of this specification and the requirements of above referred Codes and Standards, more stringent requirement shall apply unless otherwise agreed by Purchaser.

3.0 MATERIALS

The Material of flanges & fittings shall be as indicated in purchase requisition. In addition, the material shall also meet the requirements specified hereinafter.

3.1 The Carbon Steel used for the manufacture of flanges and fittings shall be fully killed.

3.2 The carbon equivalent (CE) shall not exceeding 0.45, based on check analysis calculated in accordance with following.

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Cu + Ni}{15}$$

3.3 For flanges and fittings specified to be used for gas service or LPG service, Charpy V-notch test shall be conducted on each heat of steel. Unless specified otherwise, the Charpy V-notch test shall be conducted at 0° C in accordance with the impact test provisions of ASTM A 370 for flanges and MSS-SP-75 for all fittings.

The average absorbed impact energy values of three full-sized specimens shall be 27 joules. The minimum impact energy value of any one specimen of the three specimens analyzed as above shall not be less than 22 Joules.

When Low Temperature Carbon Steel (LTCS) materials are specified for flanges and fittings in Purchase Requisition, the Charpy V-notch test requirements of applicable material standard shall be complied with.

3.4 For flanges and fittings specified to be used for Gas service or LPG service, Hardness test shall be carried out as per ASTM A 370 for each heat of steel used. A full thickness cross section shall be taken for this purpose and the maximum hardness of base metal, Weld metal and heat affected zone shall not exceed 248 HV₁₀.

3.5 In case of RTJ (Ring Type Joint) flanges, the groove hardness shall be minimum 140 BHN. Ring Joint flanges shall have octagonal section of Ring joint.

4.0 DESIGN AND MANUFACTURE

4.1 Flanges such as weld neck flanges and blind flanges shall conform to the requirements of ASME B 16.5.

4.2 Spectacle blind and spacer & blind shall conform to the requirements of ASME B 16.48.

4.3 Fittings such as tees, elbows, reducers, etc. shall be seamless type and shall conform to ASME B 16.9 for sizes DN 50mm (2") to DN 400mm (16") (both sizes included) and ASME B 16.11 for sizes DN 15mm(1½") & below.

4.4 Fittings such as weldolets, sockolets, nippolets, etc. shall be manufactured in accordance with MSS-SP-97.

4.5 Repair by Welding on flanges and fitting is not permitted.

4.6 All butt weld ends shall be beveled as per ASME B 16.5/ASME B 16.9/MSS-SP-97 as applicable

4.7 Type, face and finish of flanges shall be as specified in purchase requisition. The

**STANDARD SPECIFICATION
FOR SEAMLESS FITTINGS AND
FLANGES {SIZE UPTO DN 400MM (16")}**

interpretation of range of face finish shall be as follows:

Serrated Finish/125 AARH	:	Serration with 125 to 250 μ in AARH.
63 AARH	:	32 to 63 μ in AARH.

4.8 Flanges and fittings manufactured from bar stock are not acceptable.

5.0 INSPECTION AND TESTS

The Manufacture shall perform all inspections and tests in accordance with the requirements of this specification and the relevant codes, at his works, prior to shipment. Such inspection and testing shall include, but not be limited to, the following:

5.1 TESTING OF MATERIALS

Chemical composition and mechanical tests including yield strength, ultimate tensile strength, impact test, elongation and hardness shall be carried out for each heat of steel used as per the applicable standard as referred to in this specification.

5.2 VISUAL INSPECTION AND DIMENSIONAL CHECK

All flanges and fittings shall be visually inspected. The internal and external surface of the flanges and fittings shall be free from any strikes, gauges and other detrimental defects.

Dimensional checks shall be carried out on finished products as per ASME B 16.5 for flanges, ASME B 16.48 for spacers and blinds and ASME B 16.9/MSS-SP-97 as applicable for fittings and as per this specification.

5.3 NON-DESTRUCTIVE EXAMINATION

All finished wrought weld ends subject to welding in field, shall be 100% tested for lamination type defects by ultrasonic test. Any lamination larger than 6.35 mm shall not be acceptable.

5.4 The Purchaser reserves the right to perform stage wise inspection and witness tests as indicated above, at the Manufacturer's works, prior to shipment. The Manufacturer shall give reasonable notice of date and time for such inspection and shall provide reasonable access and facilities required for inspection, to the Purchaser's Inspector.

The Purchaser reserves the right to require additional testing, at any time, to confirm Or further investigate a suspected fault. All costs incurred shall be for the Manufacturer's account. In no case shall any action of the Purchaser, or his Inspector, relieve the Manufacturer of his responsibility for material, design, quality, or Performance of the materials concerned. Inspection and tests performed/witnessed by the Purchaser's Inspector shall in no way relieve the Manufacturer of his obligation to perform the required inspection and tests.

6.0 PAINTING

Once all inspection and test have been carried out all external surface shall be thoroughly cleaned to remove grease, dust & rust. Standard mill coating shall be applied on external surface to protect against corrosion during transmit and storage. The coating shall be removable type in field.

7.0 MARKING

All Flanges & fittings shall be stamped with the requirements of applicable dimensional manufacturing standard. The marking shall also include following:

- PO Number.
- Item Code.

8.0 TEST CERTIFICATES

Manufacture who intends bidding for fittings must possess the records of a successful proof test, in accordance with the provision of ASME 16.9/MSS-SP-75, as applicable.

Manufacturer shall furnish the following certificates:

- Test certificates relevant to the chemical analysis and mechanical properties, including hardness of the materials used for manufacture of flanges and fittings in accordance with the requirement of relevant standards and this specification.
- Test reports on radiography, ultrasonic and magnetic particle examination.
- Certificates for each fitting stating that it is capable of withstanding without leakage a test pressure, which results in a hoop stress equivalent to 100% of the specified minimum yield strength for the pipe with which the fitting is to be attached without impairment of serviceability.

9.0 PACKING & SHIPPING

Ends of all fittings and weld neck flanges shall be suitable protected to avoid any damage during transit. Metallic or high impact plastic bevel protected shall be provided for flanges and fittings. Flanges face shall be suitably protected to avoid any damage during transit.

10.0 DOCUMENTATION

The Manufacturer shall supply documentation in accordance with the Vendor Data Requirements List (VDRL) as attached with Purchase Order.

**STANDARD SPECIFICATION
FOR
SS FITTINGS**

**STANDARD SPECIFICATION
FOR SS FITTINGS**

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1.0 GENERAL

Hindustan Petroleum Corporation Limited (HPCL) is a Central Public Sector with a Navratna Status, and a Forbes 2000 and Global Fortune 500 company incorporated in 1974 engaged in refining and marketing of petroleum products with its headquarter in Mumbai, Maharashtra.

Oil India Limited (OIL) is a premier Indian National Oil Company engaged in the business of exploration, development and production of crude oil and natural gas, transportation of crude oil and production of LPG founded in 1959 with its headquarters in Duliajan, Assam.

A JVC has been incorporated in the name of HPOIL GAS PRIVATE LIMITED, which has received the authorization from PNGRB vide letter PNGRB/CGD/BID/8/2018/GA/Ambala-Kurukshetra District dated 22/02/2018 to Lay, Build and Operate City Gas Distribution networks in Ambala & Kurukshetra and vide letter PNGRB/CGD/BID/8/2017/BEC/GA-Kolhapur dated 06/03/2018 to Lay, Build and Operate City Gas Distribution networks in Ambala-Kurukshetra District.

2.0 SCOPE OF SUPPLY

- 2.1** The scope of this specification covers the requirement of design, manufacture, inspection, testing at works/ marking/ packaging/ and supply of high-pressure SS Ferrule Fittings.
- 2.2** All codes & Standards for manufacturing, testing, inspection etc. shall be of latest edition.

3.0 CODES & STANDARDS

Applicable Codes and Standards to be followed are as under but not limited to the following:

Bar Stock : ASME SA-479-316 or DIN 4401 or BS:970-316-S31
Forging : ASME SA-182-316 or DIN 4401 or BS:970- 316-S31
Thread : NPT ANSI B 1.20.1

In case of any conflict between this job specification and other document, the following order of precedence shall apply:

- Job Specification
- International Standards/ Codes Applicable.

Any discrepancy, ambiguity or conflict in or between any of the standards, specifications codes and the contract documents should be promptly referred to Owner / Owner's Representative for his decision, which shall be binding on the bidder.

4.0 TECHNICAL SPECIFICATION

All the items shall be suitable for compressed Natural Gas service and meet following specifications:

Testing shall be as per ASTM F 1387

4.1 Materials

- 4.1.1** Fittings shall be manufactured from the following materials:

**STANDARD SPECIFICATION
FOR SS FITTINGS**

- i) Bar stock shall be as per BS: 970-316-S31, EIN 1.4401 or ASME 479-316.
- ii) Forgings shall be as per BS: 970-316-S31, EIN 1.4401 or ASME SA- 182-316

4.1.2 The fittings end connections shall be compatible to tube of hardness $\leq Rb80$

4.1.3 All component parts of the fittings shall be of the same material.

4.1.4 The ferrule material shall be able to withstand an atmosphere of Natural Gas, oil and moisture without rusting.

4.2 Design & Manufacture

4.2.1 All fittings shall be designed in conformance with the requirements of ASME B31.3 and applicable standards. Area classification applicable for all items shall be Class-1, Division-1, Group-D as per NEC or Zone-1 Group- IIA/ IIB as per IS/ IEC specification or equivalent specification. Fittings shall be designed so that all parts/ components meet the requirements for the specified area classification.

4.2.2 The SS fittings shall be of flareless design and four-piece construction, consisting of front and rear ferrules, nut and body suitable for use on SS tubes conforming to ASTM A269 TP316.

4.2.3 Fittings shall be rated for at least the design pressure as stipulated in the material requisition. The design of fittings shall ensure that they shall be capable of holding full tube burst pressure after only one and a quarter turn pulls up of the nut

4.2.4 The threaded ends of fittings shall be NPT as per ANSI B1.20.1. Especially male threads are to be made by

Cold rolling method & shall be protected by plastic end caps.

4.2.5 The fittings shall hold the tube with collecting action producing a firm grip on the tube without substantially

reducing the tube wall thickness.

4.2.6 Fittings shall not torque the tubing during original or subsequent make-up of the connection and should use

geometry for inspection before and after make up the fittings shall not require disassembly for inspection

before or after makeup.

4.2.7 All tube fittings shall be guageable for sufficient pull up after one and a quarter turn. All tube fittings shall have a guageable shoulder and there will be no radius at the point where the shoulder meets the neck of the fitting body.

4.2.8 The gap inspection gauge shall be easily insertable at finger tight position of nut. The gap inspection gauge shall not be insertable between the nut and shoulder of the fitting after completing only one and a quarter turn pull up of the nut.

4.2.9 The tube seat counter bore in the body shall be faced flat 90° to the axis of the tubing to minimize tube expansion and subsequent galling.

4.2.10 The sealing and gripping power of the fitting shall be controlled such that the action between ferrules will overcome commercial variations in tubing wall thickness, hardness, diameter and installer skill.

4.2.11 The seal contact areas of the fittings body shall have a machined finish of 32 Ra or better.

4.2.12 The fittings body shall have no machined stop or shoulder to preclude additional tightening in subsequent make-up.

4.2.13 Front Ferrule

- i) The front ferrule shall affect a long, smooth repeatable seal by contact with body and a grip hold on the tube surface
- ii) The front ferrule shall always remain in a sprung condition to compensate for thermal stresses and to accomplish repeated make and break
- iii) Front ferrule which is wetted part shall not be hardened by HT.
- iv) The sealing cone of body where front ferrule sits shall be finished to remove tool marks & to give extra smooth surface for proper seating.

4.2.14 Rear Ferrule

- i) The rear ferrule shall collect the tubing surface, improving the performance of the tubing in systems of high impulse or vibration
- ii) The rear ferrule shall have a machine recess on the inside diameter and shall have complete surface hardening so as to substantially reduce the required pull up torque. Both the requirements i.e. complete surface hardness and machined recess shall be met for all rear ferrules.
- iii) Rear ferrule which grips the tubing & not typical wetted part shall be significantly Hardened than the tubing upto RC 60 Hardness.
- iv) Rear ferrule shall not be hardened at the edge by HT and should be case hardened.
- v) For hardening of back ferrule multiple process shall not be used.

4.2.15 Nuts shall have silver plated threads to act as a lubricating agent to avoid galling and to reduce tightening torque.

5.0 INSPECTION AND TESTING

The manufacturer shall submit typical type test reports for the following test carrier out on random

samples of two ferrule fittings

- i) Hydraulic burst pressure test
- ii) Helium leak test under 0.0002 PSIA negative pressure, leaks into assembly greater than 4.0×10^{-9} atm-cc/sec being unacceptable
- iii) Gas pressure test for 25 Remakes at 5000 Psig. No leakage should be detectable even after 25 remakes.

iv) Impulse & vibration testing as per ASTM F1387.

6.0 TEST REPORTS AND CERTIFICATES

- 6.1** The manufacturer shall supply material compliance certificates conforming that the raw material for fittings conforms to the requirements of ASME Section-II and ASME Section-III sub section NB, NC and ND.
- 6.2** The manufacturer shall furnish test procedure and typical test reports of all tests conducted on fittings as per the requirements of clause 5

7.0 MARKING, PACKING & SHIPMENT

- 7.1** Heat code traceability number shall be stamped or etched on both body and nut of each fitting
- 7.2** Replacement nuts and ferrules shall be packaged in a manner so as to allow safe and simple replacement.
- 7.3** All the items shall be suitably wrapped and packaged to with stand rough handling during ocean shipment and inland journey.
- 7.4** Item shall be properly tagged and package separately to facilitate easy identification.
- 7.5** Items shall be wrapped and packaged in such-a-way that they can be preserved in original as new condition.

8.0 DOCUMENTATION

Following test certificates shall be furnished along with shipment

- Test certificate of visual, chemical, mechanical testing (incl. tensile, hardness) and hydro test reports with 3.1 certificate as per EN10204.
- Manufacturers standard shop inspection & test report for all items.
- The test report for specified tests – type approval as per LR/ASTM F1387/PNV.
- Third party inspection report as applicable to meet the requirements of specified codes & standards as applicable.

**STANDARD SPECIFICATION
FOR
SS VALVES**

1. GENERAL

Hindustan Petroleum Corporation Limited (HPCL) is a Central Public Sector with a Navratna Status, and a Forbes 2000 and Global Fortune 500 company incorporated in 1974 engaged in refining and marketing of petroleum products with its headquarter in Mumbai, Maharashtra.

Oil India Limited (OIL) is a premier Indian National Oil Company engaged in the business of exploration, development and production of crude oil and natural gas, transportation of crude oil and production of LPG founded in 1959 with its headquarters in Duliajan, Assam.

A JVC has been incorporated in the name of HPOIL GAS PRIVATE LIMITED, which has received the authorization from PNGRB vide letter PNGRB/CGD/BID/8/2018/GA/Ambala-Kurukshetra District dated 22/02/2018 to Lay, Build and Operate City Gas Distribution networks in Ambala & Kurukshetra and vide letter PNGRB/CGD/BID/8/2017/BEC/GA-Kolhapur dated 06/03/2018 to Lay, Build and Operate City Gas Distribution networks in Ambala-Kurukshetra District.

2. SCOPE

- a) The scope of the bidder includes but not limited to manufacture, supply, inspection & testing at work shop marking, packing, handling and dispatch of SS Ball Valves, as per quantities given in SOR and complying all the specifications mentioned.
- b) All codes and standards for manufacture, testing, inspection etc. shall be of latest edition.
- c) Owner reserves the right to delete or order additional quantities during execution of order, based on unit rates and other terms & conditions in the original order.

3. CODES & STANDARDS

Applicable Codes and Standards to be followed are as under but not limited to the following:

1. MSS SP-99 : Instrument Valves
2. ASME/ASTM B 31.3 : Chemical Plant and Petroleum Refinery Piping

4. PRECEDENCE CONFLICT RESOLUTION

In case of any conflict between this specification, Codes & Standards and other document, the following order of precedence shall apply: -

1. Job Specification.
2. International Standards/ Codes Applicable.

5. DEVIATIONS

- a) Technical deviations, if any, required by bidder shall be separately furnished again each clause giving reasoning for each deviation. Bidder to note that except the deviation furnished by them, Bidder's offer shall be deemed to be in total conformity with the enquiry / tender specifications.

**STANDARD SPECIFICATION
FOR SS VALVES**

6. SPECIFICATIONS OF 2 WAY SS BALL VALVES

- a) Valves should be manufactured from following materials
 - i. The valve body will be made out of material conforming to ASTM A 479 Gr. SS 316/ASTM A351 CF3M.
 - ii. Material of construction of ball shall conform to ASTM A 276 Gr. SS 316.
- b) All ball valves shall be designed in conformance with the requirements of ASME B31.3, MSS SP-99 and other applicable standards. Area classification applicable for all items shall be Class 1, Division 1, Group D as per NEC or Zone-1, Group IIA/IIB as per IS/IEC specification or equivalent specification. All parts components shall meet the requirements for the specified area classification.
- c) Valves shall be rated for a maximum pressure rating of 6000 psig and shall be capable of operation between Design Temperature range of -400F to +2500F.
- d) Valves shall have spring loaded PEEK seats allowing seal-ability over the full pressure range at any port and low operating torque over the full range of pressure and temperatures.
- e) Valve shall have Nylon handle. Handle shall indicate the direction of flow.
- f) All valves should be full bore to ensure no pressure drop.

7. DOCUMENTATION

- a) The Valve Manufacturer shall submit factory test reports for the following tests carried out on each Valves.
 - i. Hydrostatic seat leak test shall be carried out with de-ionized water. There shall be no
 - ii. detectable seat leakage at 1.1 times the rated pressure of the valve.
 - iii. Gas pressure test for seat shall be carried out with nitrogen at 1000 psig. There shall be no detectable external leakage. Maximum allowable seat leakage shall be 0.1 std-cc/min.

8. OTHER REQUIREMENT

- a) Manufacturer should conform that valves are approved by Rail Road Commission of Texas, LP Gas Division under regulation for compressed natural gas or ANSI / AGA NGV 3.1 1995, CAN / CGA-12-3- M95 "Fuel Systems Components for Natural Gas Powered Vehicles" by "Canadian and Association" Spares and Accessories.
- b) Manufacturer shall furnish a list of recommended spares and accessories for valves required during startup and commissioning.

9. MARKINGS, PACKING AND SHIPMENT

- a) Heat code shall be marked on valve body to facilitate traceability.
- b) All items shall be suitably wrapped and packaged to withstand rough handling during ocean shipment and inland journey.

**STANDARD SPECIFICATION
FOR SS VALVES**

- c) Each item shall be properly tagged and packaged separately to facilitate easy identification.
- d) All items shall be wrapped and packaged in such a way that they can be preserved in their original, as new condition.

**STANDARD SPECIFICATION
FOR
PIPELINE BALL VALVES**

ABBREVIATIONS:

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

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1.0 SCOPE

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

2.0 REFERENCE DOCUMENTS

All valves shall be manufactured and supplied in accordance with the American Petroleum Institute (API) Specification 6D, Twenty Third Edition, April 2008/ ISO 14313:2007, Petroleum and Natural Gas Industries - Pipeline Transportation Systems - Pipeline Valves, with additions and modifications as indicated in the following sections of this specification.

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

2.1 AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

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

2.2 AMERICAN PETROLEUM INSTITUTE (API)

1104	:	Specification for Welding Pipelines and Related Facilities.

2.3 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

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

2.4 MANUFACTURERS STANDARDIZATION SOCIETY (MSS)

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

2.5 STEEL STRUCTURES PAINTING COUNCIL (SSPC)

- VIS-I : Visual Standard.

2.6 In case of conflict between the requirements of this specification, API 6D and the Codes, Standards and Specifications referred in clause 2.2 above, the requirements of this specification shall govern.

3.0 MATERIALS

3.1 The material of major components of the ball valves shall be as indicated in Valve Data Sheet. Remaining components shall be as per Manufacturer's standard (suitable for the service indicated in the data Sheet) and as approval by Company.

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

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

3.2 Carbon steel used for the manufacture of valves shall be fully killed.

3.3 The carbon equivalent (CE) of valve end connections which are subject to further field welding by Company shall not exceed 0.45 on check analysis for each heat of steel used, as calculated by the following formula:

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Cu + Ni}{15}$$

3.4 CHARPY V-NOTCH TEST REQUIREMENTS

For valves specified to be used for Gas service or LPG service, Charpy V-notch test, on each heat of base material shall be conducted as per API 6D-Clause 8.5, for all pressure containing parts such as body, end flanges and welding ends as well as bolting material for pressure containing parts. Unless specified otherwise, the Charpy V-notch test shall be conducted at 0°C. Test procedure shall conform to ASTM A 370. The average absorbed energy value of three full sized specimens shall be 27 J. The minimum impact energy value of any one specimen of the three specimens analyzed as above shall not be less than 22 J.

When Low Temperature Carbon Steel (LTCS) materials are specified in Valve Data Sheet or offered by Manufacturer, the Charpy V-notch test requirements of applicable material standard shall be complied with.

3.5 HARDNESS TEST REQUIREMENTS

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

3.6 ELECTROLESS NICKEL PLATING REQUIREMENTS

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

- SC2, Type II, Class 2.

The hardness of plating shall be minimum 50 RC.

4.0 DESIGN AND CONSTRUCTION REQUIREMENTS

4.1 GENERAL

Valve design shall meet the requirements of API Specification 6D and shall be suitable for the service conditions indicated in the Valve Data Sheet. The valve body and other pressure containing parts shall be designed in compliance with ASME Boiler & Pressure Vessel Code, Section VIII, Div 1. Allowable stress requirements shall comply the provisions of ASME B31.3. Also, corrosion allowance indicated in Valve Data Sheet shall be considered in valve design; however, the minimum wall thickness shall not be less than the minimum requirement of ASME B16.34. The manufacturer shall have valid license to use API monogram on valves manufactured as per API 6D.

4.2 VALVE INSTALLATION

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

4.3 VALVE BODY

Valve body design shall be either fully welded or bolted type. Valve body joints with threads are not permitted.

The Ball of valve shall be trunnion mounted. Valve design shall minimize the possibility of debris ingress into the trunnion as far as practicable.

4.4 BALL

Ball shall be of single piece, solid type construction.

4.5 VALVE CONFIGURATION

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

FULL OPENING VAVE

Full bore valves shall be suitable for the passage of all types of pipeline pigs including instrumented intelligent pigs and regular cleaning, batching and scraper pigs on regular basis without causing damage to either the valve component or the pig. The full bore, valve shall provide an unobstructed profile for pigging operations in either direction. Full bore valves shall be designed to minimize accumulation of debris in the seat ring region to ensure that valve movement is not impeded. The bore size of a full bore-valve shall be as per API 6D.

REDUCED OPENING VAVE

The bore size of reduced bore valve shall be as indicated in Table- 4.5 below:

**STANDARD SPECIFICATION
FOR PIPELINE BALL VALVES**

TABLE – 4.5			
Nominal Valve Size		Reduced Bore	
DN	mm (NPS)	DN	mm (NPS)
		mm (NPS inches)	mm (NPS inches)
	50 (2)	50 (2)	600 (24)
	80 (3)	50 (2)	650 (26)
	100 (4)	80 (3)	700 (28)
	150 (6)	100 (4)	750 (30)
	200 (8)	150 (6)	800 (32)
	250 (10)	200 (8)	850 (34)
	300 (12)	250 (10)	900 (36)
	350 (14)	250(10)	950 (38)
	400 (16)	300 (12)	1000 (40)
	450 (18)	350 (14)	1050 (42)
	500 (20)	400 (16)	1200 (48)
	550 (22)	450 (18)	

4.6 SEAT DESIGN

Valve seat shall comprise of a hard metallic seat ring energized with bellville or helical spring and shall provide bubble tight shutoff at high pressure. 'O' ring or other seals if used for drip tight sealing shall be encased in a suitable groove in such a manner that it cannot be removed from seat ring and there is no extrusion during opening or closing operation of valve, at maximum differential pressure corresponding to valve class rating.

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

4.8 DOUBLE BLOCK & BLEED DESIGN

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

4.9 SEALANT INJECTION

Full bore valves of nominal valve size DN 200 mm (8") & above and Reduced Bore valves of nominal valve size DN 250 mm (10") & above, shall have provision for secondary sealant injection under full line pressure for seat and stem seals. All sealant injection connections shall be provided with an internal non-return valve. Valve design shall have a provision to replace the sealant injection fitting under full line pressure. Valves shall be provided with vent and drain connections. Drain sizes shall be in accordance with API 6D or MSS-SP-45. Drain sizes shall be as specified in MSS-SP-45 for valve size NPS 2 to NPS 24. For sizes larger than NPS 24, manufacturer shall specify suitable drain size for purchaser approval.

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

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

4.11 SUPPORT FOOT

Full bore valves of nominal valve size DN 200 mm (8") & above and Reduced bore valves of

**STANDARD SPECIFICATION
FOR PIPELINE BALL VALVES**

nominal valve size DN 250 mm (10") & above, shall be equipped with support foot and lifting lugs unless specified otherwise. Tapped holes and eyebolts shall not be used for lifting lugs. Height of support foot shall be kept minimum. The location and size of support foot/ lifting lugs shall ensure unrestrictive operation of vent/ drain valves.

- 4.12 Valve design shall be such as to avoid bimetallic. Corrosion between carbon steel and high alloy steel components. Suitable insulation shall be provided as required.
- 4.13 For valves to be used in liquid service, the body cavity over-pressure shall be prevented by self-relieving seat rings/ assemblies. Self-relieving seat rings shall relieve at a body cavity differential pressure not exceeding 50% of the valve class rating pressure.

4.14 VALVE ENDS

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

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

Butt weld end preparation shall be as per ASME B 16.25. The thickness of the pipe to which the valve has to be welded shall be as indicated in the Valve Data Sheet. Valves shall be without transition pups. In case difference exists between thickness of welding ends of valve and connecting pipe, the welding ends of valve shall have bevel preparation as per ASME B31.4 or ASME B31.8 as applicable.

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

4.16 POSITION INDICATORS

Valve shall be provided with ball position indicator and stops of rugged construction at the fully open and fully closed positions.

4.17 STEM EXTENSIONS

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

- a. Valves provided with stem extension shall have water proof outer casing. Length of stem extension shall be as indicated in Valve Data Sheet. The length indicated corresponds to the distance between centerline of the valve opening and the top of mounting flange for valve operating device (gear operator/ power actuator as applicable).
- b. Vent and drain connections and sealant injection lines shall be terminated adjacent to the valve operator by means of suitable piping anchored to the valve body. The pipe used shall be API 5L Gr. B/ ASTM A 106 Gr. B, with Sch 160. Fittings shall be ASTM A105/ ASTM A234 Gr. WPB, Socket welded ANSI class 600.

**STANDARD SPECIFICATION
FOR PIPELINE BALL VALVES**

-
- c. Stem extension and stem housing design shall be such that the complete assembly will form a rigid unit giving positive drive under all conditions with no-possibility of free movement between valve body, stem extension or its operator.
 - d. Outer casing of stem extension shall have 3/8" or 1/2" NPT plugs at the top and bottom, for draining and filling with oil to prevent internal corrosion.
 - e. The Stem Extension shall be self-relieving.

4.18 OPERATING DEVICES

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

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

4.20 LOCKING DEVICES

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

4.21 WELDING

All welds shall be made by welders and welding procedures qualified in accordance with the provisions of ASME Section IX, except that only positions 5G and 2G shall qualify all- positional welding. The procedure qualification shall also include impact test and hardness test when required as per Clause 3.4 to 3.5 of this specification and shall meet the requirements as specified therein.

4.22 REPAIR WELDING

Repair by welding is not permitted for fabricated and forged body valves. However, repair by welding as per ASME B16.34 is permitted for cast body valves. Such repairs shall be carried out at casting supplier's care only. Repair shall be carried out before any heat treatment of casting is done. Repair welding procedure qualification shall also include impact test and hardness test when required as per Clause 3.4 to 3.5 of this specification and shall meet the requirements as specified therein.

- 4.23 Valve stem shall be capable of withstanding the maximum operating torque required to operate the valve against the maximum differential pressure corresponding to applicable class rating. The combined stress shall not exceed the maximum allowable stresses specified in ASME section VIII, Division 1. For power actuated valves, the valve stem shall be designed for maximum output torque of the selected power actuator (including gear box, if any) at valve stem.

5.0 INSPECTION & TESTS

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

Pressure Class Rating	Valve Size	Extent of Radiography
ANSI 150 # Class	All sizes	Nil
ANSI 300 # Class	≤ DN 400 mm (16")	Nil
	≥ DN 450 mm (18")	100%
ANSI 600 # Class and above	All sizes	100%

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

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

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

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

- 5.6 Full inspection by radiography shall be carried out on all welds of pressure containing parts.

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Acceptance criteria shall be as per ASME B 31.4 or ASME B31.8 as applicable and API 1104.

- 5.7 Welds, which in Company's opinion cannot be inspected, by radiographic methods, shall be checked by ultrasonic or magnetic particle methods and acceptance criteria shall be as per ASME Sec. VIII (2007 edition), Division 1, Appendix 12 and, Appendix 6 respectively.
- 5.8 All finished wrought weld ends subject to welding in field shall be 100% ultrasonically tested for lamination type defects for a distance of 50 mm from the end. Laminations shall not be acceptable.
- a. Weld ends of all cast valves subject to welding in field shall be 100% radio graphically examined and acceptance criteria shall be as per ASME B16.34.
 - b. After final machining, all bevel surfaces shall be inspected by dye penetrant or wet magnetic particle methods All defects longer than 6.35 mm are rejected, as are the defects between 6.35 mm and 1.59 mm that are separated by a distance less than 50 times their greatest length. Rejectable defects must be removed. Weld repair of bevel surface is not permitted.
- 5.9 All valves shall be tested in compliance with the requirements of API 6D. During pressure testing, valves shall not have sealant lines and other cavities filled with sealant, grease or other foreign material: The drain, vent and sealant lines shall be either included in the hydrostatic shell test or tested independently. Test pressure shall be held for at least 30 minutes. No leakage is permissible during hydrostatic testing. The body cavity self- relieving feature meeting the requirements of clause 4.13 of this specification shall also be checked.
- 5.10 A supplementary air seat test as per API 6D (Annex B, Para B.3.3 Type II) shall be carried out for all valves. A bubble tight seal is required without the use of any sealant. No leakage is allowed. Test pressure shall be held for at least 15 minutes.
- 5.11 Valves shall be subjected to Operational Torque Test as per API 6D (Annex B, Para B.6) under hydraulic pressure equal to maximum differential pressure corresponding to the applicable ANSI class rating of valve. It shall be established that the force required to operate the valve does not exceed the requirements stated in section 4.18 (C) of this specification.
- 5.12 Power actuated valves shall be tested after assembly of the valve and actuator, at the valve Manufacturer's works. At least five Open-Close-Open cycles without internal pressure and five Open-Close-Open cycles with maximum differential pressure corresponding to the valve rating shall be performed on the valve actuator assembly. The time for Full Open to Full Close shall be recorded during testing. If required, the actuator shall be adjusted to ensure that the opening and closing time is within the limits stated in Valve Data Sheet.

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

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

- 5.13 Subsequent to successful testing as specified in clause 5.11 and 5.12 above, one (1) valve out of the total ordered quantity shall be randomly selected by the Company Representative for cyclic testing as mentioned below:
- a. The valve shall be subjected to at least 100 Open-Close-Open cycles with maximum differential pressure corresponding to the valve rating.
 - b. Subsequent to the above, the valve shall be subjected to hydrostatic test and supplementary air seat test in accordance with clause 5.9 and 5.10.

In case this valve fails to pass these tests, the valve shall be rejected and two more valves shall be selected randomly and subjected to testing as indicated above. If both valves pass these tests, all valves manufactured for the order (except the valve that failed) shall be

**STANDARD SPECIFICATION
FOR PIPELINE BALL VALVES**

deemed acceptable. If either of the two valves fails to pass these tests, all valves shall be rejected or each valve shall be tested at the option of manufacturer.

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

- 5.14 Checks shall be carried out to demonstrate that the dissimilar metals used in the valves are successfully insulated as per the requirement of clause 4.12 of this specification.
- 5.15 Company reserves the right to perform stage wise inspection and witness tests as indicated in clause 5.1 above at Manufacturer's works prior to shipment. Manufacturer shall give reasonable access and facilities required for inspection to the Company's Inspector. Company reserves the right to require additional testing at any time to confirm or further investigate a suspected fault. The cost incurred shall be to Manufacturer's account.

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

Inspection and tests performed/ witnessed by the Company's Inspector shall in no way relieve the Manufacturer's obligation to perform the required inspection and tests.

6.0 TEST CERTIFICATES

Manufacturer shall submit the following certificates in accordance with EN 10204 3.2.

- a. Mill test certificates relevant to the chemical analysis and mechanical properties of the materials used for the valve construction as per the relevant standards.
- b. Report on heat treatment carried out.
- c. Test certificates of hydrostatic and pneumatic tests complete with records of timing and pressure of each test.
- d. Test reports of radiograph and ultrasonic inspection, MPI and DP Inspection
- e. Test report on operation of valves conforming to clause 5.11, 5.12 and 5.13 of this specification.
- f. All other test reports and certificates as required by API 6D and this specification.

The certificates shall be considered valid only when signed by Company's Inspector. Only those valves which have been certified by Company's Inspector shall be dispatched from Manufacturer's works.

7.0 PAINTING

Valve surface shall be thoroughly cleaned, freed from rust and grease and applied with sufficient coats of corrosion resistant paint. Surface preparation shall be carried out by shot blasting to SP-6 in accordance with "Steel Structures Painting Council - Visual Standard SSPC-VIS-1". For the valves to be installed underground, when indicated in Valve Data Sheet, the external surfaces of buried portion of the valve shall be painted with three coats of suitable coal tar epoxy resin with a minimum dry film thickness of 300 microns.

8.0 MARKING & SHIPMENT

- 8.1 All valves shall be marked as per API 6D. The units of marking shall be metric except nominal diameter, which shall be in inches.
- 8.2 Valve ends shall be suitably protected to avoid any damage during transit. All threaded and machined surfaces subject to corrosion shall be well protected by a coat of grease or other suitable material. All valves shall be provided with suitable protectors for flange faces, securely

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FOR PIPELINE BALL VALVES**

attached to the valves. Bevel ends shall be protected with metallic or high impact plastic bevel protectors.

- 8.3 All sealant lines and other cavities of the valve shall be filled with sealant before shipment.
- 8.4 Packaging and shipping instructions shall be as per API 6D.
- 8.5 The serial number of each valve indicated on its nameplate shall appear on all required documentation in accordance with EN 10204 3.2.
- 8.6 All valves shall be transported with ball in fully opened condition
- 8.7 On packages, following shall be marked legibly with suitable marking ink:
 - a. Order Number
 - b. Manufacturer's Name
 - c. Valve size and rating
 - d. Tag Number
 - e. Serial Number

9.0 SPARES & ACCESSORIES

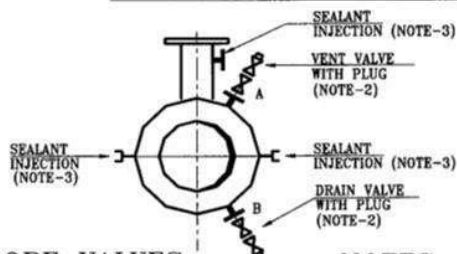
- 9.1 Manufacturer shall furnish list of recommended spares and accessories for valves required during start-up and commissioning and supply of such spares shall be included in the price quoted by Manufacturer.
- 9.2 Manufacturer shall furnish list of recommended spares and accessories required for two years of normal operation and maintenance of valves and price for such spares shall be quoted separately.

10.0 DOCUMENTATION

The Manufacturer shall supply documentation in accordance with the Vendor Data Requirements List (VDRL) as attached with Purchase Order.

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FOR PIPELINE BALL VALVES**

ABOVE GROUND INSTALLATION



FULL BORE VALVES

VALVE SIZE, DN(mm)	A, DN(mm)	B, DN(mm)
50 AND 150	-	15
200 TO 600	15	25
650 & ABOVE	15	50

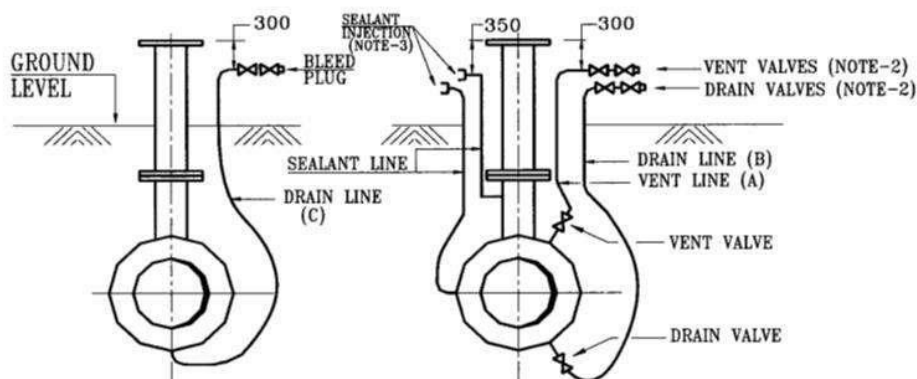
REDUCED BORE VALVES

VALVE SIZE, DN(mm)	A, DN(mm)	B, DN(mm)
50 AND 200	-	15
250 TO 750	15	25
ABOVE 750	15	50

NOTES:-

- 1 ALL VALVES (BALL OR PLUG) AND PLUGS FOR A AND B SHALL BE APPROVED BY THE PURCHASER.
- 2 VALVES OF SIZE 50 mm SHALL BE MANUFACTURED AS PER API-6D.
- 3 SEALANT POINTS SHALL BE PROVIDED FOR FULL BORE VALVES OF NOMINAL VALVE SIZE 200 mm (8") & ABOVE AND REDUCED BORE VALVES OF NOMINAL VALVE SIZE, DN 250 mm (10") AND ABOVE ONLY. SEALANT LINES SHALL HAVE PROVISION TO REPLACE THE SEALANT INJECTION FITTING UNDER FULL LINE PRESSURE.
- 4 ALL VENT/DRAIN CONNECTION SHALL BE WELDED WITH THE BODY.

UNDERGROUND INSTALLATION



FB VALVES DN 50 mm(2") TO DN 150 mm(6")
RB VALVES DN 50 mm(2") TO DN 200 mm(8")

FB VALVES ≥ DN 200 mm(8")
RB VALVES ≥ DN 250 mm(10")

FULL BORE (FB) VALVES

VALVE SIZE, DN(mm)	A, DN(mm)	B, DN(mm)	C, DN(mm)
50 AND 150	-	-	15
200 TO 300	25	25	-
350 TO 600	25	25	-
650 & ABOVE	50	50	-

REDUCED BORE (RB) VALVES

VALVE SIZE, DN(mm)	A, DN(mm)	B, DN(mm)	C, DN(mm)
50 AND 200	-	-	15
250 TO 400	25	25	-
450 TO 750	25	25	-
800 & ABOVE	50	50	-

NOTES:-

- 1 ALL VALVES (BALL OR PLUG) AND PLUGS FOR A AND B SHALL BE APPROVED BY THE PURCHASER.
- 2 VALVES OF SIZE 50 mm SHALL BE MANUFACTURED AS PER API-6D.
- 3 SEALANT POINTS SHALL BE PROVIDED FOR FULL BORE VALVES OF NOMINAL VALVE SIZE 200 mm (8") & ABOVE AND REDUCED BORE VALVES OF NOMINAL VALVE SIZE, DN 250 mm (10") AND ABOVE ONLY. SEALANT LINES SHALL HAVE PROVISION TO REPLACE THE SEALANT INJECTION FITTING UNDER FULL LINE PRESSURE.
- 4 ALL VENT/DRAIN CONNECTION IN BURIED SECTION SHALL BE OF WELDED CONSTRUCTION.

FIGURE-4.9

**STANDARD SPECIFICATION
FOR
PIPELINE PLUG VALVES (ONSHORE)**

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FOR PIPELINE PLUG VALVES
(ONSHORE)**

ABBREVIATIONS:

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

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**STANDARD SPECIFICATION
FOR PIPELINE PLUG VALVES
(ONSHORE)**

1.0 SCOPE

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

2.0 REFERENCE DOCUMENTS

2.1 All valves shall be manufactured and supplied in accordance with the American Petroleum Institute (API) Specification 6D, Twenty Third Edition, April 2008/ ISO 14313:2007, Petroleum and Natural Gas Industries - Pipeline Transportation Systems - Pipeline Valves, with additions and modifications as indicated in the following sections of this specification.

2.2 Reference has also been made in this specification to the latest edition (edition enforce at the time of issue of enquiry unless specified otherwise) of the following Codes, Standards and Specification.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

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

AMERICAN PETROLEUM INSTITUTE (API)

1104	:	Specification for Welding Pipelines and Related Facilities.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A370	:	Standard Test Methods and Definitions for Mechanical Testing of Steel Products.

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B 733 : Auto catalytic (Electroless) Nickel - Phosphorus Coatings on Metal.

MANUFACTURERS STANDARDIZATION SOCIETY (MSS)

SP-6 : Standard Finishes for Contact Faces of Pipe Flanges and Connecting – End Flanges of Valves and Fittings.

SP-44 : Steel Pipeline Flanges.

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

VIS-I : Visual Standard.

2.3 In case of conflict between the requirements of this specification, API 6D and the Codes, Standards and Specifications referred in clause 2.2 above, the requirements of this specification shall govern.

3.0 MATERIALS

3.1 The Material for Construction of major components of the Plug valves shall be as indicated in Valve Data Sheet. Other components shall be as per Manufacturer's standard (suitable for the service conditions indicated in the Valve Data Sheet) and shall be subject to approval by Company.

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

3.2 Carbon steel used in the manufacture of valves shall be fully killed.

3.3 The carbon equivalent (CE) of valve end connections which are subject to further field welding by Company shall not exceed 0.45 on check analysis for each heat of steel used, as calculated by the following formula:

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Cu + Ni}{15}$$

3.4 CHARPY V-NOTCH TEST REQUIREMENTS

3.4.1 For valves specified to be used for Gas service or LPG service, Charpy V-notch test, on each heat of base material shall be conducted as per API 6D Clause - 8.5, for all pressure containing parts such as body, end flanges and welding ends as well as bolting material for pressure containing parts. Unless specified otherwise, the Charpy Impact test shall be conducted at 0°C. Test procedure shall conform to ASTM A 370. The average absorbed energy value of three full sized specimens shall be 27 J. The minimum impact energy value of any one specimen of the three specimens analyzed as above shall not be less than 22 J.

3.4.2 When Low Temperature Carbon Steel (LTCS) materials are specified in Valve Data Sheet or offered by Manufacturer, the Charpy V-notch test requirements of applicable material standard shall be complied with.

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3.5 HARDNESS TEST REQUIREMENTS

For Valves specified to be used for Gas service or LPG service, Hardness test shall be carried out as per ASTM A 370 for each method of manufacture and each heat of steel used in the manufacture of valves. A full thickness cross section shall be taken for this purpose and the maximum hardness of the materials of valve components shall not exceed 248 HV₁₀.

3.6 ELECTROLESS PLATING REQUIREMENTS

For all such valves where Carbon Steel is used as plug material, the plug shall have 75 micrometers (0.003 inches) thick Electroless Nickel Plating (ENP) as per ASTM B 733 with following classification:

- SC2, Type II, Class 2.

The hardness of plating shall be minimum 50 RC.

4.0 DESIGN AND CONSTRUCTION REQUIREMENTS

4.1 GENERAL

Valve design shall meet the requirements of API Specification 6D and shall be suitable for the service conditions indicated in the Valve Data Sheet. The valve body and other pressure containing parts shall be designed in compliance with ASME Boiler & Pressure Vessel Code, Section VIII, Div1. Allowable stress requirements shall comply the provisions of ASME B31.3. Also corrosion allowance indicated in Valve Data Sheet shall be considered in valve design. However, the minimum wall thickness shall not be less than the minimum requirement of ASME B16.34. The manufacturer shall have valid license to use API monogram on valves manufactured as per API 6D.

4.2 VALVE PATTERN

Valve pattern area shall be as specified in the following table: -

ANSI Pressure Rating	SIZE RANGE, DN MM (INCH)	PATTERN
Class 150 #	50-100 (2- 4)	Short
	150-300 (6 – 12)	Regular
	350(14) & above	Venturi
Class 300 #	50 -100(2 – 4)	Short
	150 - 250 (6 -10)	Regular
	300 (12) & above	Venturi
Class 600 #	50 - 250 (2 – 10)	Regular
	300 (12) & above	Venturi
Class 900 #	50 - 250 (2 – 10)	Regular
	300 (12) & above	Venturi

4.3 PLUG DESIGN

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The valves shall have an inherent feature to ensure that under line pressure cannot cause taper locking of plug/ plug movement in to the taper, i.e. valves shall be of "Pressure-Balanced" design type.

4.4 Cover shall be bolted to the valve body and screwed connections are not acceptable.

4.5 Soft seats to achieve a seal between plug and body are not permitted.

4.6 SEALANT INJECTION REQUIREMENT

All valves shall have the provision for secondary sealant injection under full line pressure for seat and stem seals. All sealant injection connection shall be provided with an internal non-return valve. Valve design shall have a provision (e.g. Ball Type Check Valve/ Needle Valve) to replace the sealant injector fitting under full line pressure. Location and arrangement of sealant injection points shall be as per Fig - 4.6.

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

4.8 Valve design shall ensure repair of gland packing under full line pressure.

4.9 VALVE ENDS

- a. Valve ends shall be either flanged/ or butt welded or one end flanged and one end butt welded as indicated in the Valve Data Sheet. Flanges of the flanged end cast/ forged body valves shall be integrally cast/ forged with the body of the valve. Face to face/ end to end dimensions shall conform to API 6D. Face-to-face and end-to-end dimensions for valve sizes not specified in API 6D shall be in accordance with ASME B 16.10. Face-to-face and end-to-end dimensions not shown in API 6D or in ASME B 16.10 shall be as per Manufacturer Standard and shall be subject to approval by Company.
- b. Flanged ends, if specified, shall have flanges as per ASME B16.5 for valve sizes up to DN 600 mm (24") excluding DN 550 mm (22") and as per MSS-SP-44/ ASME B 16.47 Series A for valve sizes DN 550 mm (22") and for DN 650 mm (26") and above. Flange face shall be either raised face or ring joint type (RTJ) as indicated in Valve Data Sheet. Flange face finish shall be serrated or smooth as indicated in Valve Data Sheet. In case of RTJ flanges, the groove hardness shall be minimum 140 BHN.
- c. Butt weld end preparation shall be as per ASME B 16.25. The thickness of the pipe to which the valve has to be welded shall be as indicated in the Valve Data Sheet. Valves shall be without transition pups. In case difference exists between thickness of welding ends of valve and connecting pipe, the welding ends of valve shall have bevel preparation as per ASME B31.4 or ASME B31.8 as applicable.

4.10 POSITION INDICATORS

Valve shall be provided with Plug position indicator and stops of rugged construction at the fully open and fully closed positions.

4.11 VALVE INSTALLATION

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

4.12 LOCKING DEVICES

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

- 4.13** Valves of size NPS 8" and larger shall be equipped with lifting lugs. Tapped holes and eye bolts shall not be used for lifting lugs.

4.14 STEM EXTENSIONS

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

- a. Valves provided with stem extension shall have water proof outer casing. Length of stem extension shall be as indicated in Valve Data Sheet. The length indicated corresponds to the distance between centerline of the valve opening and the top of mounting flange for valve operating device (gear operator/ power actuator as applicable).
- b. Seat sealant injection lines shall be extended and terminated adjacent to the valve operator by means of suitable piping anchored to the valve body/ stem housing. The pipe used shall be API 5L Gr. B/ ASTM A 106 Gr. B, with Sch 160. Fittings shall be ASTM A105/ ASTM A 234 Gr. WPB, Socket welded ANSI class 600.
- c. Stem extension and stem housing design shall be such that the complete assembly will form a rigid unit giving positive drive under all conditions with no-possibility of free movement between valve body, stem extension or its operator.
- d. Outer casing of stem extension shall have 3/8" or 1/2" NPT plugs at the top and bottom, for draining and filling with oil to prevent internal corrosion.

- 4.15** The valve stem shall be capable of withstanding the maximum operating torque required to operate the valve against the maximum differential pressure as per the appropriate class. The combined stress shall not exceed the maximum allowable stresses specified in the ASME Section VIII Div 1.

The valve stem shall have anti-blowout feature with antistatic device. The valve stem may be integral with plug or be a separate component.

4.16 OPERATING DEVICES

- a. Valves shall have a power actuator or manual operator as indicated in the Valve Data Sheet. In case of manual operator, valve sizes, DN $\leq$ 100 mm (4") shall be wrench operated and valve sizes, DN $\geq$ 150 mm (6") shall be gear operated. Each wrench operated valve shall be supplied with wrench. Valve design shall be such that damage due to malfunctioning of the operator or its controls will only occur in the operator gear train or power cylinder and that damaged parts can be replaced without the valve cover being removed.
- b. The power actuator shall be in accordance with the Company Specification issued for the purpose and as indicated in the Valve and Actuator Data Sheet. Operating time shall be as indicated in Valve Data Sheet. Valve operating time shall correspond to full close to full open/ full open to full close under maximum differential pressure corresponding to the valve rating. For actuated valves, the actuator's rated torque output shall be at least 1.25 times the break torque required to operate the valve under the maximum differential pressure corresponding to the valve class rating.
- c. For the manual operator of all valves, the diameter of the hand wheel or the length of operating wrench shall be such that under the maximum differential pressure, the total

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force required to operate the valve does not exceed 350N. Manufacturer shall also indicate the number of turns of hand wheel (In case of gear operators) required for operating the valve from full open to full close position.

- d. Direction of operation of hand wheel or wrench shall be in clock-wise direction while closing the valve. Hand wheels shall not have protruding spokes.
- e. Gear operators, when provided, shall have a self-locking provision and shall be fully encased in water proof/ splash proof enclosure and shall be filled with suitable grease.

4.17 WELDING

All welds shall be made by welders and welding procedures qualified in accordance with the provisions of ASME Section IX, except that only positions 5G and 2G shall qualify all-positional welding. The procedure qualification shall also include impact test and hardness test when required as per Clause 3.4 and 3.5 of this specification and shall meet the requirements as specified therein.

4.18 REPAIR WELDING

Repair by welding is not permitted for fabricated and forged body valves. However repair by welding as per ASME B16.34 is permitted for cast body valves. Such repairs shall be carried out at casting supplier's care only. Repair shall be carried out before any heat treatment of casting is done. Repair welding procedure qualification shall also include impact test and hardness test when required as per Clause 3.4 and 3.5 of this specification and shall meet the requirements as specified therein.

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

5.0 INSPECTION AND TESTS

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

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PRESSURE CLASS RATING	VALVE SIZE	EXTENT OF RADIOGRAPHY
ANSI 150 # Class	All Sizes	Nil
ANSI 300 # Class	≤ DN 400 mm (16")	Nil
	≤ DN 450 mm (18")	100%
ANSI 600 # Class above	All Sizes	100%

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

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

5.6 Areas, which in Company's opinion cannot be inspected, by radiographic methods, shall be checked by ultrasonic or magnetic particle methods and acceptance criteria shall be as per ASME Sec. VIII (2007 edition), Division 1, Appendix 12 and Appendix 6 respectively.

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

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

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

5.8 All valves shall be tested in compliance with the requirements of API 6D. The drain, vent and sealant lines shall be either included in the hydrostatic shell test or tested independently. Test pressure shall be held for at least 30 minutes. No leakage is permissible during hydrostatic testing. After pressure testing and acceptance, valves shall be thoroughly drained and dried. Drying of valves internal shall be with compressed air and lint free rags. The internal surfaces shall be coated with suitable water dispelling anti-corrosion fluid. To ensure total coverage, the valve shall be placed in the half open position, filled with the fluid and drained.

5.9 Pneumatic seat test as per API 6D (Annex B, Para B 3.3 Type II) shall be carried out for all valves. No leakage is allowed. Test pressure shall be held for at least 15 minutes.

5.10 Valves shall be subjected to an Operational Torque Test as per API 6D (Annex B, Para B.6) under hydraulic pressure equal to maximum differential pressure corresponding to the applicable ANSI class rating of valve. For manually operated valves, testing shall confirm that the torque required to operate the valve does not exceed 4.16 (c) of this specification.

5.11 Power actuated valves shall be tested after assembly of the valve and actuator, at the valve Manufacturer's works. At least five Open-Close-Open cycles without internal pressure and five Open-Close-Open cycles with maximum differential pressure corresponding to the valve rating shall be performed on the valve actuator assembly. The time for Full Open to Full

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Close shall be recorded during testing. If required, the actuator shall be adjusted to ensure that the opening and closing time is within the limits stated in Valve Data Sheet.

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

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

- 5.12** Company reserves the right to perform stage wise inspection and witness tests as indicated in clause 5.1 above at Manufacturer's works prior to shipment. Manufacturer shall give reasonable access and facilities required for inspection to the Company's Inspector. Company reserves the right to require additional testing at any time to confirm or further investigate a suspected fault. The cost incurred shall be to Manufacturer's account.

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

Inspection and tests performed/ witnessed by the Company's Inspector shall in no way relieve the Manufacturer's obligation to perform the required inspection and tests.

6.0 TEST CERTIFICATES

Manufacturer shall submit the following certificates in accordance with EN10204 3.2.

- a. Mill test certificates relevant to the chemical analysis and mechanical properties of the materials used for the valve construction as per the relevant standards.
- b. Report on heat treatment carried out.
- c. Test certificates of hydrostatic and pneumatic tests complete with records of timing and pressure of each test.
- d. Test reports of radiograph and ultrasonic inspection, MPI and DP Inspection.
- e. Test report on operation of valves conforming to clause 5.0 of this specification.
- f. All other test reports and certificates as required by API 6D and this specification.

The certificates shall be considered valid only when signed by Company's Inspector. Only those valves which have been certified by Company's Inspector shall be dispatched from Manufacturer's works.

7.0 PAINTING

Valve surface shall be thoroughly cleaned, freed from rust and grease and applied with sufficient coats of corrosion resistant paint. Surface preparation shall be carried out by shot blasting to SP-6 in accordance with "Steel Structures Painting Council - Visual Standard SSPC-VIS-1". For the valves to be installed underground, when indicated in Valve Data Sheet, the external surfaces of buried portion of the valve shall be painted with three coats of suitable coal tar epoxy resin with a minimum dry film thickness of 300 microns.

8.0 MARKING & SHIPMENT

- 8.1** All valves shall be marked as per API 6D. The units of marking shall be metric except nominal diameter, which shall be in inches.

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- 8.2** Valve ends shall be suitably protected to avoid any damage during transit. All threaded and machined surfaces subject to corrosion shall be well protected by a coat of grease or other suitable material. All valves shall be provided with suitable protectors for flange faces, securely attached to the valves. Bevel ends shall be protected with metallic or high impact plastic bevel protectors.
- 8.3** All sealant lines and other cavities of the valve shall be filled with sealant before shipment.
- 8.4** Packaging and shipping instructions shall be as per API 6D.
- 8.5** On packages, following shall be marked legibly with suitable marking ink:
- a. Order Number
 - b. Manufacturer's Name
 - c. Valve size and rating
 - d. Tag Number
 - e. Serial Number

9.0 SPARES AND ACCESSORIES

- 9.1** Manufacturer shall furnish list of recommended spares and accessories for valves required during start-up and commissioning and supply of such spares shall be included in the price quoted by Manufacturer.
- 9.2** Manufacturer shall furnish list of recommended spares and accessories required for two years of normal operation and maintenance of valves and price for such spares shall be quoted separately.

10.0 DOCUMENTATION

The Manufacturer shall supply documentation in accordance with the Vendor Data Requirements List (VDRL) as attached with Purchase Order.

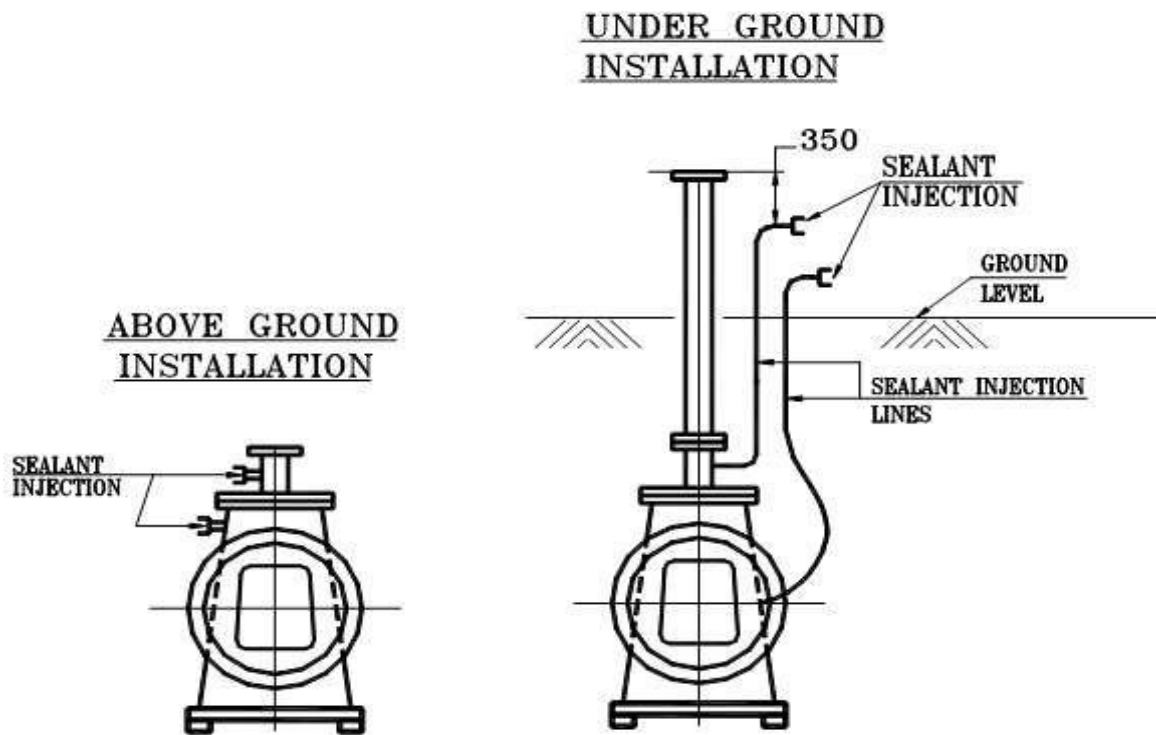


FIGURE- 4.6

**STANDARD SPECIFICATION
FOR INSULATING JOINTS**

ABBREVIATIONS:

ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
API	American Petroleum Institute
BHN	Brinell Hardness Number
HAZ	Heat Affected Zone
MSS-SP	Manufacturers Standardization Society - Standard Practice
RTJ	Ring Type Joint
SSPC	Steel Structures Painting Council

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1.0 SCOPE

This Specification covers the minimum requirement for the design, manufacture, testing and supply of carbon steel insulating joints to be installed in onshore pipeline systems handling non sour hydrocarbons in liquid or gaseous phase including Liquefied Petroleum Gas (LPG).

2.0 REFERENCE DOCUMENTS

The design, materials, fabrication, inspection, testing and supply of insulating joints shall comply with the latest edition of the following codes and standards.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

B31.4	:	Pipeline Transportation System for Liquid Hydrocarbon & Other Liquids.
B 31.8	:	Gas Transmission and Distribution Piping Systems.
B16.9	:	Factory made Wrought Butt Weld Fittings.
B 16.25	:	Butt Welding Ends.
BPVC Section VIII	:	Boiler and Pressure Vessel Code - Rules for Construction of Pressure Vessels, Division 1.
BPVC Section IX	:	Welding and Brazing Qualifications.
BPVC Section V	:	Non-Destructive Examination.

AMERICAN PETROLEUM INSTITUTE (API)

Specification 5L	:	Specification for Line Pipe.
1104	:	Specification for Welding Pipelines and Related Facilities.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A370	:	Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
D2000	:	Classification System of Rubber Products.
D709	:	Laminated Thermosetting Material.

MANUFACTURERS STANDARDIZATION SOCIETY (MSS)

SP-25	:	Standard Marking System for Valves, Fittings, Flanges and Unions.
SP-75	:	Specification for High Test Wrought Butt-Welding Fittings.
SP-53	:	Quality Standard for Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping

Components - Magnetic Particle Examination
Method.

National Association of Corrosion Engineers (NACE)

RP 0286 : Standard Recommended Practice, Electrical
Isolation of Cathodically Protected Pipelines.

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

VIS-I : Visual Standard.

SP-10 : Surface Preparation.

OIL INDUSTRY SAFETY DIRECTORATE (OISD)

Std. 141 : Design and Construction Requirements for
Cross Country Hydrocarbon Pipelines.

Std. 226 : Natural Gas Transmission Pipelines and City Gas
Distribution Network.

MISCELLANEOUS

NEC : National Electric Code.

ISO 2409 : Paints and Varnishes - Cross-Cut test.

In case of conflict between various requirements of this specification and reference standards mentioned above, more stringent requirement shall apply unless otherwise agreed by Purchaser.

3.0 MATERIALS

3.1 METALLIC COMPONENTS

3.1.1 Material for the pressure containing parts of the insulating joints shall be as indicated in the Insulating joint Data Sheet. Other parts shall be as per the Manufacturer's standard (Suitable for the service conditions indicated in the Insulating Joint Data Sheets), which shall be subject to approval by Company. In addition, the material shall also meet the requirements specified hereinafter.

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

3.1.3 All carbon steel used for fabrication of various components of insulating joints shall be fully killed.

3.1.4 For Insulating joints specified to be used for Gas Service or LPG Service, hardness test shall be carried out as per ASTM A370 for each heat of steel used. A full thickness cross section shall be taken for this purpose. The maximum hardness of base metal, weld metal & HAZ of all the pressure containing parts shall not exceed 248 HV10.

3.1.5 The carbon equivalent (CE) based on product analysis calculated by the formula shall not exceed 0.45%.

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Cu + Ni}{15}$$

3.1.6 The Manufacturer shall select materials as indicated in the data sheet along with the as defined operating (Temperature/ Pressure) parameters and in accordance with ASME B 31.4/ B 31.8, as applicable and ANSI B16.25 for butt welding ends. Internal bore of weld joints shall not impede the pigging process or represent potential pig damage. The Manufacturer shall perform post weld heat treatment (PWHT) as/ if required by the corresponding approved weld procedures. The Manufacturer shall prove by calculations to ASME VIII Division I that the materials supplied satisfy the pressure/temperature rating as specified in Data Sheet.

3.1.7 For Insulating Joint Specified to be used for Gas Service or LPG Service. Charpy V-notch test shall be conducted on each heat of steel used in manufacturing of the pressure containing parts in accordance with ASTM A370. The specimens shall be taken in the direction of principal grain flow and notch perpendicular to original sample of plate or forging.

The minimum average absorbed impact energy value of the set of three (3) full size specimen tested at 0°C shall be 27J. The minimum impact energy value of any one specimen of three specimen analyzed as above shall not be less than 22J.

In case of Low Temperature Carbon Steel (LTCS) material specified in data sheet or offered manufacturers, the Charpy-V notch test requirement of applicable material standard shall be compiled with.

3.2 NON METALLIC COMPONENTS

Minimum thickness requirement of insulating material shall comply with NACE RP 0286.

Epoxy resin filler material used shall be CIBA Araldite CY-220 & Araldite HT-951 hardener or an approved equivalent.

Insulating rings and joint filler material shall be flame resistant and capable of safely withstanding the maximum operating temperature without distortion or loss of insulating properties. Non-metallic seal materials, if provided, shall be resistant to amine based corrosion inhibitors and explosive decompression.

The spacing ring shall be of epoxy glass fiber reinforced laminate. It shall possess high insulating properties that would comply with ASTM D 709 Type TV, Group G.1.1 properties. The materials compressive properties shall be equal to or greater than 450 MPa. The epoxy glass fiber laminates material shall possess anti-aging properties. The spacing ring, sealing gasket and filling material shall be resistant to flames and diffusion of gases, absorption of moisture and shall be capable of maintaining their required compressive strength and insulating properties over the design life of the pipeline.

Adhesive sealant or a low viscosity, cold curing thermosetting resin shall be used as filling material. Its compressive strength shall be equal to or greater than 150 MPa.

Plastic material shall be compatible to the materials they are in contact with. The Manufacturer shall give the details of the plastic used and its mechanical, chemical and temperature resistance properties.

4.0 DESIGN AND MANUFACTURE

4.1 GENERAL

- a. The monolithic insulating joints as per figure shall be designed so as to provide an effective electrical barrier by isolation between the buried pipeline and the above ground pipeline and other pipelines. Suitable for above or below ground installation as defined in the data sheet. The Manufacturer shall provide a proven design.
- b. The insulating joints shall be of the monolithic bolt-less design comprising of forged sections assembled together by welding to form an integral unit. Insulating joint shall be fabricated by welding the forged retainer to pre-assembled insulating components and hub, under compression, so as to ensure effective sealing. Final assembly of joint shall be by welding only. Crimped and screwed closing joints are not permitted.
- c. The hydrostatic test pressure for the insulating joints shall be 1.5 times the design pressure.
- d. The insulating joints shall be designed for welding to the line pipe with weld ends. Bolted and flanged connections are not allowed.
- e. The insulating joint shall have a smooth clear bore and be suitable for uninterrupted passage of pigs, spheres and on-line inspection tools. The internal bore of insulating joint shall match the bore of connected pipe as indicated in datasheet.
- f. The design shall ensure that over the time of service the carrier product shall not permeate in the cavity.
- g. The selected seal material shall be resistant to the chemicals and the operating temperature and pressure of the pipe system. At least 90% of the gasket shall be in contact with bare metal surface. The sealing gasket shall be of sufficient thickness and shall be made out of one piece of material, no joints are permitted.
- h. When specified in data sheet, the insulating joint shall be able to sustain an internal vacuum of five (5) millibar.
- i. No stress inducing recess, protrusions or notches, are permitted in the internal surface of the supplied joint. Additional fillers are not permitted to fill these flaws.
- j. The cavities inside the joint shall be filled with low viscosity dielectric material that solidifies on curing. Air pockets and impurities in the dielectric material shall not be accepted.
- k. The Manufacturer shall submit the detailed sectional drawing of the longitudinal face of the joint. The cross sectional drawing shall show all parts, materials, dimensions surface finishes and tolerances.
- l. Calculations shall be provided to show that the designed joint can withstand torsional stress up to 10% of the SMYS of the pipe material.
- m. The electrical resistance of the joint shall not decrease with time. The joint shall include permanent terminals for survey lead connections.
- n. The insulating joint material shall be resistant to creep.

- o. The external fasteners shall be hot dip galvanized as per ASTM A 153.

4.2 DESIGN

4.2.1 MECHANICAL DESIGN

- a. Main components of insulating joints such as forged hub, the stub end and the retainer ring, gaskets etc. shall be designed in accordance with Section VIII, Division 1, Appendix-II of ASME, Boiler and Pressure Vessel Code. Design factor shall be in accordance with the data sheet.
- b. Design shall be checked for both design and hydro-test conditions considering an axial force equal to 10% of total force developed due to internal pressure.
- c. A corrosion allowance, as indicated in data sheets, shall be considered in design for operating condition.
- d. Surfaces of the annular space between pup and retainer shall be abrasive blasted to a SA 2½ finish. Assembly of the insulating joint shall commence within two hours of completion of abrasive blasting. The annular space between the retainer and the spool shall be filled with epoxy resin.
- e. The joint shall be assembled in a way that the internal components are firmly locked in position. The completed joint shall be capable of withstanding the operating and testing stresses. The neck of the bell shall be sealed with mastic. The design shall consider the position of the spacing ring, sealing gasket and filling material, so that the temperature of these materials remains below 60°C during tie-in welding operation.

4.2.2 PUPS

- a. Insulating joints shall be supplied with pup pieces welded to each end by the Manufacturer. Pipe material used shall be as indicated in data sheets. The pup pieces shall be of equal length. The length of pup pieces shall be minimum 500mm or as specified on the data sheet.
- b. The end of the pups to be field welded shall be beveled in accordance with ASME B 31.4/31.8, as applicable. Pipe pups shall be welded to the insulation joint assembly prior to hydrostatic strength and leak testing.
- c. When SAW pipes are used as pups, the reinforcement of inside weld seam shall be removed for a distance of at least 50 mm from each end.
- d. The diameter tolerance and out of roundness at the ends to be field welded shall be as per API 5L.

4.2.3 ELECTRICAL

- a. The average dielectric strength of the insulating joint shall be 15 KV or more.
- b. Two cleats/cable terminators shall be welded on pups on each side of insulating joint. The cleats shall be suitable for connecting 10mm² and 50mm² cables for measurement/shorting purposes. Refer Fig 4.1 for details.

4.2.4 WELDING

- a. All welds except closing weld shall be butt welds. The closing weld shall be full

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FOR INSULATING JOINTS**

penetration girth weld in accordance with ASME BPVC Section VIII, Division I. The weld design shall conform to the ASME acceptable standards. Fillet welds if required, shall have minimum two passes.

- b. Welding end of the pipe pups to be welded to the insulating joint shall be prepared in accordance with ASME B31.4/ B31.8, as applicable. All butt weld ends shall be checked for surface defects using dye penetrate prior to welding.
- c. All welding shall be carried out by welders and welding procedure qualified in accordance with ASME Section IX. The procedure quantification to include hardness and impact test shall meet the requirement of clause 3.1.4 & 3.1.7.
- d. No repairs by welding shall be carried out on base metal of any component of insulating joint. Manufacturer shall obtain Purchaser approval prior to carrying out any repair of welds. The repair welding shall be carried out by welders and welding procedures duly qualified per ASME Section IX and records for each repair shall be maintained. Welding procedure and repair welding procedure qualification shall include requirements for impact testing.
- e. Cold die stamping on insulating joints or pups is not permitted on the body. Cold die stamping can be done on the pipe bevel.
- f. The repair of the forging by welding is not permitted. All production welding, including tacking shall be done as per the qualified procedure by the qualified welder/operators. The acceptable weld processes are:
 - Shielded Metal Arc Welding (SMAW)
 - Submerged Arc Welding (SAW)
 - Gas Metal Arc Welding (GMAW)
- g. The Manufacturer shall ensure that all the mechanical works are completed prior to the post weld heat treatment and hydrostatic test. Any re-work (welding, cutting and grinding) on the surface of the material after the PWHT or hydrostatic testing is not permitted.
- h. The need for Post Weld Heat Treatment (PWHT) shall be assessed by the Manufacturer in accordance with the relevant weld procedure.

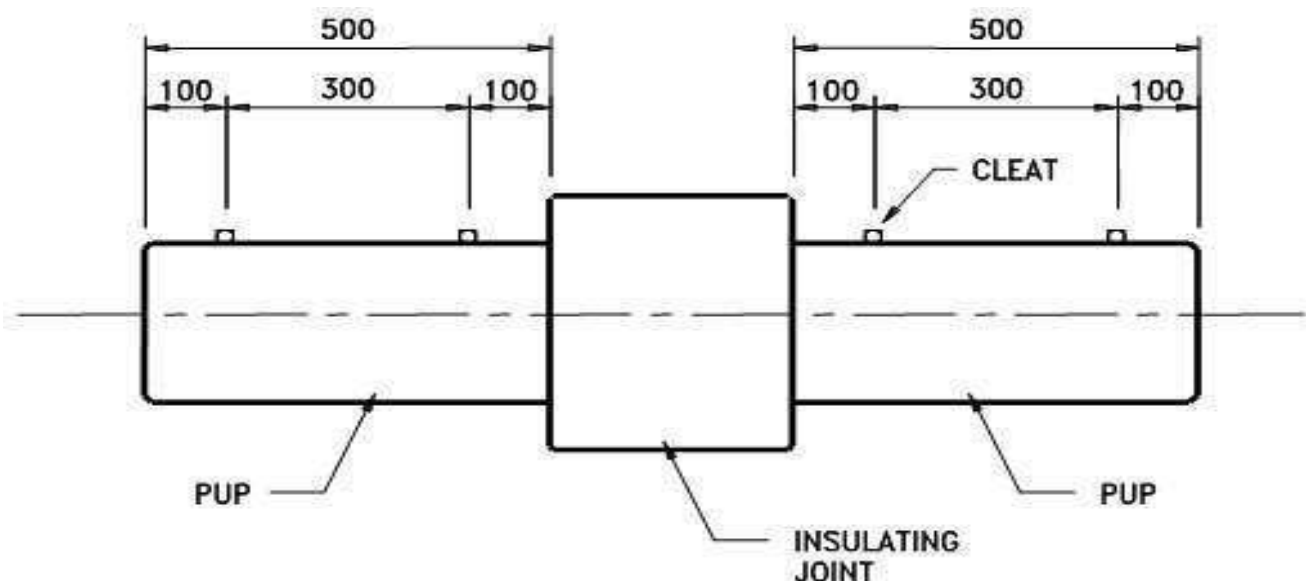


FIG. 4.1

5.0 INSPECTION AND TESTS

The Manufacturer shall ensure all equipment used for testing and inspection purposes is calibrated and certified accordingly. The Manufacturer shall record all inspection and testing activity on the appropriate inspection certificate. The following inspection and testing shall be carried out prior to painting, marking and shipment of insulating joints.

5.1 TESTING OF MATERIALS

Chemical composition and mechanical tests including yield strength, ultimate tensile strength, impact test, elongation and hardness shall be carried out for each heat of steel used as per the applicable standard as referred to in this specification.

5.2 VISUAL INSPECTION AND DIMENSIONAL CHECK

All insulating joints shall be visually inspected for visible surface defects and compliance with related documents. Bevels at butt weld ends shall show a smooth contour. All dimensions shall be checked for conformance with approved drawings.

5.3 NON-DESTRUCTIVE EXAMINATION

As a minimum all NDT shall be performed in accordance with ASME Section V and examination according to ASME Section VIII or as defined herein.

- a. Full length of all pressure containing butt welds, including welds that have been repaired, shall be examined by radiography. Acceptance limits shall be as per ASME Section IX.
- b. Any other weld that, in Purchaser's opinion, cannot be radiographed shall be inspected by ultrasonic or magnetic particle methods. Acceptance criteria shall be as per ASME Section VIII Appendix 12 and Appendix 6 respectively. Root pass of joint closure weld shall be examined by magnetic particle inspection method.

- c. 100 percent surface of all forging shall be wet magnetic particle inspected. Method of inspection and acceptance shall comply MSS-SP-53.
- d. Wet Magnetic Particle Inspection of all finished bevel surfaces shall be carried out. Any lamination extending into bevel face and having transverse dimension greater than 6.4 mm shall not be acceptable.
- e. All fillet welds shall be non-destructively examined as follows:

Fillet thickness < 6 mm :	100% by magnetic particle inspection, acceptance criteria as per ASME Sec VIII Appendix 6.
Fillet Thickness $\geq$ 6 mm :	100% by Ultrasonic Testing, acceptance criteria as per ASME Sec VIII Appendix 12 respectively.
- f. All NDT shall results shall documented and be available for Purchasers review.

5.4 HYDROSTATIC TEST

A hydrostatic test shall be carried out on each insulating joint complete in all respects. The test pressure as indicated in data sheets shall be held for a period of 15 min and the assembly visually inspected for leaks. Any pressure changes must correspond with temperature changes otherwise the test will not be acceptable. Test records to be maintained accordingly by Manufacturer.

5.5 DIELECTRIC TEST

Insulation resistance of each insulating joint shall be at least 25 Mega Ohms, when checked with 500-1000 V DC.

In addition, prior to and after hydro testing, each insulating joint shall be tested for dielectric integrity at 5000 V AC, 50 Hz for one minute and the leakage current before and after the hydrostatic test shall be equal. Testing time, voltage and leakage shall be recorded and certified.

No repair shall be permitted to the insulating joints failed in the above mentioned tests.

Company reserves the right to perform stage wise inspection and witness tests as indicated in clause 5 at Manufacturer's Works prior to shipment. Manufacturer shall give reasonable notice of time and shall provide without charge reasonable access and facilities required for inspection by the Company's Inspector. Inspection and tests performed/witnessed by the Company's Inspector shall in no way relieve the Manufacturer's obligation to perform the required inspection and tests.

6.0 PAINTING

SURFACE PREPARATION

Surface preparation for all coated surfaces according to coating Manufacturers recommended standard or to SSPC-SP-10 surface preparation for coating as a minimum.

PAINTING

Exterior surfaces of all insulating joints shall be painted with a non-conducting epoxy, three layer paint coating system. The internal lining shall be of a two-pack (solvent free) non-conducting epoxy compound (cold or hot curing).

The internal coating shall be suitable for the service and design conditions indicated in data sheets, and shall neither be damaged by or cause damage to pipeline pigs including inspection and scraper pigs.

The internal and external coating/lining shall be cut back by 75mm from the weld-edge. Coating system and procedure shall be approved by Purchaser prior to manufacture.

7.0 MARKING

All insulating joints shall be fitted with a stainless steel name plate with following markings die stamped or raised letters in metric units:

- Manufacturer's Name.
- Suitable for _____ Inch Nominal Diameter Pipeline.
- End Thickness in mm.
- Material.
- Design Pressure / Hydrostatic Test Pressure.
- ANSI Class Rating.
- Tag No.
- Year of Manufacture.

8.0 TEST CERTIFICATES

Manufacturer shall submit following certificates to Company's inspector:

- Test certificates relevant to the chemical analysis and mechanical properties of the materials used for construction of insulating joint as per this specification and relevant standards.
- Test reports on non-destructive testing.
- Test certificates for hydrostatic and air tests.
- Test certificate for electrical tests.

9.0 PACKING & SHIPPING

All butt weld ends shall be suitably protected to avoid any damage during transit by means of metallic or high impact plastic bevel protectors; and all assemblies shall be cleaned from inside of all foreign materials, grease, rust etc. prior to packing. Prior to shipment, parts and equipment which have bare metallic surfaces shall be protected with a rust preventative which will provide protection at temperatures up to 50°C. Sealing surfaces and moving parts to have a graphite grease coating applied.

The Manufacturer shall supply packing and shipping procedure with the tender. All Insulation joints shall be packed and prepared for shipment/transport in accordance with the procedures included in the Request for Quotation (RFQ) documentation, subsequently approved by the Purchaser.

10.0 DOCUMENTATION

The Manufacturer shall supply documentation in accordance with the Vendor Data Requirements List (VDRL) as attached with Purchase Order.

**STANDARD SPECIFICATION
FOR
CO₂ TYPE EXTINGUISHER**

**STANDARD SPECIFICATION
FOR
CO2 TYPE EXTINGUISHER**

ABBREVIATIONS:

kg : Kilogram
IS : Indian Standard
M.S. : Mild Steel

**STANDARD SPECIFICATION
FOR
CO2 TYPE EXTINGUISHER**

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1.0 SCOPE

This standard lays down requirements regarding material, shape, construction, method of operation performance and tests of portable fire extinguisher of carbon dioxide type. The extinguisher shall be supplied along with CO2 gas duly charged.

2.0 REFERENCES

IS: 2878 & IS: 307

3.0 MATERIAL, SHAPE, CONSTRUCTION, METHOD OF OPERATION, PERFORMANCE, CONTENTS AND TESTS

3.1 The material, shape, construction, method of operation, performance and test shall comply with IS: 2878.

3.2 Nominal size.

3.2.1 The extinguisher shall be of following nominal sizes in kg: 2, 3 and 5.0 for portable type and 7, 9 and 22.5 for trolley mounted.

3.3 Contents

3.3.1 Carbon dioxide gas used shall conform to IS: 307 and extinguisher shall be filled as per Clause no.4.0 of IS: 2878

4.0 APPROVALS

A clearance/ approval certificate for filling the extinguisher from "Chief Controller Explosive" Govt. of India, Nagpur shall be submitted for each cylinder.

5.0 MARKING

Each extinguisher shall be clearly and permanently marked as per IS: 2878 along with IS: certification mark and purchaser's name

6.0 ACCESSORIES

Each extinguisher shall be supplied with M.S. bracket, wood screws and spanner as may be necessary. The details of the bracket shall be submitted with the offer.

7.0 INSPECTION

Authorized representative shall have access at all reasonable time to the manufacturer's works where extinguishers ordered are being manufactured and or tested.

**STANDARD SPECIFICATION
FOR
PORTABLE FIRE EXINTGUISHER**

**STANDARD SPECIFICATION
FOR
PORTABLE FIRE EXINTGUISHER**

ABBREVIATION

MS	MILD STEEL
IS	INDIAN STANDARD
PESO	PETROLEUM EXPLOSIVE SAFETY ORGANISATION

**STANDARD SPECIFICATION
FOR
PORTABLE FIRE EXINTGUISHER**

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**STANDARD SPECIFICATION
FOR
PORTABLE FIRE EXINTGUISHER**

1.0 SCOPE

This standard lays down requirements regarding material, shape, construction, method of operation, performance and tests of portable fire extinguisher of Carbon Dioxide type, Dry Chemical Powder Type Fire Extinguisher and water based or foam based (Gas Pressure) Fire Extinguishers.

The extinguisher shall be supplied along with respective extinguishing media duly charged.

2.0 CODES AND STANDARDS

IS:5	Colors for ready mixed paints and enamels
IS: 2932	Enamel, synthetic, exterior; a) undercoating, b) finishing - specification
IS: 4308	Dry Chemical Powder for Fighting Band C Class Fires
IS: 4861	Dry Chemical Powder for Fighting Fires in Burning Metals
IS: 4989	Foam concentrate for producing mechanical foam for firefighting specification
IS: 14609	Dry Chemical Powder for Fighting A, B, C Class Fires
IS: 15222	Carbon dioxide as the extinguishing media for fire protection - Specification
IS: 15683	Portable Fire Extinguishers, Performance and Construction - Specification

Note: Latest Edition of all standard documents shall be followed

3.0 MATERIAL OF CONSTRUCTION & BASIC REQUIREMENT

- 3.1 The material, shape, construction, method of operation, performance, contents and test shall comply with IS: 15683.
- 3.2 Carbon dioxide used in extinguishers shall comply with IS: 15222
- 3.3 Dry powder conforming to IS: 14609, IS. 4308 or IS: 4861 shall be used for charging the extinguishers.
- 3.4 The extinguishing media for water or / and foam-based fire extinguishers shall be pure water or water with additives such as wetting agents, viscosity increasing agents, flame retardants or foaming agents etc. as per the requirement. Foam concentration shall be as per the requirements specified in IS: 4989.

4.0 APPROVALS

Portable extinguishers shall have approval from PESO, Government of India

**STANDARD SPECIFICATION
FOR
PORTABLE FIRE EXINTGUISHER**

5.0 COLOR & MARKING

The color of extinguisher bodies shall be Red conforming to shade no.536 or 538 of IS: 5. The paint shall conform to IS: 2932. Each extinguisher shall be clearly and permanently marked with the information specified in IS: 15683, along with IS certification mark and purchaser's name.

6.0 ACCESSORIES

Each extinguisher shall be supplied with MS bracket, screws and spanner as may be necessary. The details of the bracket shall be submitted with the offer.

7.0 INSPECTION

Owner's / VCS authorized representative shall have access at all reasonable times to vendor's works where Extinguishers are being manufactured and/or tested. Vendor shall arrange for all tests and inspection facilities for checking material, design and fabrication, workmanship, finish, performance (operating performance and performance required for test fires), and testing as per IS: 15683.

INFORMATION REQUIRED FROM VENDOR

Following information shall be furnished by the vendor along with the supply of extinguisher:

Instruction book(s) - Instruction book(s) for guidance of the user including both the operating and normal maintenance procedures shall be supplied. The book(s) shall include an itemized and illustrated part list/spare parts list giving reference number of all the wearing parts.

Approval certificate from PESO as described in clause 4.

**STANDARD SPECIFICATION
FOR
50 KG & 75 KG CAPACITY
DRY CHEMICAL POWDER EXTINGUISHER**

**STANDARD SPECIFICATION
FOR 50 KG & 75 KG CAPACITY
DRY CHEMICAL POWDER EXTINGUISHER**

ABBREVIATION

DCP	Dry Chemical Powder
IS	Indian Standard
OISO	Oil Industry Safety Directorate
PESO	Petroleum Explosive Safety Organization (formerly known as CCOE)

**STANDARD SPECIFICATION
FOR 50 KG & 75 KG CAPACITY
DRY CHEMICAL POWDER EXTINGUISHER**

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**STANDARD SPECIFICATION
FOR 50 KG & 75 KG CAPACITY
DRY CHEMICAL POWDER EXTINGUISHER**

1.0 SCOPE

This specification lays down the requirements regarding material, shape, construction, chemical charges, anticorrosive treatment, painting and test for trolley mounted dry powder fire extinguishers of capacities 50 kg and 75 kg.

2.0 CODES AND STANDARDS

IS: 10658 Specification for Higher Capacity Dry Powder Fire Extinguisher (Trolley Mounted).

OISD-GDN-115 Guidelines on Fire Fighting, Equipment and Appliances in Petroleum Industry.

Note: - Latest Edition of all standard documents shall be followed.

3.0 DESIGN REQUIREMENTS

- 3.1 The method of expulsion of dry powder shall be by means of pressure produced from compressed or liquefied gas from gas cylinder attached to the body or gas cartridge attached to the cap.
- 3.2 The total capacity of the dry powder extinguisher when filled for the various capacities shall be as under:

Nominal Size (Kg)	Dry Powder content (Kg. minimum.)
50	50
75	75

- 3.3 Discharge hose length shall be 5.0 M.
- 3.4 The expellant gas shall be CO₂ unless otherwise specified.

4.0 MATERIAL OF CONSTRUCTION

- 4.1 The material of construction shall be as per IS: 10658 Standard Specification for Higher Capacity Dry Powder Extinguisher (Trolley Mounted).
- 4.2 Construction, anticorrosive treatment, painting, test requirement, wheeled carriage and other design criteria shall be as per IS: 10658.

5.0 SAFETY CLIP

Safety Clip should be provided to prevent accidental actuation of piercing mechanism.

6.0 MARKING

Each extinguisher shall be clearly and permanently marked with the information specified in IS:10658 along with the BIS certification mark and purchaser's name.

7.0 APPROVALS AND INSPECTION

A clearance/approval certificate from the PESO, Nagpur shall be submitted for each N2 cylinder I gas cartridge supplied with the DCP extinguishers.

VCS or its authorised representatives shall have access at all reasonable times to the manufacturer's works where the extinguishers are being manufactured or being tested.

8.0 INFORMATION REQUIRED FROM VENDOR

8.1 The vendor shall furnish the following information along with the offer and for approval prior to fabrication.

- General arrangement of trolley mounted extinguisher showing plan and elevation.
- Fabrication details and plate thickness calculation for pressure vessel.
- Catalogues for all bought out items with Model No. If any.

8.2 Following information shall be furnished by the vendor along with the supply of extinguisher:

- Instruction book(s) - Instruction book(s) for guidance of the user including both the operating and normal maintenance procedures shall be supplied.
The book(s) shall include an itemized and illustrated part list/spare parts list giving reference number of all the wearing parts.
- Duly approved final drawings listed in clause 8.1.
- A clearance/approval certificate from PESO as described in clause 7.

**TECHNICAL SPECIFICATION
FOR
ASSORTED PIPES**

**TECHNICAL SPECIFICATION
FOR ASSORTED PIPES**

ABBREVIATIONS:

ASME	American Society of Mechanical Engineers.
ASTM	American Society for Testing and Materials.
API	American Petroleum Institute.
ISO	International Standards Organization.

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GENERAL:

This scope of the specification covers pipe other than API 5L carbon steel pipe. This specification is organized into four sections plus an appendices section.

- Part I - Seamless Carbon Steel Pipe (ASTM A106 Grade B).
- Part II - Seamless Stainless Steel Pipe (ASTM A312M, Type 304L, 316L).
- Part III - Low Temperature Carbon Steel Pipe (ASTM A333M).
- Part IV - Additional Requirements.
- Appendices.

PART I - SEAMLESS CARBON STEEL PIPE (ASTM A106 GRADE B)

1.0 SCOPE

This Specification establishes the minimum requirements for the manufacture and supply of seamless carbon steel pipe. Pipe shall be supplied in accordance with ASTM Standard Specification A106-02a together with additional requirements detailed in this specification, and any other requirements specified in the Purchase Order.

For ease of reference, the sections, paragraphs and appendices contained herein have the same numbering as that of ASTM A106. Additional requirements, that are not specified in ASTM Specification A106 have also been numbered and marked as "(New)". Unless specifically amended and/or modified by requirements specified in this document, all requirements of ASTM A106 shall remain applicable.

2.0 REFERENCED DOCUMENTS

In addition to the standards listed in ASTM A106 the following standards shall also apply.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

B36.10 Welded and Seamless Wrought Steel Pipe

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO 9712 Non-destructive Testing - Qualification and Certification of Personnel

In case of conflict between various requirements of this specification and reference standards mentioned above, the more stringent requirement shall apply unless otherwise approved by Purchaser.

3.0 PRODUCT ANALYSIS

Analysis of two pipes from each lot (Note 4) of 400 lengths or fraction thereof, of each size up to, but not including, DN150 (NPS 6), and from each lot of 200 lengths or fraction thereof of each size DN150 (NPS 6) and over, shall be made by the manufacturer from the finished pipe. The results of this analysis shall be reported to the purchaser or the purchaser's representative and shall conform to the requirements specified in Section 7.

4.0 BENDING REQUIREMENTS

For pipe whose diameter exceeds 254 mm (10 in.), it shall be permissible for the bend test to be substituted for the flattening test described in Section 12. The bend test specimens shall be bent at room temperature through 180° with the inside diameter of

the bend being 25.4 mm (1 in), without cracking on the outside portion of the bent portion.

5.0 NON DESTRUCTIVE ELECTRIC TEST

Non-destructive electric eddy-current (ET) testing is required in addition to hydrostatic testing requirements per Section 13. All Section 14 sub-sections regarding ET testing are applicable.

6.0 WORKMANSHIP, FINISH AND APPEARANCE

Weld repair is not permitted.

7.0 CERTIFICATION

Material test reports are required in addition to the requirements of ASTM Specification A530M. The producer or supplier shall furnish to the purchaser a chemical analysis report for the elements specified in Table 1.

8.0 PRODUCT MARKING

8.1 GENERAL

Marking shall be in English language and International System (SI) of units. Marking shall also include ASTM specification and grade designation, Buyer's purchase order number, item number, pipe number, heat number, wall thickness (mm) and weight. Marking shall be legible and of a size consistent with the available area and resistant to sunlight, heat, freezing and rain.

8.2 LOCATION OF MARKINGS

Regardless of size, marking shall be paint stenciled on the outer surface of each length of the pipe at each end and at mid-length. End marking shall begin approximately 300 mm from the end.

8.3 SPECIFIED DIMENSIONS

Diameter shall be marked in mm and the weight shall be marked in kg. Weight marked shall be actual weight of the pipe.

8.4 GRADES AND CLASS

A color code band shall be marked on the outside surface of finished pipe for identification of pipes of same diameter but different wall thickness, as indicated in the Purchase Order. The color code band shall be 50 mm wide and shall be marked at a distance of 150 mm from the pipe ends.

8.5 DIE STAMPING

Cold die stamping and low stress cold die stamping are not permitted on the pipe body or pipe end faces.

PART II - SEAMLESS STAINLESS STEEL PIPE (ASTM A312M TYPE 304L, 316L)

1.0 SCOPE

This Specification establishes the minimum requirements for the manufacture and supply of seamless austenitic stainless steel pipe. Pipe shall be supplied in accordance with ASTM

**TECHNICAL SPECIFICATION
FOR ASSORTED PIPES**

Standard Specification (metric) A312M-03 together with additional requirements detailed in this specification, and any other requirements specified in the Purchase Order.

For ease of reference, the sections, paragraphs and appendices contained herein have the same numbering as that of ASTM A312M. Additional requirements, that are not specified in ASTM Specification A312M have also been numbered and marked as "(New)". Unless specifically amended and/or modified by requirements specified in this document, all requirements of ASTM A 312M shall remain applicable.

2.0 REFERENCED DOCUMENTS

In addition to the standards listed in ASTM A312M the following standards shall also apply.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

B36.10 Welded and Seamless Wrought Steel Pipe

B36.19 Stainless Steel Pipe

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO 9712 Non-destructive Testing - Qualification and Certification of Personnel

In case of conflict between various requirements of this specification and reference standards mentioned above, the more stringent requirement shall apply unless otherwise approved by Purchaser.

3.0 MATERIALS AND MANUFACTURE

The pipe shall be manufactured by the seamless process.

4.0 PRODUCT ANALYSIS

An analysis of one billet or one length of flat-rolled stock from each heat, or two pipes from each lot shall be made by the manufacturer. A lot of pipe shall consist of the following number of lengths of the same size and wall thickness from any one heat of steel:

NPS Designator	Lengths of pipe in Lot
Under 2	400 or fraction thereof
2 to 5	200 or fraction thereof
6 and over	100 or fraction thereof

5.0 LENGTHS

All pipe sizes from DN 3 (NPS 1/8) to and including DN200 (NPS 8) shall be provided in lengths up to 7.3 meters with a permissible range of 4.5 to 7.3 meters. Short lengths less than 4.5 meters are not acceptable.

6.0 WORKMANSHIP, FINISH AND APPEARANCE (NEW)

Repair by welding is not permitted.

7.0 MARKING

7.1 GENERAL

Marking shall be in English language and International System (SI) of units. Marking shall also include ASTM specification and grade designation, Buyer's purchase order number,

item number, pipe number, heat number, wall thickness (mm) and weight. Marking shall be legible and of a size consistent with the available area and resistant to sunlight, heat, freezing and rain.

7.2 LOCATION OF MARKINGS

Regardless of pipe size, marking shall be paint stenciled on the outer surface of each length of the pipe at each end and at mid-length. End marking shall begin approximately 300 mm from the end.

7.3 SPECIFIED DIMENSIONS

Diameter shall be marked in mm and the weight shall be marked in kg. Weight marked shall be actual weight of the pipe.

7.4 GRADES AND CLASS

A color code band shall be marked on the outside surface of finished pipe for identification of pipes of same diameter but different wall thickness, as indicated in the Purchase Order. The color code band shall be 50 mm wide and shall be marked at a distance of 150 mm from the pipe ends.

7.5 DIE STAMPING

Cold die stamping and low stress cold die stamping are not permitted on the pipe body or pipe end faces.

PART III - CARBON STEEL LOW TEMPERATURE PIPE (ASTM A333M)

1.0 SCOPE

1.1 PURPOSE AND COVERAGE

This Specification establishes the minimum requirements for the manufacture and supply of welded or seamless carbon steel pipe for use at low temperatures. Pipe shall be supplied in accordance with ASTM Standard Specification (metric) A333M-99 together with additional requirements detailed in this specification, and any other requirements specified in the Purchase Order.

For ease of reference, the sections, paragraphs and appendices contained herein have the same numbering as that of ASTM A333M. Additional requirements, that are not specified in ASTM Specification A333M have also been numbered and marked as "(New)". Unless specifically amended and/or modified by requirements specified in this document, all requirements of ASTM A333M shall remain applicable.

1.2 SUPPLEMENTARY REQUIREMENT S1

Supplementary Requirement S1 applies.

1.3 UNITS OF MEASUREMENT

SI (metric) units shall apply.

1.4 DIMENSIONS

This specification shall be applied to seamless pipe in sizes DN15 (1/2") thru DN400 (16") and to longitudinal welded or seamless pipe in sizes greater than DN400(16").

Sizes and dimensions of steel pipe are in accordance with ASME B36.10.

2.0 REFERENCED DOCUMENTS

In addition to the standards listed in ASTM A333M the following standards shall also apply.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

B36.10 Welded and Seamless Wrought Steel Pipe

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO 9712 Non-destructive Testing - Qualification and Certification of Personnel.

In case of conflict between various requirements of this specification and reference standards mentioned above, the more stringent requirement shall apply unless otherwise approved by Purchaser.

3.0 MATERIALS AND MANUFACTURE

Pipe in sizes DN15 (1/2") thru DN400 (16") shall be manufactured by the seamless process. Pipe in sizes greater than DN400 (16") shall be manufactured by the seamless (preferred) or longitudinal welding process or as specified in the purchase order. The pipe material grade shall be as specified in the purchase order.

4.0 PRODUCT ANALYSIS

An analysis of one billet from each heat or of two pipes from each lot shall be made by the manufacturer. A lot of pipe shall consist of the following:

NPS PIPE SIZE	LENGTH OF PIPE IN LOT
Under 2	(400) or fraction thereof
2 to 6	(200) or fraction thereof
Over 6	(100) or fraction thereof

5.0 LENGTHS AND PIPE ENDS

Pipe lengths shall be provided in single random lengths of 4.75 meters to 6.74 meters with 5% 3.6 meters to 4.9 meters. Pipe ends shall be plain end (PE).

6.0 WORKMANSHIP, FINISH AND APPEARANCE

Repair welding is not permitted.

7.0 HYDROSTATIC AND ULTRASONIC TESTING

Each pipe shall be subjected to the hydrostatic test in accordance with ASTM Specification A 530M and applicable paragraphs of ASTM A333M Section 15.

Each pipe shall be ultrasonically tested (UT) in accordance with applicable paragraphs of ASTM A333M, section 15.

Each pipe shall be eddy-current tested (ET) in accordance with applicable paragraphs of ASTM A333M Section 15.

8.0 PRODUCT MARKING

8.1 GENERAL

Marking shall be in English language and International System (SI) of units. Marking shall also include ASTM specification and grade designation, Buyer's purchase order number, item number, pipe number, heat number, wall thickness (mm) and weight. Marking shall be legible and of a size consistent with the available area and resistant to sunlight, heat, freezing and rain.

8.2 LOCATION OF MARKINGS

Regardless of pipe size, marking shall be paint stenciled on the outer surface of each length of the pipe at each end and at mid-length. End marking shall begin approximately 300 mm from the end.

8.3 SPECIFIED DIMENSIONS

Diameter shall be marked in mm and the weight shall be marked in kg. Weight marked shall be actual weight of the pipe.

8.4 GRADES AND CLASS

A color code band shall be marked on the outside surface of finished pipe for

identification of pipes of same diameter but different wall thickness, as indicated in the Purchase Order. The color code band shall be 50 mm wide and shall be marked at a distance of 150 mm from the pipe ends.

8.5 DIE STAMPING

Cold die stamping and low stress cold die stamping are not permitted on the pipe body or pipe end faces.

PART IV - ADDITIONAL REQUIREMENTS

1.0 COATING AND PROTECTION

Unless otherwise specified in the Purchase order, the pipes shall be delivered bare, free of any traces of oil, stain, grease and paint. Varnish coating shall be applied on the marking area only. Ends shall be free of any coating.

2.0 DOCUMENTS

2.1 RETENTION OF RECORDS

In addition to the records required by the applicable ASTM specification, the manufacturer shall retain the records of all additional tests mentioned in this specification including the hard copy records of ultrasonic testing carried out.

2.2 LINES-PIPE DATA

The manufacturer shall supply all the information required in the Mill Test Certificate and Pipe tally sheet in MS Excel format in CD ROM suitable for electronic data transfer to Purchaser's Pipe Tracking System. Extent of data to be supplied shall be agreed with the Purchaser prior to commencement of production.

3.0 PIPE LOADING

All relevant loading calculations shall be submitted to the Purchaser for approval prior to commencement of loading.

4.0 INSPECTION OF FIELD TEST AND WARRANTY

Manufacturer shall reimburse Purchaser for any pipe, furnished on this order that fails under field hydrostatic test if such failure is caused by a material/manufacturing defect in the pipe. The reimbursement cost shall include pipe, labor and equipment rental for finding, excavating, cutting out, installation of replaced pipe in position and retesting. The field hydro static test pressure will not exceed that value which will cause a calculated hoop stress equivalent to 95 percent of specified minimum yield strength.

In case Manufacturer so desires, he will be advised at least two weeks in advance so that this representative may witness the hydrostatic test in field, however, the testing and leak (if any) finding and repair operation shall not be postponed because of absence of the Manufacturer's Representative. The Manufacturer shall express his desire in this regard at the time of bidding.



BALL VALVES - DATA SHEET

**HPOIL GAS PRIVATE LIMITED
(HOGPL)**

**CITY GAS DISTRIBUTION PROJECT AT
KOLHAPUR GA**

DATA SHEET BALL VALVES



DATA SHEET: BALL VALVES (2" to 8" SIZE) WELDED

GENERAL SPECIFICATION

Process Fluid	Natural Gas	ANSI Pressure Rating	300#
Design Temperature	(-)29°C to 65°C	Design Pressure (Barg)	49 Barg
Design Standard	API 6D	Piping Class	30HC
Size, DN (inch)	50 to 200" (02" to 08")		
Valve Type	Full Bore/Reduced Bore, Trunion Mounted, Double Block & Bleed & welded body construction.		
End Connection Type	Welded	Material Standard	ANSI B16.25
Face Finish	NA	Special Requirement	Vent, Drain & Sealant connection with Anti Blow Out Stem, Secondary Metal to Metal contact, Primary Soft Seat
Locking Arrangement	Yes		

VALVE DESIGN CONDITIONS

Corrosion Allowance	1.5 mm	Design Factor	0.5
Installation	Under Ground	Stem Ext Length, mm	Not Applicable

VALVE OPERATION

Actuation Type	Not Applicable	Type of Actuator	Not Applicable

PUP PIECE DETAILS

Diameter / Length	300 mm (Applicable for 6& 8inch valve)	Material & Thickness	API 5L Gr. X-52 ,6.4 mm or Equivalent

VALVE MATERIAL SPECIFICATION

PART DISCRIPTION	MATERIAL SPECIFIED	MATERIAL OFFERED (Equivalent or Higher)
Body	ASTM A216 GR. WCB	
Ball	13% Cr. Steel / SS-304 / SS-316 (Solid) /(ASTM A 216 Gr. WCB) + 0.003" ENP	
Seat Rings	(AISI 4140 + 0.003" ENP) / AISI 410	
Body Seat	R-PTFE with Secondary Metal to Metal	
Stem	13% Cr. Steel / SS-316 (No Casting)/(AISI 4140 + 0.003" ENP) / AISI 410	
Stem Seal	PTFE V-RINGS+GRAFOIL	
Gland	13% Cr. Steel / SS-304 / SS-316	
Handle / Lever / Hand Wheel	Carbon Steel	

TESTING REQUIREMENT

Hydrostatic Test Pressure & Time	Body: 73.5 barg & 30 min	Seat: 53.9 barg & 30 min
Pneumatic Test Pressure & Time	7.0 barg & 15 min	
Anti-Static Testing Requirement	As per API 6D Latest Edition	
Hardness Test	248 HV10 max	
Charpy Impact Test @ Temperature	Yes (at -29 °C)	
Fire Safe Test	API 6FA/ ISO10497	
Valve Painting Specification	High Build Epoxy Coating (R-95)	
Manufacturer's Painting Specification	XXX	

DOCUMENT NO.

1007-000-PL-DS-008A		C1	16.10.2020	JR	DG	HK	ISSUED FOR CLIENT REVIEW
SHEET NO.	1 OF 2	REV	DATE	PRPD	CHKD	APVD	REMARKS

PROJECT NUMBER : 1007



GLOBE VALVES - DATA SHEET

**HPOIL GAS PRIVATE LIMITED
(HOGPL)**

CITY GAS DISTRIBUTION PROJECT AT KOLHAPUR GA

DATA SHEET GLOBE VALVES



DATA SHEET : GLOBE VALVES (2" to 12" SIZE)

GENERAL SPECIFICATION

Process Fluid	Natural Gas	ANSI Pressure Rating	300#
Design Temperature	(-)29°C to 65°C	Design Pressure (Barg)	49 Barg
Design Standard	BS-1873	Piping Class	30HC
Size, DN (inch)	50 to 300" (02" to 12")		
Valve Type	Rising Stem, Welded Ends		
End Connection Type	Welded	Material Standard	ANSI B16.25
Face Finish	NA	Special Requirement	XXX
Locking Arrangement	Yes		

VALVE DESIGN CONDITIONS

Corrosion Allowance	1.5 mm	Design Factor	0.4
Installation	Under Ground	Stem Ext Length, mm	Not Applicable

VALVE OPERATION

Actuation Type	Not Applicable	Type of Actuator	Not Applicable

PUP PIECE DETAILS

Diameter / Length	Not Applicable	Material & Thickness	Not Applicable

VALVE MATERIAL SPECIFICATION

PART DISCRIPTION	MATERIAL SPECIFIED	MATERIAL OFFERED (Equivalent or Higher)
Body	ASTM A216 GR. WCB	
Disc	13% Cr. Steel Facing/ 13% Cr. Steel	
Seat Ring	13% Cr. Steel Facing/ 13% Cr. Steel	
Stem	13% Cr. Steel / SS-316 (No Casting)/(AISI 4140 + 0.003" ENP) / AISI 410	
Bonnet	ASTM A234 GR.WPB	
Gland/Stem Packing	Graphite Asbestos with Sacrificial Corrosion Inhibitor Inconel Wire Reinforcement.	
Body Stud	ASTM A 193 Gr. B7	
Body Nut	ASTM A 194 Gr. 2H	
Handle / Lever / Hand Wheel	Carbon Steel	

TESTING REQUIREMENT

Hydrostatic Test Pressure & Time	Body: 73.5 barg & 30 min	Seat: 53.9 barg & 30 min
Pneumatic Test Pressure & Time	7.0 barg & 15 min	
Hardness Test	248 HV10 max	
Charpy Impact Test @ Temperature	Yes (at -29 °C)	
Fire Safe Test	API 6FA/ ISO10497	
Valve Painting Specification	High Build Epoxy Coating (R-95)	
Manufacturer's Painting Specification	XXX	



NOTES

- 1 This Data Sheet shall be read in conjunction with Tender Documents & Specifications.
- 2 Dimension / Input Data as & where marked "XXX" shall be supplied by Vendor.
- 3 Valve body & other pressure containing parts shall be designed as per ASME Sec-VIII Div-I. Minimum thickness shall not be less than ASME B16.34.
- 4 Manufacturer shall have valid license to use API monogram.
- 5 Valve design shall ensure repair of stem seals / packing under full line pressure.
- 6 Valves shall have support foot & lifting lugs.
- 7 Wrench operated valves shall be supplied with wrench.
- 8 100.0 % Valve castings shall undergo Radiographic Examination.
- 9 Bidder to submit Soft Seal details and type, grade & class selected for R-PTFE from ASTM D4745 with manufacturer's recommendation like Pressure-Temperature Curve/Table for not to damage the soft seal during welding of valve ends at site.
- 10 The Charpy Impact temperature specified in data sheet shall superceded the Specification (VPC-SS-PL-0004) requirement at 0 °C
- 11 A supplementary air seat test as per API 6D (Annex B, Para B.3.3 type II) shall be carried out for all valves. A bubble tight seal is required without the use of any sealant. No leakage is allowed. Test pressure shall be held for at least 15 minutes.
- 12 All the valves should have full bore/ reduced bore markings as per the API 6D Table 12.
- 13 Design of weld end valves shall be such that during field welding operations, the soft seals or plastic compnents of the valve (where ever used) is not liable to be damaged. The manufacture shall furnish necessary field welding instructions and post-weld test procedure to demonstrate integrity and leak-tightness of valves after field welding operations.
- 14 Valves of size 8" and above shall have Sealant connection.

LEGEND

FB	Full Bore	RB	Reduced Bore
BW	Butt Welded Ends	RF	Raised Face - Flanged Ends
UG	Under Ground	AG	Above Ground
GOV	Gas Operated Valve	HOV	Hydraulically Operated Valve
FBV	Floating Ball Valve	TMBV	Trunion Mounted Ball Valve



DATA SHEET – FLANGES

**HPOIL GAS PRIVATE LIMITED
(HOGPL)**

CITY GAS DISTRIBUTION PROJECT AT KOLHAPUR GA

DATA SHEET – FLANGE

DATA SHEET – FLANGE

DESIGN DATA FOR FLANGE	
Specification	VCS-SS-PL-0025
Service	NG/ RLNG
Design Pressure (Kg/Cm2)	49.0
Design Temperature (°C) (Max/Min)	65.0
Design Life	25 years
Corrosion Allowance (mm)	1.5
Design Code	ASME B 16.5
Design Factor (F)	0.4
Rating	# 300
Hydrostatic Test Pressure (Kg/Cm2)	73.5
Installation	Above Ground
End Face Type	Raised face
Neck	Weld Neck
Thickness	Match to Pipe
FLANGE MATERIAL (EQUIVALENT OR SUPERIOR)	
Description	Material of Construction
Flange	ASTM A 105/ ASTM A 694 F42/F46/F48/F50/F52/F56/F60/F65/F70
Nut	ASTM A 193 Gr. B7
Stud Bolt	ASTM A 193 Gr. 2H
FLANGE DIMENSION	
Groove dimension	ASME B 16.5
1. Outside Diameter 2. Dia of Bolt Circle 3. Dia of Bolt Holes 4. thickness of lap joint 5. Length of Welding Neck 6. Thickness of Lap joint 7. Hub Dia 8. Number of Bolts	ASME B 16.5
CONNECTING PIPE DETAILS	
Run Pipe Details	Flange Detail

DATA SHEET – FLANGE

S. No.	Outside Diameter, D1 (mm)	Thickness/ Schedule	Material	Thickness/ Schedule	Material
1	114.3	6.4	API 5L Gr.X-52	6.4	ASTM A 105/ ASTM A 694 F42/ F46/F48/F50/F52/F56/F60/F65/ F70
2	114.3	6.4	API 5L Gr.X-52	6.4	ASTM A 105/ ASTM A 694 F42/ F46/F48/F50/F52

Notes:

1. The details which not mentioned here shall be as per Specification VCS-SS-PL-0025 and for details not covered in VCS specification shall be as per ASME 16.5
2. Charpy impact test shall be carried out at (-)29 degree Celsius.
3. Repair by Welding on flanges is not permitted.
4. The internal and external surface of the flanges and fittings shall be free from any strikes, gauges and other detrimental defects.
5. Flanged assemblies using low-strength carbon steel bolts should not be used above 200°C (400°F) or below –29°C (–20°F).
6. The user is responsible for selection of gasket materials that will withstand the expected bolt loading without injurious crushing and that are suitable for the service conditions
7. A principle of design in this Standard is to maintain a fixed position for the flange edge with reference to the body of the fitting. In case of raised face flanged fittings, the outside edge of the flange includes the raised
8. For approval testing, three through thickness macro sections shall be taken at 120° intervals from the hub and ring of the test flange, and from the test swivel ring.
9. All flanges shall be ultrasonically tested for laminations in accordance with ASTM A 388

PROJECT NUMBER: 1007



DATA SHEET – INSULATING JOINT

**HPOIL GAS PRIVATE LIMITED
(HOGPL)**

**CITY GAS DISTRIBUTION PROJECT AT KOLHAPUR
GA**

DATA SHEET – INSULATING JOINT

**DATA SHEET
INSULATING JOINT**

DOC NO: 1007-000-PP-DS-016
Rev No : 00

Insulating Joint for 4" (30HC)			
Insulating Joint Manufacturer		-	
IJ Specification No.		VCS-SS-PL-0022	
DESIGN DATA FOR INSULATING JOINT FOR CS LINE			
Service, Design Life		Natural Gas/ RLNG, 30 yrs.	
Size mm (inch)		4"	
Design Pressure		49 Kg/Cm ² g	
ANSI Rating / Design Factor		300# / 0.4	
Design Temperature (°C)		-29 to 65.0	
Corrosion Allowance (mm)		1.5	
Hydrostatic Test Pressure		73.5 Kg/Cm ² g	
Design Code (Pipeline / Insulating Joint)		ASME B31.8 & OISD 226 / ASME SEC. VIII DIV. I	
End Connection		Butt weld ends	
Installation		Above ground	
Charpy Impact Test		Required, at (-)29°C	
Hardness Test		Required, as per specification	
INSULATING JOINT MATERIAL (EQUIVALENT OR SUPERIOR)			
Part	Material of Construction		
	Specified	Offered	
Body	• ASTM A105 - 4"		
Pups	• ASTM A106 Gr. B - 4"		
Insulation	As per Manufacturer's standard		
ATTACHED PIPE SPECIFICATION			
S. No.	Outside Diameter, OD mm (inch)	Wall Thickness, (mm)/ Schedule	Material
1.	4"	6.4	ASTM A106 Gr. B

Notes:

1. For the welding end, the out of roundness (i.e. difference between maximum and minimum ID at pipe end) shall be 3.0 mm and tolerance on internal diameter at pipe ends shall be same as diameter tolerance for the pipe ends indicated in API 5L.
2. Insulating Joint shall be suitable for pigging operation including intelligent pigging.
3. Insulating Joint shall be boltless Mono block type.
4. The Charpy Impact temperature specified in data sheet shall supersede the temperature requirement specified in Specification.
5. vender shall confirm the heat generated by welding at site is not detrimental to the isolating & filler material and internal coating
6. Vender shall propose appropriate measures that need to be taken at site during held welding by contractor.

	PIPING MATERIAL SPECIFICATION	



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PIPING MATERIAL SPECIFICATION

1.0 INTRODUCTION

This specification covers minimum requirements for the material specification for pipe, fittings, flanges, line blinds, bolts, gaskets, and valves that shall be used for CGD pipeline network and associated facilities in accordance with ASME B31.8 and PNGRB guideline T4S CGD (GSR 612(E)).

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

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

2.0 CODES AND STANDARDS

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

ASME B 31.8	Gas transmissions and Distribution Piping System
PNGRB – T4S CGD (GSR 612(E))	Petroleum & Natural Gas Regulatory Board Technical Standards and Specifications including Safety Standards for City or Local Natural Gas Distribution Network

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

3.0 MATERIAL SPECIFICATIONS

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

4.0 CLASS DESIGNATION CODE

The piping class designation shall generally consist of three digits made up of a letter, number & letter e.g., 15HC, 15HLT, 30HC, 30 HLT, 60HC etc. as follows:

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

15 - 150 Class
30 - 300 Class
60 - 600 Class

The first alphabet indicates differences in the specifications within the same class rating and material, e.g., H stands for Hydrocarbon, etc.

The last letter indicates type of material, e.g.,

C - Carbon steel

PIPING MATERIAL SPECIFICATION

S - Stainless Steel

LT- LTCS

5.0 PIPELINE

Line pipe material grade and wall thickness details are to be referred in design document.

6.0 PIPES

- 6.1 Carbon steel pipe shall be made by open hearth, electric furnace or basic oxygen process only. The steel used shall be fully killed and made with fine grain structure. The grade and wall thickness of various sizes of pipes shall be as per piping material specification for the applicable class.
- 6.2 Pipe dimensions shall be in accordance with ASME B 36.10 for carbon steel ASTM standard pipes & API 5L for carbon steel. API 5L pipes grade and thickness specified shall be referred.
- 6.3 All pipe threads shall conform to American Standard taper as per ASME B 1.20.1 NPT, unless otherwise specified.
- 6.4 For butt weld end, bevel shall be in accordance with API specification 5L or ASME B16.25 as applicable.

7.0 FITTINGS

- 7.1 Fully killed carbon steel shall be used in the manufacture of fittings. The fitting shall have carbon equivalent not exceeding 0.45, based on check analysis.
- 7.2 Threaded joints, if used, shall conform to American Standard taper as per ASME B1.20.1 NPT.
- 7.3 Dimensions of socket welded/screwed fittings shall conform to ASME B 16.11. Swage shall be as per BS 3799.
- 7.4 Dimensions of steel butt welded fittings shall be as per ASME B 16.9.
- 7.5 Bore of socket welded fittings shall suit outside diameter (OD) of pipe and its thickness.
- 7.6 Butt welding ends shall conform to API specification 5L or ASME B 16.25 as applicable. In case of difference in thickness of matching ends, requirements of ASME B 31.8 shall apply.
- 7.7 Integrally reinforced forged branch fittings such as Sockolet, Weldolet etc. shall be as per MSS-SP-97. Fittings not covered in ASME B16.9 and MSS-SP-97 shall conform to manufacturer's standard.
- 7.8 Fittings thickness tolerances shall match pipe thickness tolerance.

8.0 BENDS

- 8.1 Unless otherwise specified for process piping, elbow of radius $R = 1.5 D$ shall only be used.
- 8.2 In order to accommodate changes in vertical and horizontal alignment in piggable section of pipeline, Elastic bends/ Cold field bends/ Hot formed long radius bends shall be used.

D = Specified Outside Diameter

PIPING MATERIAL SPECIFICATION

Long Radius Bend shall be used only when indicated in AFC drawing.

8.3 Miters shall not be used.

9.0 FLANGES

9.1 Pressure Temperature rating of flanges shall conform to B16.5/ MSS-SP44/ B16.47 Series A, as applicable.

9.2 Dimensions of flanges shall be in accordance with B16.5/ MSS-SP44/ B16.47 Series A, as applicable.

9.3 Neck of weld neck (WN) flanges shall suit pipe bore and thickness.

9.4 Bore of socket welded (SW) flanges shall suit pipe O.D. and its thickness.

9.5 Threads for screwed flanges, if used, shall conform to American Standard taper as per ASME B 1.20.1 NPT.

9.6 Sizes for blind flanges shall be indicated by nominal pipe size and schedule.

9.7 Unless specified otherwise in Piping Material Specification the flange face finish shall be as per ASME B16.5.

9.8 Butt welding ends of WN flanges shall conform to ASME B 16.25.

9.9 Spectacle blind/spacer & blinds shall be in accordance with ASME B 16.48/ manufacturer's standard.

10.0 GASKETS

10.1 Spiral wound metallic gasket with Graphite filled winding with SS316 inner ring and CS outer ring and shall conform to ASME B 16.20/ API 601.

10.2 Spiral wound gasket shall be self-aligning type.

11.0 BOLTING & THREADS

11.1 Nuts for stud bolts shall be American Standard Hexagon Heavy Series and double chamfered.

11.2 Dimension and tolerances for stud bolts and nuts shall be as per ASME B 18.2.1 and 18.2.2 with full threading to ASME B 1.1 Class 2A thread for bolts and Class 2B for nuts. Diameter and length of stud bolts shall be as per ASME B 16.5/ASME B16.47 with full threading.

11.3 Threads for nuts shall be as per ASME B 1.1 as follows,

Nuts for stud bolts dia ¼" to 1" : UNC-2B

Nuts for stud bolts dia 1⅛" to 3¼" : 8UN-2B

11.4 Threads for stud bolts shall be as per ASME B 1.1, as follows:

Stud bolts dia ¼" to 1" : UNC-2A

Stud bolts dia 1⅛" to 3¼" : 8UN-2A

11.5 Threads for threaded pipe, fitting, flanges and valve shall be in accordance with B 1.20.1 taper threads, unless specified otherwise.

11.6 Heads of jack screws shall be heavy hexagonal type. Jack screw end shall be rounded. Stud bolts shall be fully threaded with two hexagonal nuts.

PIPING MATERIAL SPECIFICATION

12.0 THREAD SEALANT

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

13.0 VALVES

13.1 Valve ends shall be as per valve data sheets for various piping class.

Sectionalizing valves, Block valves and other isolation valves installed on the main pipeline shall be ball valves with butt welding ends. All inline isolation valves on the mainline (pipeline) shall be full bore valves to allow smooth passage of cleaning as well as intelligent pigs.

All buried valves shall be provided with stem extension, sealant, vent/drain and shall have butt welded ends as per relevant specification/ data sheet.

13.2 Flange dimensions and face finish of flanged end valves shall conform to clause 9.0 of this specification.

13.3 Butt welding ends of Butt-Welded valves shall conform to ASME B 16.25.

13.4 Face to face and end to end dimensions shall conform to applicable standards.

13.5 Valves shall conform to following standards unless specified otherwise in piping material specification for various piping class.

13.6 **FLANGED/SOCKET WELDED END VALVES (1½" AND BELOW)**

Design STD. for Process lines

Gate Valves	:	API 602
GlobeValves	:	BS EN ISO 15761
Check Valves	:	BS EN ISO 15761
Ball Valves	:	BS EN ISO 17292/ API 6D
Plug Valves	:	BS 5353

13.7 **FLANGED/BUTT WELDED END VALVES (2" AND ABOVE)**

Design STD. for Process Lines

Gate Valves	:	API 6D
GlobeValves	:	BS 1873
Check Valves	:	API 6D
Ball Valves	:	API 6D
Plug Valves	:	API 6D

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

13.8.1 **GATE VALVES**

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

PIPING MATERIAL SPECIFICATION

For ANSI class 600	Hand wheel operated for size ≤ 10 " NB. Gear operated for size ≥ 12 " NB.

13.8.2 **GLOBE VALVES**

For ANSI class 150, 300, 600 and 900 - Hand Wheel operated for all size

13.8.3 **BALL VALVES & PLUG VALVES**

For all ANSI class - Wrench operated for size ≤ 4 " NB.
Gear operated for size ≥ 6 " NB.

13.8.4 **ACTUATED VALVES**

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

14.0 **QUICK OPENING END CLOSURE**

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

15.0 **HYDROTESTING VENTS AND DRAINS**

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

16.0 **PIPELINE SPECIALTY ITEMS**

Pipeline specialty items viz. scraper traps, flow tees, insulating joints, LR bends etc. shall be as per data sheets and specification.

For Mainline Items, corrosion allowance shall be as per data sheet

17.0 **INSULATING GASKET, SLEEVE AND WASHER**

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

Insulating gasket shall include the following applications,

- Flange isolation in conjunction with cathodic protection.
- Isolation between dissimilar metals to prevent galvanic corrosion.
- Mating mismatched ring-joint to raised -face flanges.
- Eliminate fluid trap corrosion between ring-joint (RTJ) flanges where high concentrations of CO_2 , H_2S and other aggressive hydrocarbon media are present.

PIPING MATERIAL SPECIFICATION

- Eliminate turbulence and flow induced erosion between ring-joint (RTJ) flanges.
- Protect against coating impingement on coated flange faces.
- To seal between flanges subjected to vibration/ cavitation.

17.1 **INSULATING GASKET, SLEEVES AND WASHERS MATERIAL PROPERTIES:**

Compressive strength	:	65000 PSI
Average Dielectric strength	:	15 KV
Electrical resistance	:	> 1 Mega Ohm (When tested with 500-1000 V DC megger)
Max. Operating temp.	:	302°F (150°C)
Min. Operating temp.	:	(minus) -200°F
Water absorption	:	5%
Flexural strength	:	70000 PSI
Tensile strength	:	50000 PSI
Bond strength	:	2600 lb
Shear strength	:	22000 lb.

17.2 **Seal Material**

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

Viton as a seal material shall consist following properties,

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

Isolating Sleeve

Mylar as a seal material shall consist following properties,

- Spiral wound Mylar is a general-purpose material recommended for bolting application with flange temperatures below 250°F.
- Material shall be fair resistance to crushing, cracking, breaking and thread pinch.

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

Steel Washer: ZPS standard – Zinc plated steel washers.

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

The dimensions of insulating components (gaskets, sleeves and washers) shall be as indicated in Data Sheet. The insulating gasket and washers shall have adequate

PIPING MATERIAL SPECIFICATION

compressive strength to permit proper tightening of flange bolts for leak proof joint.

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

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

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

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

18.0 CHARPY V-NOTCH TEST

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

PIPING MATERIAL SPECIFICATION

PIPING MATERIAL SPECIFICATION INDEX

Sr. No.	Piping Class	Pressure Rating #	C.A.	Spl. Reqt.	Basic Material	Service	Remarks
1	15HC	150	1.5	NON IBR	CARBON STEEL	NON-CORROSIVE PROCESS-FLAMMABLE /NONFLAMMABLE, NON LETHAL- HYDROCARBONS	Page 11 to 15
2	30HC	300	1.5	NON IBR	CARBON STEEL	NON-CORROSIVE PROCESS-FLAMMABLE / NONFLAMMABLE, NON LETHAL- HYDROCARBONS	Page 16 to 20
3	60HC	600	1.5	NON IBR	CARBON STEEL	NON-CORROSIVE PROCESS-FLAMMABLE / NONFLAMMABLE, NON LETHAL- HYDROCARBONS	Page 21 to 25

PIPING MATERIAL SPECIFICATION

PIPE CLASS	:	15HC
RATING	:	150#
BASE MATERIAL	:	Carbon Steel
CORROSION ALLOWANCE	:	1.5 MM
SPECIAL REQUIREMENT	:	Non IBR

TEMPERATURE (Deg. C) AND PRESSURE (Kg/Sq.cm g) RATINGS

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

SERVICE

Natural Gas, Utilities (water, inst. air, plant air, nitrogen gas, carbon dioxide)

NOTES

1. All vents and drains shall be provided with ball valve with blind flange assembly unless otherwise indicated in P&ID.
2. NDT of welds shall be as follows:
Radiography : All butt welds 100%
MPI : Socket welds 100%
3. Piping design as per ASME B 31.8 & PNGRB 2008 Guidelines
4. Charpy V notch test and hardness test shall be conducted for pipes, fittings and flanges at (-) 29°C.
5. All branch connections including vent, drain, pressure and temperature connection shall be as per branch connection table.
6. For valves, refer valve data sheets.

ITEM	SIZE	DESCRIPTION
Maintenance joints	ALL	Flanged, to be kept minimum
Pipe joints	1.5" & BELOW	SW coupling
	2.0" & ABOVE	Butt welded
Drains	ON LINES <= 1.5"	Refer std. SD-PI-019
	ON LINES >= 2.0"	As per P&ID or 0.75". Refer std. SD-PI-018
Vents	ON LINES <= 1.5"	Refer std. SD-PI-019
	ON LINES >= 2.0"	As per P&ID or 0.75". Refer std. SD-PI-018

PIPING MATERIAL SPECIFICATION

ITEM	SIZE	DESCRIPTION
Temp. Connection	1.5"	Flanged, installation as per std. SD-PI-014 & 015, except skin temperature measurement.
Press. Connection	0.75"	SW nipple with Plug/ Ball Valve to spec. as per Refer std. SD-PI-011, 012 & 013

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		T	T	S	S	S	S	S	S	S	S	
	T	T	T	S	S	S	S	S	S	S	S	
T	T	T	T	S	S	S	S	S	S	S	S	

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0.5	0.75	1	1.5	2	3	4	6	8	10	12	14

RUN PIPE

T	TEES
W	WELDOLETS
S	SOCKOLETS

PIPING MATERIAL SPECIFICATION

Item	Lower Size (Inch)	Upper Size (Inch)	Sch./ Thk.	Dmn. STD	Material (Charpy)	Description
Pipe Group						
PIPE	00.500	00.750	S160	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS
PIPE	01.000	01.500	XS	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS
PIPE	02.000	02.000	STD	B-36.10	ASTM A 106 GR.B (Charpy)	BE, SEAMLESS
PIPE	03.000	04.000	STD	B-36.10	ASTM A 106 GR.B (Charpy)	BE, SEAMLESS
PIPE	04.000	06.000		API 5L	API 5L GRX52 PSL2	BE, ERW/SEAMLESS
PIPE	08.000	12.000		API 5L	API 5L GRX52 PSL2	BE, ERW/SEAMLESS
NIPPLE	00.500	01.500	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS
NOTE: In case API 5L is used from 4" and above, the thickness to be considered based on design factor of 0.5 and CA -1.5mm. However fittings schedule shall remain corresponding ASTM A 106 pipe schedule.						
Flange Group						
FLNG.SW	00.500	01.500	M	B-16.5	ASTM A 105	150, RF/125AARH
FLNG.WN	2.000	12.000	M	B-16.5	ASTM A 105	150, RF/125AARH
FLNG.BLIND	00.500	01.500		B-16.5	ASTM A 105	150, RF/125AARH
FLNG.BLIND	2.000	12.000		B-16.5	ASTM A 105	150, RF/125AARH
FLNG.FIG.8	00.500	08.000		ASME B16.48	ASTM A 105	150, FF/125AARH
SPCR&BLND	10.000	12.000		ASME B16.48	ASTM A 105	150, FF/125AARH
Fitting Group						
ELBOW	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
ELBOW	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
ELBOW	02.000	12.000	M	B-16.11	ASTM A 105	BW, 1.5D
TEE's	00.500	01.500		B-16.11	ASTM A 105	SW, 6000

PIPING MATERIAL SPECIFICATION

Item	Lower Size (Inch)	Upper Size (Inch)	Sch./ Thk.	Dmn. STD	Material (Charpy)	Description
TEE's	02.000	12.000	M	B-16.9	ASTM A 105 (Charpy)	BW
REDUCER	02.000	12.000	M, M	B-16.11	ASTM A 234 GR.WPB (Charpy)	BW
SWAGE	00.500	03.000	M, M	BS-3799	ASTM A 105 (Charpy)	PBE
CAP	00.500	00.750		B-16.11	ASTM A 105	SCRF, 6000
CAP	01.000	01.500		B-16.11	ASTM A 105	SCRF, 3000
CAP	02.000	12.000	M	B-16.9	ASTM A 234 GR.WPB	BW
PLUG	00.500	00.750		B-16.11	ASTM A 105	SCRM, 6000
O'let						
WELDOLET	02.000	06.000	M, S160	MSS-SP97	ASTM A 105 (Charpy)	BW
SOCKOLET	00.500	00.750		MSS-SP97	ASTM A 105	SW, 6000
SOCKOLET	01.000	01.500		MSS-SP97	ASTM A 105	SW, 3000
Valves						
AS PER DATA SHEET						
Bolt Group						
BOLT.STUD	00.500	16.000		B-18.2	BOLT:A193 GR.B7, NUT:A194 GR.2H	
Gasket Group						
GASKET	00.500	16.000		B-16.20-ANSI B16.5	SS316 Spiral wind with GRAFOIL	SPIRAL, 150

PIPING MATERIAL SPECIFICATION

PIPE CLASS	:	30HC
RATING	:	300#
BASE MATERIAL	:	Carbon Steel
CORROSION ALLOWANCE	:	1.5 MM
SPECIAL REQUIREMENT	:	Non IBR

TEMPERATURE (Deg. C) AND PRESSURE (Kg/Sq. cm g) RATINGS

TEMP	-29	38	93	149	204	260	316	343
PRESS	52.02	52.02	47.45	46.05	44.64	42.18	38.66	37.61

SERVICE

Natural Gas, Utilities (water, inst. air, plant air, nitrogen gas, carbon dioxide)

NOTES

1. All vents and drains shall be provided with ball valve with blind flange assembly unless otherwise indicated in P&ID
2. NDT of welds shall be as follows:
 - Radiography : All butt welds 100%
 - MPI : Socket welds 100%
3. Piping design as per ASME B 31.8 & PNGRB 2008 Guidelines
4. Charpy V notch test and hardness test shall be conducted for pipes, fittings and flanges at (-) 29°C.
5. Corrosion allowance of 1.5 mm has been considered for terminal piping.
6. All branch connections including vent, drain, pressure and temperature connection shall be as per branch connection table.
7. For valves, refer valve data sheets as enclosed.
8. Design factor 0.5.
9. Ball Valve to be used in main pipeline shall have butt welded ends.

PIPING MATERIAL SPECIFICATION

ITEM	SIZE	DESCRIPTION
Maintenance Joints	all	Flanged, to be kept minimum
Pipe joints	1.5" & below	SW coupling
	2.0" & above	Butt welded
Drains	on lines $\leq 1.5"$	Refer std. SD-PI-019
	on lines $\geq 2.0"$	As per P&ID or 0.75". Refer std. SD-PI-018
Vents	on lines $\leq 1.5"$	Refer std. SD-PI-019
	on lines $\geq 2.0"$	As per P&ID or 0.75". Refer std. SD-PI-018
Temp. Connection	1.5"	Flanged, installation as per std. SD-PI-014 & 015, except skin temperature measurement.
Press. Connection	0.75"	SW nipple with Plug/ Ball Valve to spec. as per Refer std. SD-PI-011, 012 & 013

BRANCH TABLE

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0.50

RUN PIPE

CODE DESCRIPTION

T	TEES
W	WELDOLETS
S	SOCKOLETS

PIPING MATERIAL SPECIFICATION

Item	Lower Size (Inch)	Upper Size (Inch)	Sch./ Thk.	Dmn. STD	Material (Charpy)	Description
PIPE GROUP						
PIPE	00.500	00.750	S160	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS
PIPE	01.000	01.500	XS	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS
PIPE	02.000	02.000	XS	B-36.10	ASTM A 106 GR.B (CHARPY)	BE, SEAMLESS
PIPE	03.000	04.000	STD	B-36.10	ASTM A 106 GR.B (CHARPY)	BE, ERW/SEAMLESS
PIPE	06.000	08.000		API 5L	API 5L GRX52 PSL2	BE, ERW/SEAMLESS
PIPE	10.000	12.000		API 5L	API 5L GRX52 PSL2	BE, ERW/SEAMLESS
NIPPLE	00.500	01.500	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS
NOTE: In case API 5L is used from 4" and above, the thickness to be considered based on design factor of 0.5 and CA -1.5mm. However fittings schedule shall remain corresponding ASTM A 106 pipe schedule.						
FLANGE GROUP						
FLNG.SW	00.500	01.500	M	B-16.5	ASTM A 105	300, RF/125AARH
FLNG.WN	02.000	12.000	M	B-16.5	ASTM A 105 (CHARPY)	300, RF/125AARH
FLNG.BLIND	00.500	01.500		B-16.5	ASTM A 105	300, RF/125AARH
FLNG.BLIND	02.000	12.000		B-16.5	ASTM A 105 (CHARPY)	300, RF/125AARH
FLNG.FIG.8	00.500	01.500		ASME-B16.48	ASTM A 105	300, FF/125AARH
FLNG.FIG.8	02.000	08.000		ASME-B16.48	ASTM A 105 (CHARPY)	300, FF/125AARH
SPCR&BLND	10.000	12.000		ASME-B16.48	ASTM A 105 (CHARPY)	300, FF/125AARH
FITTING GROUP						
ELBOW	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
ELBOW	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
ELBOW	02.000	12.000	M	B-16.9	ASTM A 234 GR.WPB (CHARPY)	BW, 1.5D
TEE's	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
TEE's	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
TEE's	02.000	12.000	M	B-16.9	ASTM A 234 GR.WPB (CHARPY)	BW

PIPING MATERIAL SPECIFICATION

Item	Lower Size (Inch)	Upper Size (Inch)	Sch./ Thk.	Dmn. STD	Material (Charpy)	Description
REDUCER	02.000	12.000	M, M	B-16.9	ASTM A 234 GR.WPB (CHARPY)	BW
SWAGE	00.500	03.000	M, M	BS-3799	ASTM A 105 (CHARPY)	PBE
CAP	00.500	00.750		B-16.11	ASTM A 105	SCRF, 6000
CAP	01.000	01.500		B-16.11	ASTM A 105	SCRF, 3000
CAP	02.000	16.000	M	B-16.9	ASTM A 234 GR.WPB (CHARPY)	BW
PLUG	00.500	00.750		B-16.11	ASTM A 105	SCRM, 6000
PLUG	01.000	01.500		B-16.11	ASTM A 105	SCRM, 3000
COUPLING	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
COUPLING	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
O'let						
SOCKOLET	00.500	00.750		MSS-SP97	ASTM A 105	SW, 6000
SOCKOLET	01.000	01.500		MSS-SP97	ASTM A 105	SW, 3000
WELDOLET	02.000	08.000	M,M	MSS-SP97	ASTM A 105 (CHARPY)	BW
VALVE GROUP						
AS PER DATA SHEET						
BOLT GROUP						
BOLT.STUD	00.500	12.000		B-18.2	BOLT:A193 GR.B7, NUT:A194 GR.2H	
GASKET						
GASKET	00.500	12.000		B-16.20- ANSI B16.5	SS 316 Spiral wind with GRAFOIL	SPIRAL, 300

PIPING MATERIAL SPECIFICATION

PIPE CLASS	:	60HC
RATING	:	600#
BASE MATERIAL	:	Carbon Steel
CORROSION ALLOWANCE	:	1.5 MM
SPECIAL REQUIREMENT	:	Non IBR

TEMPERATURE (Deg. C) AND PRESSURE (Kg/Sq. cmg) RATINGS

TEMP	-29	38	93	149	204	260	316	343
PRESS	104.05	104.05	94.91	92.45	89.29	84.36	79.68	75.58

SERVICE

Natural Gas, Utilities (water, inst. air, plant air, nitrogen gas, carbon dioxide).

NOTES

1. All vents and drains for hydrotest shall be provided with ball valve with blind flange assembly unless otherwise indicated in P&ID.
2. NDT of welds shall be as follows:
Radiography : All butt welds 100%
MPI : Socket welds 100%
3. Piping design as per ASME B 31.8 & PNGRB 2008 Guidelines.
4. Charpy V notch test and hardness test shall be conducted for pipes, fittings and flanges at (-) 29°C.
5. Corrosion allowance of 1.5 mm has been considered for terminal piping.
6. All branch connections including vent, drain, pressure and temperature connection shall be as per branch connection table.
7. For valves, refer valve data sheets as enclosed.
8. Design factor 0.5.
9. Ball Valve to be used in main pipeline shall have butt welded ends.

PIPING MATERIAL SPECIFICATION

ITEM	SIZE	DESCRIPTION
Maintenance Joints	all	Flanged, to be kept minimum
Pipe joints	1.5" & below	SW coupling
	2.0" & above	Butt welded
Drains	on lines $\leq 1.5"$	Refer std. SD-PI-019
	on lines $\geq 2.0"$	As per P&ID or 0.75". Refer std. SD-PI-018
Vents	on lines $\leq 1.5"$	Refer std. SD-PI-019
	on lines $\geq 2.0"$	As per P&ID or 0.75". . Refer std. SD-PI-018
Temp. Connection	1.5"	Flanged, installation as per std. SD-PI-014 & 015, except skin temperature measurement.
Press. Connection	0.75"	SW nipple with Plug/ Ball Valve to spec. as per Refer std. SD-PI-011, 012 & 013

BRANCH TABLE

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0.5	0.75	1	1.5	2	3	4	6	8	10	12	14

RUN PIPE

CODE DESCRIPTION

T	TEES
W	WELDOLETS
S	SOCKOLETS

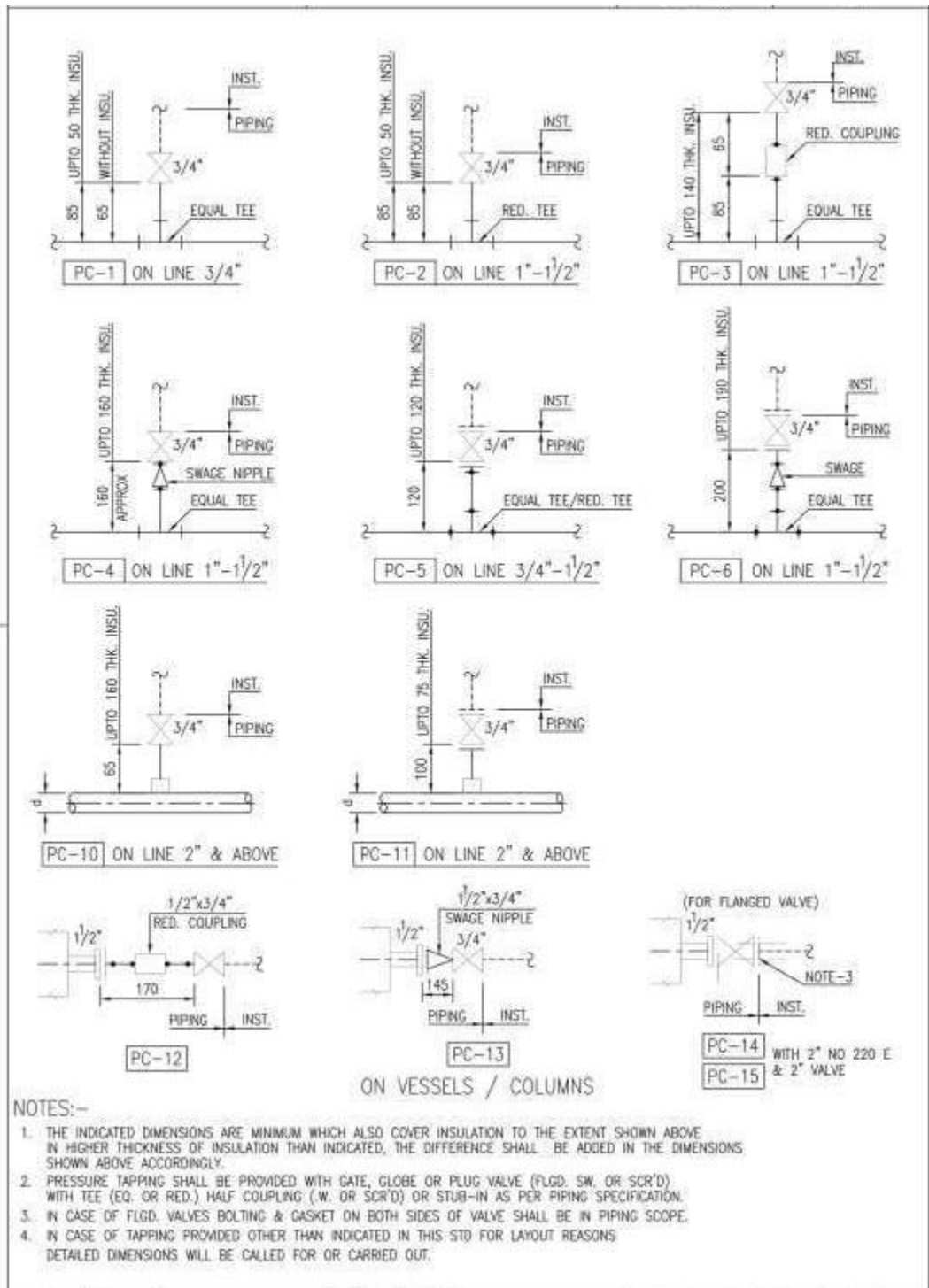
PIPING MATERIAL SPECIFICATION

Item	Lower Size (Inch)	Upper Size (Inch)	Sch./ Thk.	Dmn. STD	Material (Charpy)	Description
PIPE GROUP						
PIPE	00.500	00.750	S160	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS
PIPE	01.000	01.500	XS	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS
PIPE	02.000	03.000	XS	B-36.10	ASTM A 106 GR.B (CHARPY)	BE, SEAMLESS
PIPE	04.000	06.000		API 5L	API 5L GRX52 PSL 2	BE, ERW/SEAMLESS
PIPE	08.000	12.000		API 5L	API 5L GRX52 PSL 2	BE, ERW/SEAMLESS
NIPPLE	00.500	01.500	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS
NOTE: In case API 5L is used from 4" and above, the thickness to be considered based on design factor of 0.5 and CA -1.5mm. However fittings schedule shall remain corresponding ASTM A 106 pipe schedule.						
FLANGE GROUP						
FLNG.SW	00.500	01.500	M	B-16.5	ASTM A 105	600, RF/125AARH
FLNG.WN	02.000	12.000	M	B-16.5	ASTM A 105 (CHARPY)	600, RF/125AARH
FLNG.BLIND	00.500	01.500		B-16.5	ASTM A 105	600, RF/125AARH
FLNG.BLIND	02.000	12.000		B-16.5	ASTM A 105 (CHARPY)	600, RF/125AARH
FLNG.FIG.8	00.500	01.500		ASME-B16.48	ASTM A 105	600, FF/125AARH
FLNG.FIG.8	02.000	12.000		ASME-B16.48	ASTM A 105 (CHARPY)	600, FF/125AARH
SPCR&BLND	10.000	12.000		ASME-B16.48	ASTM A 105 (CHARPY)	600, FF/125AARH
FITTING GROUP						
ELBOW	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
ELBOW	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
ELBOW	02.000	12.000	M	B-16.9	ASTM A 234 GR.WPB (CHARPY)	BW, 1.5D
TEE's	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
TEE's	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
TEE's	02.000	12.000	M	B-16.9	ASTM A 234 GR.WPB (CHARPY)	BW
REDUCER	02.000	12.000	M, M	B-16.9	ASTM A 234 GR.WPB (CHARPY)	BW

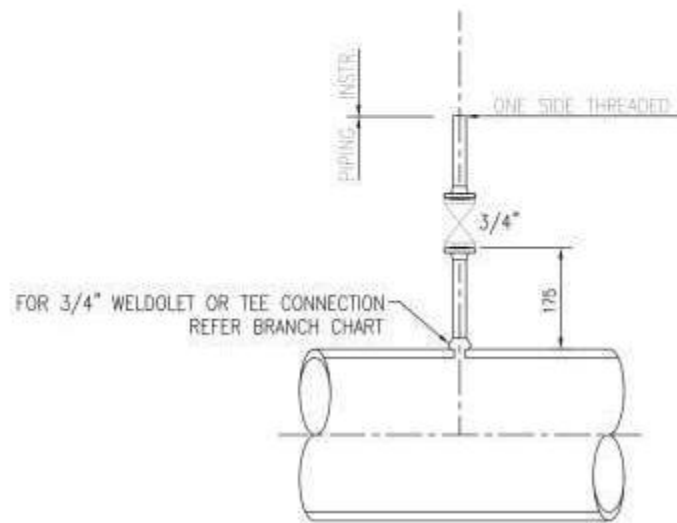
PIPING MATERIAL SPECIFICATION

Item	Lower Size (Inch)	Upper Size (Inch)	Sch./ Thk.	Dmn. STD	Material (Charpy)	Description
SWAGE	00.500	03.000	M, M	BS-3799	ASTM A 105 (CHARPY)	PBE
CAP	00.500	00.750		B-16.11	ASTM A 105	SCRF, 6000
CAP	01.000	01.500		B-16.11	ASTM A 105	SCRF, 3000
CAP	02.000	12.000	M	B-16.9	ASTM A 234 GR.WPB (CHARPY)	BW
PLUG	00.500	00.750		B-16.11	ASTM A 105	SCRM, 6000
PLUG	01.000	01.500		B-16.11	ASTM A 105	SCRM, 3000
COUPLING	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
COUPLING	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
O'let						
SOCKOLET	00.500	00.750		MSS-SP97	ASTM A 105	SW, 6000
SOCKOLET	01.000	01.500		MSS-SP97	ASTM A 105	SW, 3000
WELDOLET	02.000	08.000	M,XS	MSS-SP97	ASTM A 105 (CHARPY)	BW
VALVE GROUP						
AS PER DATA SHEET						
BOLT GROUP						
BOLT.STUD	00.500	12.000		B-18.2	BOLT:A193 GR.B7, NUT:A194 GR.2H	
GASKET						
GASKET	00.500	12.000		B-16.20- ANSI B16.5	SS 316 Sprial wind with GRAFOIL	SPIRAL, 600

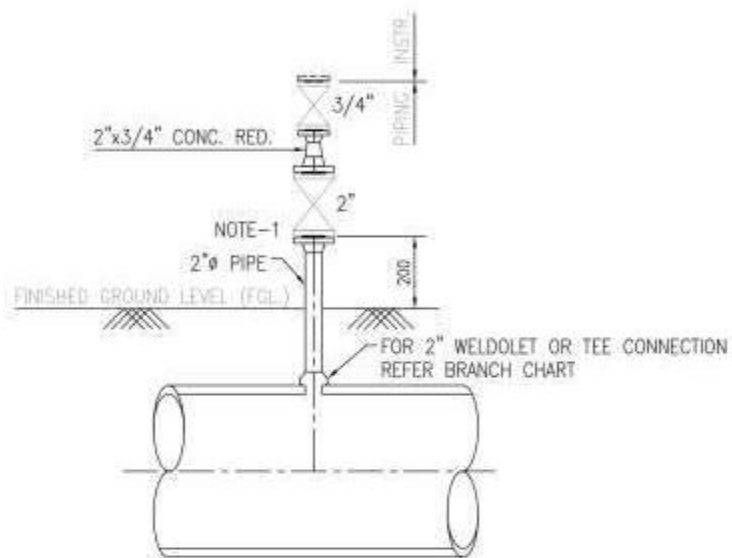
PIPING MATERIAL SPECIFICATION



PIPING MATERIAL SPECIFICATION



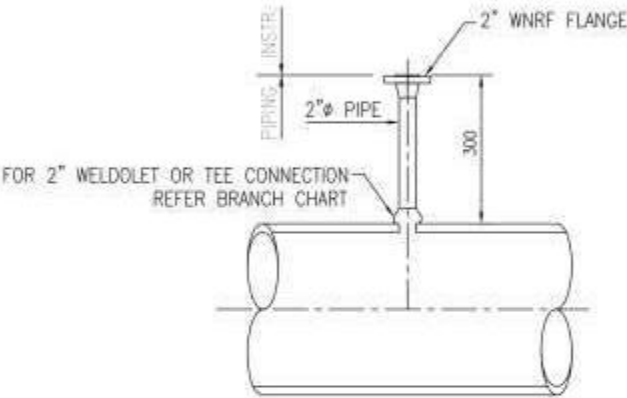
PIPING MATERIAL SPECIFICATION



NOTE:

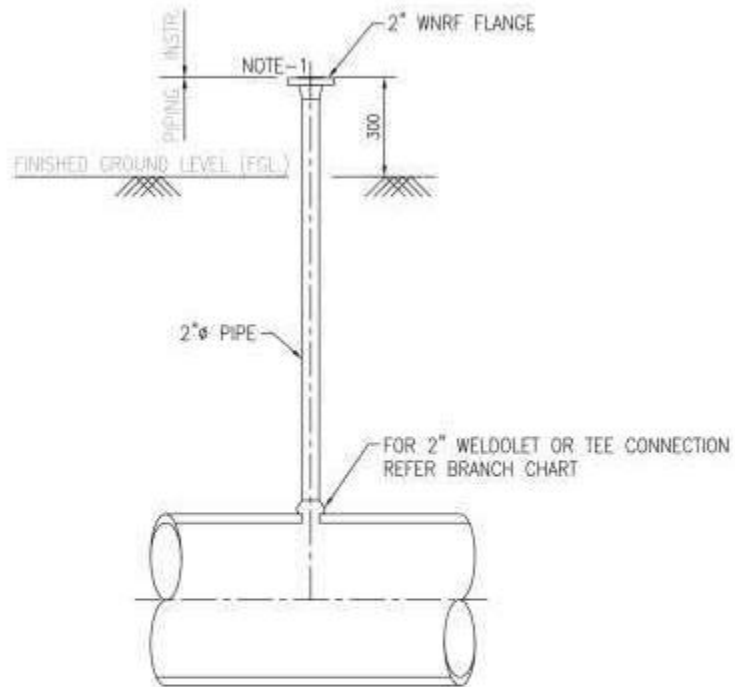
1. INSULATION GASKET SHALL BE INSTALLED.

PIPING MATERIAL SPECIFICATION



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REV. NO.	DATE	SUBJECT OF REVISION	PREP	CHKD	APPD

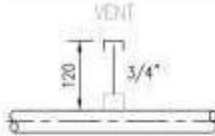
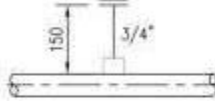
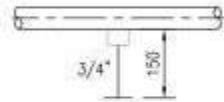
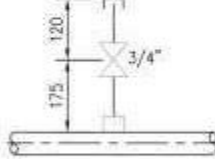
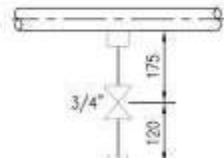
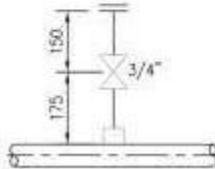
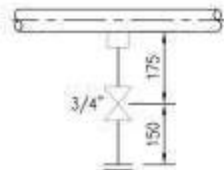
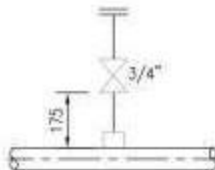
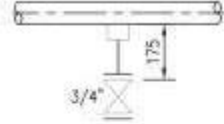
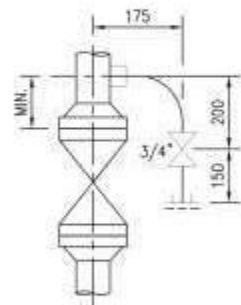
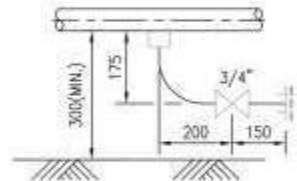
PIPING MATERIAL SPECIFICATION



NOTE:

- 1 INSULATION GASKET SHALL BE INSTALLED.

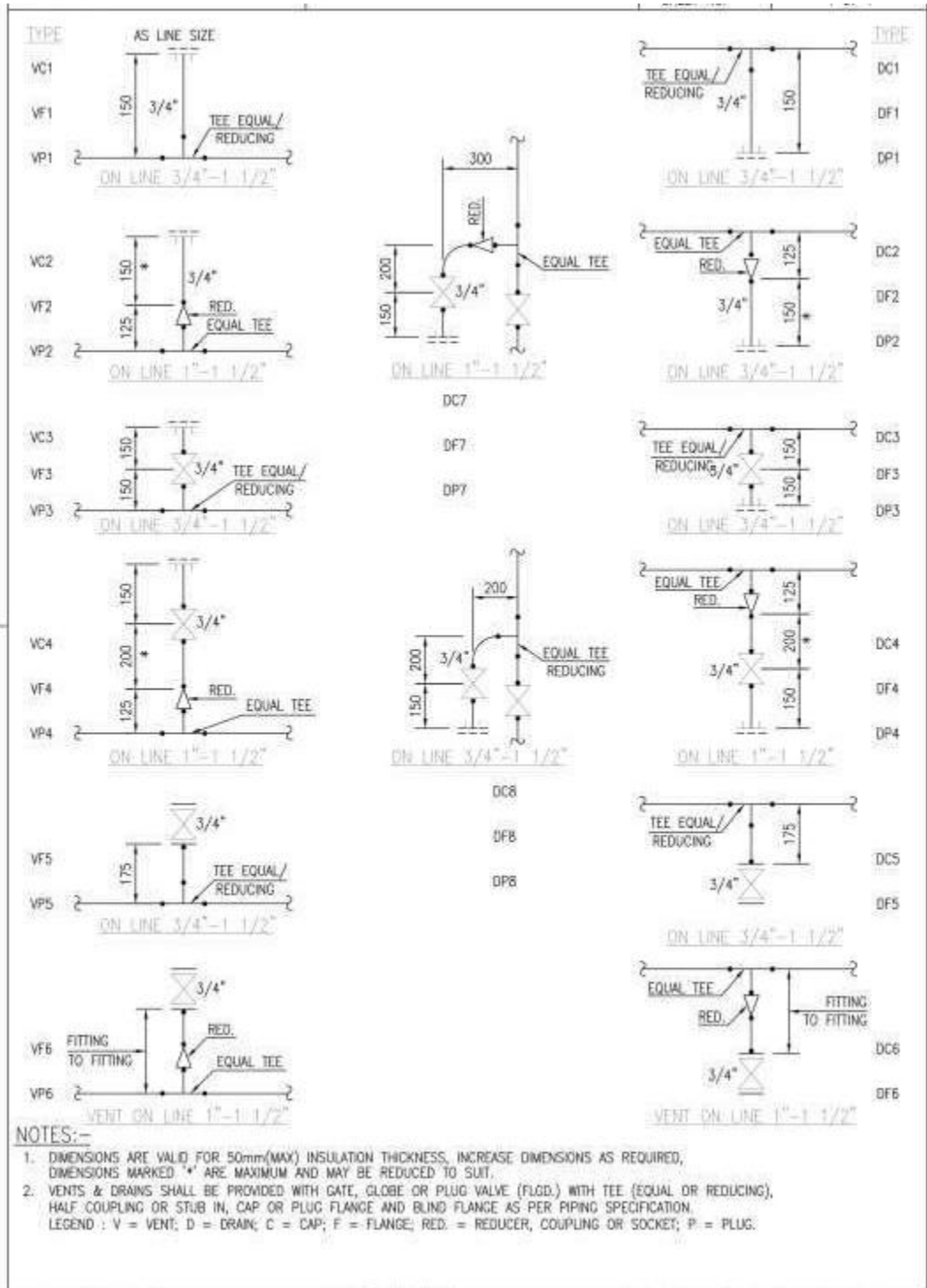
PIPING MATERIAL SPECIFICATION

TYPE	VENT	DRAIN	TYPE	
VP1 VIC			D1 D1C	
V2F			02F	
V3 V3C			D3 D3C	
V4F			04F	
V5F			05F	
			DC9 DF9	DC10 DF10

NOTES:-

1. DELETED.
2. VENTS & DRAINS SHALL BE PROVIDED WITH GATE, GLOBE OR PLUG VALVE (FLG'D.) WITH HALF COUPLING. OR STUB IN, WITH CAP OR FLANGE & BLIND FLANGE AS PER PIPING SPECIFICATIONS.
3. DELETED.
4. LEGEND : V = VENT; D = DRAIN; C = CAP; F = FLANGE; P = PLUG.

PIPING MATERIAL SPECIFICATION



**STANDARD SPECIFICATION
FOR
LOW VOLTAGE SWITCHBOARD**

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FOR
LOW VOLTAGE SWITCHBOARD**

ABBREVIATION

BIS/IS:	Bureau of Indian standards
IEC:	International Electro-Technical Commission
BS:	British Standards
IEEE:	Institute of Electrical and Electronics Engineers
NEMA:	National Electrical Manufacturers Association
OISD:	Oil Industries Safety Directorate
CCE:	Chief Controller of Explosive
DGMS:	Director General Mines Safety
IE Rules:	Indian Electricity Rules
CPRI:	Central Power Research Institute
SWG:	Switchgear
CRCA:	Cold Rolled Cold Annealed
PCC:	Power Control Centre
PMCC:	Power and Motor Control Centre
MCCB:	Moulded Case Circuit Breaker
MCB:	Miniature Circuit Breaker
MCC:	Motor Control Centre
CT:	Current Transformer
PT:	Potential Transformer
PVC:	Polyvinyl chloride

**STANDARD SPECIFICATION
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**STANDARD SPECIFICATION
FOR
LOW VOLTAGE SWITCHBOARD**

1.0 SCOPE

This specification covers the requirements of design, manufacture, testing, packing and supply of Fixed / draw out type Low Voltage Switchboards.

2.0 REFERENCE DOCUMENTS

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

IS 5:	Colours for ready mixed paints and enamels
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 1000V AC and 1200V DC.Part -II particular requirements for busbar trunking 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

2.2 In case of imported equipments, 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.

2.5 In case of any contradiction between various referred Standards / Specifications / Data Sheet and statutory regulations the following order of priority shall govern:

**STANDARD SPECIFICATION
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- a. Local Statutory regulations
- b. Data Sheets
- c. Job Specifications
- d. Standards Specification
- e. Codes and Standards

3.0 DEFINITIONS

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

OWNER / COMPANY	OWNER of the particular Project (Project Specific).
CONSULTANT	The party which is doing engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
BIDDER / SUPPLIER / VENDOR	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.

4.0 MATERIALS

- 4.1** The frame, of individual vertical panels shall be fabricated using pressed and cold rolled sheet steel. The sheet steel used for panel shall be of minimum 2mm (14SWG) CRCA except that the doors and covers may be made of 1.6mm (16SWG) CRCA. Wherever required, stiffeners shall be provided to increase stiffness of large size doors and covers.
- 4.2** Bus bars shall be of high conductivity electrolytic aluminium /copper supported on insulators made of non-hygroscopic, non-inflammable material with tracking index equal to or more than that defined in Indian standards.
- 4.3** All hardware shall be corrosion resistant. All joints and connections of the panel members shall be made by zinc passivated cadmium plated high quality steel bolts, nuts and washers.

5.0 DESIGN

5.1 GENERAL REQUIREMENTS

- 5.1.1 The offered equipment shall be brand new with state of art technology and proven field track record. No prototype equipment shall be offered.
- 5.1.2 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.
- 5.1.2 Vendor shall give a notice of at least one year to the end user of equipment and Consulted before phasing out the product/spares to enable the end user for placement of order for spares and services.

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5.2 TECHNICAL REQUIREMENTS

- 5.2.1 Low voltage switchboard shall be metal enclosed fully draw out, free standing, floor mounting, compartmentalized, modular type suitable for indoor installation.
- 5.2.2 The switchboard enclosure shall be dust and vermin proof and shall provide a degree of protection not less than IP-42.
- 5.2.3 The switchboard shall be assembled out of vertical panels of uniform height in single line up.
- 5.2.4 It shall be possible to extend the switchboards, in either direction at a later date. Ends of bus bars shall be suitably drilled for this purpose. Panels at extreme ends shall have openings, which shall be covered with plates screwed to the panel. Details of drilled holes in bus bar and openings in the panels, provided for future extension shall be clearly shown in the vendor drawings.
- 5.2.5 The switchboard shall be designed to ensure maximum safety during operation, inspection, connection of cables, relocation of outgoing circuits and maintenance, with the bus bar system energised and without taking any special precautions.
- 5.2.6 Adequate means shall be provided to prevent shorting of power and / or control terminals due to accidental dropping of maintenance tools etc. inside the switchboard. Checking and removal of components shall be possible without disturbing adjacent equipment.

5.3 SPECIFIC REQUIREMENTS OF AIR CIRCUIT BREAKER PANELS

- 5.3.1 The breaker panels shall have distinct bus bar, breaker and cable compartments.
- 5.3.2 The design of each compartment shall be such as to prevent movement of vermin from a particular compartment to any other compartment of the panel when the breaker is withdrawn and compartment door is closed.
- 5.3.3 Blanking plates shall be provided for each circuit breaker compartments, which would be used after installation, to cover the openings in the event of taking out the breaker outside the compartment.
- 5.3.4 In order to minimise accidental access and avoid accidents due to falling tools, all the outgoing links shall be shrouded.
- 5.3.5 Outgoing Air circuit breaker can be mounted in a maximum of two-tier execution while the incoming/bus coupler Air circuit breaker shall be in single tier execution only.

5.4 CABLE COMPARTMENT

- 5.4.1 Separate compartment totally enclosed from all sides shall be provided for cable termination, on the rear side. Access to cables shall be from the rear side after opening the cabling compartment door.
- 5.4.2 The incoming / outgoing cable termination shall be staggered for each circuit and barriers of sheet steel or insulating material shall be provided between termination of two circuits such that maintenance on one circuit could be carried out while the other circuit is live. Suitable clamping arrangements shall be provided for cables and cable termination. Terminal blocks shall not be used for supporting the cables.

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- 5.4.3 The incoming supply for PCC/ PMCC panels shall be through top entry bus ducts or through bottom entry cables unless specified otherwise. The outgoing cables shall have bottom entry unless specified otherwise.
- 5.4.4 The cable terminations shall be suitably sized for receiving specified number of cables per termination and provision shall be made for terminating each outgoing cable with a separate bolted connection. In case the total number of cables entering a particular panel cannot be accommodated in the cabling compartment of the panels an extension panel of full height shall be added to the cabling compartment for accommodating extra cables.

5.5 CIRCUIT BREAKER COMPARTMENT

- 5.5.1 The circuit breaker compartment shall be fully draw out. Suitable guides shall be provided to facilitate easy withdrawal of the circuit breaker.
- 5.5.2 The current transformers for the ammeter/protection circuits shall be mounted on the fixed portion of the compartment. However, current transformers associated with built-in releases may be mounted on the breaker trolley.
- 5.5.3 All terminals except wiping/sliding type control terminals shall be shrouded with plastic covers to prevent accidental contact. For direct termination - clip on shrouded type terminals shall be provided.
- 5.5.4 There shall be three positions for the draw out trolley viz:
- a. "Service" position - In this position both power and control circuits shall be connected. This shall be the normal operating position of the circuit breaker.
 - b. "Test" position - The power contacts shall be disconnected in this position but the control connections shall not be disturbed, it shall be possible to close and trip the breakers in this position.
 - c. "Draw out" Position - both power and control circuits shall be disconnected in this position and breaker removed from the cubicle.
- 5.5.5 The circuit breaker shall be lockable in "service" and "test" positions. Safety shutters shall be provided when the breaker is in withdrawn/drawout position.
- 5.5.6 The earth connection must remain connected in "Test" position; Earthing of the unit shall be done with a "pin" or with scrapping earth connections.
- 5.5.7 The earth connection shall make before the main power / control contacts make and break after the power /control contacts are disconnected. Earthing connection through a plug and socket connection shall not be acceptable.

5.6 INTERLOCKS

Following interlocks shall be provided:

- 5.6.1 Compartment doors shall be interlocked against opening when breaker is in closed condition. However, it shall be possible to defeat this interlock for inspection purposes.
- 5.6.2 It shall not be possible to push "in" a drawn out circuit breaker in closed condition or withdraw a circuit breaker in closed condition.

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- 5.6.3 It shall be possible to operate a circuit breaker only in the defined "Full in" or "service" and "test" position inside the panel. It shall not be possible to operate the breaker in intermediate positions while inserting or withdrawing circuit breaker.
- 5.6.4 Any unused circuit breaker compartment shall be fully equipped and provided with compartment door, vertical busbars and control terminals/wiring etc, such that the same could be used for housing outgoing breakers in future without any modifications to the panel.

5.7 SPECIFIC REQUIREMENTS OF NON-AIR CIRCUIT BREAKER FEEDERS

- 5.7.1 The design of drawout feeder modules shall not change for single front or double front execution. Separate vertical bus bars shall be provided for each front side modules.
- 5.7.2 All identical feeder modules shall be interchangeable.
- 5.7.3 Each vertical panel shall have a separate cable alley. The width of this cable alley shall be sufficient to accommodate all the cables and shall have free access for cable terminations and in any case shall not be less than 200mm minimum. Cable alleys shall be provided with suitable doors.
- 5.7.4 Sheet steel barriers shall be provided between individual compartments and cable alley. This barrier shall be provided with opening for power and control connections and it shall be possible to safely carryout maintenance work on cable connections to any one circuit in the cable alley with the Bus bars and the adjacent circuits live.
- 5.7.5 Maintenance and connection of cables to any modules shall be possible without having to take out the modules from its position from the panel.
- 5.7.6 The outgoing feeder trolleys for drawout type switchboard shall be fully drawout and shall have the following features.
- a. It shall be possible to withdraw the trolley without having to unbolt or unscrew any power and control connections to the equipment mounted on the withdrawable trolley.
 - b. Both power and control connections shall be drawout type. All line and bus PTs shall be in drawout execution only. However, outgoing modules having size more than half of the useful vertical height of the panel may be in mixed combination of drawout/fixed type.
 - c. Control supply transformer modules with burden higher than 2.5KVA may be in fixed execution.
 - d. The trolley withdrawal shall be by means of crank and screw arrangement. Alternatively movement on guided rollers may also be acceptable. Plug in operation shall be independent of manual force.
 - e. For drawout type feeders of size equal to or greater than half the useful vertical height of panel, positive clamping arrangement shall be provided on the top portion of the trolley in addition to clamping arrangement at the bottom, to ensure all round positive pressure on the power drawout contacts once the trolley is plugged in.
 - f. Power drawout contacts shall preferably be located towards the bottom portion of each trolley. The trolley shall be lockable in fully plugged in position and devices shall be

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provided to ensure positive plugging in. In test position, power contacts shall be totally isolated and a device shall be provided for indication of test position.

- g. The incomer and bus tie feeders with load break switches rated 800A and above may be in fixed execution.

5.7.7 Various compartment sizes in a vertical panel shall be multiples of a basic dimension. However the minimum module size for switch fuse feeder and motor starter/contactator feeder shall not be less than that defined in Data Sheet/Job Specification. Vertical bus bars shall be pre-drilled at regular intervals for complete flexibility for changes in size of modules.

5.7.8 All switch drives other than rotary control switches, shall be lockable in both 'ON' and 'OFF' positions.

5.7.9 The Switches / Moulded case circuit breakers / MCB shall be interlocked with the compartment door to prevent opening of the door when the Switch/ Moulded case circuit breaker is in 'ON' position and to prevent switching on when the door is open. A defeat mechanism for this interlock shall also be provided.

5.7.10 The maximum height of the operating handle and switches shall not exceed 1900 mm and the minimum height not below 300 mm.

5.7.11 Unused modules in the panel shall be fully equipped with hinged door, power and control terminals for starter modules and cradle for future use.

5.8 SWITCHGEAR MODULES

5.8.1 Switchboard shall be completely lined up in one straight row with the type and quantities of feeders as defined in switchboard Data Sheet. Generally the feeders of three main categories are identified as circuit breaker, motor starters and switch-fuse,

5.8.1 Starter modules required for motor control shall be of following types and internal control wiring of all starter modules of each type shall be identical for all ratings.

FVNR Full voltage non -reversing starter with minimum 18 control terminals.

FVR Full voltage reversing starter with minimum 24 control terminals.

FVNR HD Full voltage non -reversing heavy duty starter with long starting time such as for compressors and fans etc, with minimum 18 control terminals.

5.8.2 Switch fuse /contactor feeder modules shall be of following types and internal control wiring of all modules of each type shall be identical for all ratings.

SFU Switch fuse modules with no control terminals.

SFUC Switch fuse contactor modules with 18 control terminals.

5.8.3 Type of modules for fixed type switchboard shall be similar to above specified drawout modules except that the modules shall be of fixed type.

5.8.4 Minimum 2000 VA control transformer shall be provided for each bus section of the PMCC/MCC switchboard having contactor control feeders and each transformer shall be

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sized for the entire switchboard. For switchboard having two bus sections and coupled by bus tie shall have manual changeover switch for the control transformers.

- 5.8.5 To facilitate site modification due to changes in motor KW ratings and to minimise spares inventory, overload relays and power fuse links shall meet the following requirements.
- a. All bimetal overload relays shall be separately mounted type with connecting links rated for the maximum rating of the contactor in a starter module.
 - b. Bimetal overload relays of various current ranges required for motors likely to be connected to a contactor must be identical in dimension for inter-changeability. In case offered relays are with different dimension for any particular starter module, special mounting plate suitable for mounting different relays shall be provided in all the modules of that size.
 - c. Heavy duty starters shall be provided with saturable type current transformer operated overload relays only, which shall be suitable for motor starting time of 15-60 seconds.
 - d. All contactor controlled starter feeders shall meet the requirements of type-2 co-ordination as per IS: 13947.

5.9 SWITCHGEAR COMPONENTS

5.9.1 CIRCUIT BREAKER

- a. Circuit breakers shall be air break, 3 pole and drawout type. However Circuit breaker for generator incomer shall be with four poles unless specified otherwise.
- b. The circuit breakers shall be provided with mechanically operated emergency tripping device. This device shall be available on the front of the panel. Mechanically operated 'closing' device shall be provided for all breakers. However mechanical closing shall be inhibited for all breakers in service position.
- c. The circuit breakers shall be provided with minimum 4 NO + 4 NC contacts, wired and available for Purchaser's use.
- d. Circuit breakers Open and closed positions; Service and test locations and spring charged condition shall also be indicated mechanically in addition to electrical indications.
- e. Unless otherwise specified, all circuit breakers in the switchboard shall be provided with electrical power operating mechanism. Wherever circuit breakers are provided in place of Isolators, Breaker can be manually operated type.

5.9.2 OPERATING MECHANISM

- a. Electric power operating mechanism shall be motor wound spring charged stored energy type. However, manual-operating mechanism may be of the spring charging stored energy type or the spring assisted type. For circuit breakers with electrical power operating mechanism, provision shall also be made for manual spring charging. Closing time of circuit breakers with manual operating mechanism shall be independent of the speed of the operating handle.
- b. All stored energy operating mechanism shall be equipped with following features.
 - i. Failure of springs, vibrations or shocks shall not cause unintended operation of breaker or prevent intended tripping operation.

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- ii. Closing of circuit breakers shall be prevented unless the spring is fully charged.
- c. All electrical power operating mechanisms shall be suitable for remote operation and shall be equipped with following features.
 - i. Provided with universal motor operable on AC or DC control supplies.
 - ii. Provided with emergency manual charging facility. The motor shall be automatically, decoupled (mechanically) once the manual-charging handle is inserted.
 - iii. Closing operation of circuit breaker shall automatically initiate charging of the spring for the next closing operation without waiting for tripping of circuit breaker.
 - iv. Closing operation shall be completed once the closing impulse is given and the first device in the control scheme has responded even though the control switch / Push Button is released provided no counter trip impulse is present.
 - v. Circuit breaker trip and closing coils in case of electrically operated breakers and trip coil in case of mechanically operated breakers and circuit breaker indication shall be suitable for satisfactory operation on a control supply system indicated in data sheets/job specification.
 - vi. Circuit breakers shall be provided with anti-pumping and trip free feature.
 - vii. Circuit breakers shall be provided with operation counters.
 - viii. Releases are not required to be provided with breakers where relays are used. However breaker having AC control supply voltage shall be provided with under voltage release unless specified otherwise.

5.9.3 SWITCHES

- a. All switches or fuse switches shall be air break type provided with quick make/break manual operating mechanism. The operating handle shall be mounted on the door of the compartment having the switch.
- b. Rating of switches for starter module shall meet the requirements of AC-23 duty as per IS: 513947 and minimum rating shall be as specified in job specification/data sheets.

5.9.4 FUSES

- a. Fuses shall be non-deteriorating HRC cartridge link type.
- b. Power fuses shall be pressure fitted type and shall preferably have ribs on the, contact blades to ensure good line contact.
- c. It shall be possible to handle fuses during off load conditions with full voltage available on the terminals. Wherever required, fuse pullers shall be provided. The fuse base shall be so located in the modules to permit insertion of fuse pullers and removal of fuse links without any problem.

5.9.5 CONTACTORS

- a. The contactors shall be air break type, equipped with three main contacts and minimum 1NO+1NC auxiliary contacts: The main contacts of a particular contactor for motor starter module shall have AC-3 or AC-4 ratings as specified in Data Sheet.
- b. Unless specified otherwise, the coil of the contactor shall be suitable for operation on 240 V, I Phase, AC supply and shall work satisfactorily between 65 to 110% of the rated value.

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5.9.6 THERMAL OVERLOAD RELAY

- a. Bimetal relays shall be provided for protecting the motor from thermal overload.
- b. Bimetal relays shall be manually reset type with the reset push button brought out on the front of the panel. The reset push button shall be capable of being operated without opening the compartment door.
- c. Bimetal relays shall be positive acting ambient temperature compensated type with adjustable setting range.
- d. Bimetal relays shall have built-in single phasing prevention feature, which operate even with 50% rated current at the time of single phasing.

5.9.7 MOULDED CASE CIRCUIT BREAKERS

- a. MCCBs shall be provided with spring assisted quick make/ break manually operated trip free mechanism. Wherever specified, MCCB shall be suitable for remote tripping operation and the tripping device shall be suitable for the specified control supply voltage.
- b. MCCBs shall be provided tripping device with inverse time characteristic for over load protection and instantaneous characteristics for short circuit protection and MCCB rated above 125A shall preferably have adjustable settings.
- c. 'ON' and 'OFF' position of the operating handle of MCCB shall be displayed and the operating handle shall be mounted on the door of the compartment housing MCCB.
- d. Each MCCB shall be provided with minimum 1 NO + 1 NC auxiliary contact and 1NO contact for tripping indication/alarm for Purchaser's use.
- e. MCCBs shall be provided with solenoid/ Motorised closing mechanism to make them suitable for remote closing operation if specified. The closing solenoid/motor shall be suitable for specified (control supply voltage).
- f. MCCB's as part of motor starter module shall be current limiting type and type tested for type-2 coordination as per IS: 13947.

5.9.8 RELAYS

- a. Type of relay shall be numerical, static or electromagnetic type as specified in the Data Sheet /Job Specification.
- b. All electromagnetic protective relays shall be back connected, of drawout type, suitable for flush mounting, and fitted with dust-tight covers. Alternatively, "plug-in" type relays will also be acceptable. Auxiliary relays are acceptable in fixed execution.
- c. The protective relay cases shall have provision at the front for "testing and calibration" purposes. It shall be possible to test the relays without disconnecting the wiring and without withdrawing the relays. The insertion of the test plug shall automatically short circuit the CTs and permit extension of external power supply to the relay.
- d. Each protective relay shall be provided with minimum 2 nos. potential free contacts of required configuration.
- e. Each tripping relay shall be lockout type with hand reset coil cut-off contact. The tripping relay shall be suitable for satisfactory operation from 50 % to 110 % of the specified control supply voltage.

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- f. Protective relays shall be preferably mounted on the front side and upper part of the panel and mounting of relays on the lower portion shall be avoided.

5.9.9 INSTRUMENT TRANSFORMERS (CTS/PTS)

- a. Current transformers shall generally conform to IS : 2705 and any special requirement with respect to Numerical relay shall be taken care by the Vendor.
- b. For general guidance the Vendor shall note that the protective current transformers shall have an accuracy class "5 P" and an accuracy limit factor greater than "10 ". However CTs for restricted earth fault shall be of class "PS". Vendor shall co-ordinate the knee point voltage, magnetising current for PS class CTs to avoid saturation and mismatching of CTs provided at other end by other Vendor.
- c. Current transformers for instruments shall have an accuracy class 1.0 and accuracy limit factor less than 5.0. However accuracy class of 3.0 is acceptable for CT's meant for remote ammeters.
- d. The current transformers in breaker feeders shall be capable of withstanding the applicable peak momentary short circuit and the symmetrical short circuit current for 1.0 second.
- e. The voltage transformers shall be cast resin type transformers and PT shall generally conform to IS : 3156. PT shall be provided with HRC fuses on primary side and Miniature circuit breakers with auxiliary contact on the secondary side.

5.9.10 MEASURING INSTRUMENTS

- a. All measuring instruments shall be of 96 x 96, mm and 72 x 72 mm square pattern, flush mounting type for incomer and outgoing feeders respectively in the switchboard.
- b. All auxiliary equipment such as shunts transducers, CT's PT's etc. as required shall be included in the supply of the switchboard.
- c. All AC ammeters and voltmeters shall be of moving iron type with accuracy class of 1.5 as per IS: 1248. Ammeters for motor feeders shall have a non-linear compressed scale at the end to indicate motor starting current and red mark for the full load current.
- d. The KW/KWH meters shall be suitable to measure unbalanced loads on 3 phases 4-wire system. Test terminal block shall be provided for KWH meters. The accuracy class of KW/KWH meters shall be a minimum of 2.5.
- e. Digital meters shall be provided if specified in Job Specification/Data Sheets. All digital meter shall be high reliable, accurate, compact and self powered. Digital meter data shall be saved in case of power failure. Field programming from front of the meter shall be possible and shall be RS232/485 port in case specified in the Job Specification/Data Sheet.

5.9.11 CONTROL SWITCHES

- a. All control switches shall be rotary type, having a cam operated contact mechanism. Switch shall have pistol grip handles for circuit breaker control and knob type handle for other applications.
- b. Ammeter selector switches shall have make before break feature on its contacts. The selector switch shall generally have 4 positions for reading 3 phase currents and fourth position for off. The voltmeter selector switch shall also have 4 positions, Three positions shall be used to measure phase to phase voltage and fourth shall be OFF position.

5.9.12 PUSH BUTTONS:

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Push button colours shall be as follows:

- a. Stop /open/emergency : Red
- b. Start/close : Green
- c. Reset/test : Yellow / Black /white

5.9.13 INDICATIONS

- a. Clustered LED type indicating light with minimum 8mm diameter size shall be provided for indications.
- b. Breaker positions (Close, Open, spring-charged, test position, service position) electrical indications, with colors as given below, shall also be provided:

Breaker `Close'	:	Red lamp
Breaker 'Open'	:	Green lamp
Breaker auto-trip	:	Amber lamp
Trip circuit healthy	:	White lamp
Spring charging	:	Blue lamp

- c. Outgoing feeder (Close, Open, trip) electrical indications, with colors as given below, shall also be provided:

'Close'	:	Red lamp
'Open'	:	Green lamp
`Trip'	:	Amber lamp

5.9.14 AUXILIARY RELAYS/CONTACTORS

Auxiliary relays/contactors shall generally be used for interlocking and multiplying contacts. Auxiliary contacts shall be capable of carrying the maximum anticipated current.

5.9.15 TIMERS

For re-acceleration duty, timers unless otherwise stated, shall be pneumatic type and shall have adjustable time setting of 0-60 seconds, Alternatively static timer may be considered. The time settings, where specified, shall be accurately set before dispatch of the switchboard. Timer provided for control of capacitor feeder shall have minimum setting of 0-5 minutes.

5.9.16 MINIATURE CIRCUIT BREAKER

- a. MCB shall provide high mechanical and electrical life, reliable protection of circuits against overload and short circuit and shall have minimum breaking capacity of 9KA unless otherwise specified. Positive ON/OFF indication shall be provided.
- b. Earth leakage circuit breaker shall have earth sensitivities range 30mA to 300mA unless otherwise specified.

6.0 FABRICATION

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- 6.1.** All identical equipment and corresponding part shall be fully interchangeable.
- 6.2** The frame, of individual vertical panels shall be fabricated using pressed and cold rolled sheet steel. The sheet steel used for panel shall be of minimum 2mm (14SWG) CRCA except that the doors and covers may be made of 1.6mm (16SWG) CRCA. Wherever required, stiffeners shall be provided to increase stiffness of large size doors and covers.
- 6.3** The switchboard shall be provided with integral base frame for each vertical panel. The switchboard integral base frame shall be suitable for tack welding.
- 6.4** All openings, covers and doors shall be provided with neoprene Gaskets. Removable blanking plates shall be provided to cover the openings in the event of withdrawing the feeder modules. Number of blanking plates shall be 10% of each module size with a minimum of one number.
- 6.5** All hardware shall be corrosion resistant. All joints and connections of the panel members shall be made by zinc passivated cadmium plated high quality steel bolts, nuts and washers.
- 6.6** Suitable removable type eyebolts shall be provided for the lifting of the panel/shipping section. These bolts, when removed shall not leave any opening in the panels.
- 6.7** Non-magnetic cable gland plates shall be provided for termination of single core cables.
- 6.8** The switchboard shall be formed using distinct vertical panels each comprising of following compartments.
- 6.8.1 A metal enclosed horizontal bus bar compartment running at top unless otherwise specified. Individual feeder modules in multitier mode.
- 6.8.2 Vertical bus bars serving all feeder modules in the vertical panel.
- 6.9 CABLE TERMINATION COMPARTMENT**
- 6.9.1 Perforated sheet steel/insulating material enclosed horizontal auxiliary bus bars for control, interlock, indication and metering wiring running horizontally.
- 6.9.2 Metal sheets shall be provided between two adjacent vertical panels running up to full useful height of the switchboard.
- 6.9.3 MCC shall be of single/double front execution as specified in Data Sheet/Job Specification. However Circuit breaker panels and fixed type switchboard shall be in single front execution only.
- 6.9.4 Motor starter and switch fuse modules shall not be accommodated at front and rear of ACB Incomer and bus coupler panel.
- 6.9.5 All metering and protection equipment associated with a particular circuit as specified in Data Sheet shall be housed in separate and independent compartment earmarked for that particular circuit and in the fixed portion of the vertical panel in case of breaker panels.
- 6.9.6 All auxiliary devices for control, reset, indication, measurement and protection such as push buttons, control and selector switches, indicating lamps, measuring instruments and protective relays shall be mounted on the front side of the respective compartment. The

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design shall be such that all power on/off or start / stop and relay reset operations shall be performed without opening the panel door.

6.10 SPACE HEATERS

6.10.1 The switchboard panels shall be provided with space heaters to prevent moisture condensation. The space heater shall be located in the bottom part of each panel and shall be supplied from 240 V AC auxiliary bus for space heater. The space heater shall be provided with a thermostat having adjustable setting and double pole miniature circuit breaker.

6.11 AUXILIARY BUS BARS

6.11.1 Auxiliary bus bars each of minimum size 18-mm² copper shall be provided for following applications. Exact number of bus bars shall depend on various control, metering and auxiliary power distribution requirement.

6.11.2 Panel space heater supply and motor space heater supply.

6.11.3 Control supply for breaker tripping, closing and indication circuits.

6.11.4 Control supply for breaker spring charging motors, motor starter control and indication circuit. AC potential supply for energy meters, voltage operated relays etc.

6.11.5 Tee-off connectors shall be used for distributing auxiliary supply to each vertical panel. Rubber grommets shall be used for all wire entries to make the entries dust and vermin proof.

6.11.6 Provision to hook up of external DC control supply to be provided either in bus PT panel or bus coupler panel.

6.12 BUS BAR

6.12.1 Bus bars shall be of high conductivity electrolytic aluminium /copper supported on insulators made of non-hygroscopic, non-inflammable material with tracking index equal to or more than that defined in Indian standards.

6.12.2 The main bus bars shall have uniform current ratings throughout their length as specified in Data Sheet/Job Specification. The current rating of the neutral shall be half that of the phase bus bars, Removable neutral links shall be provided on feeders to permit isolation of the neutral bus bar.

6.12.3 Both horizontal and vertical bus bars, bus joints and supports shall be capable of withstanding dynamic and thermal stresses of the specified short circuit currents for 1 second, The short circuit capacity of the neutral bus bars shall be in line with IS:13947.

6.12.4 Only zinc passivated or cadmium plated high tensile strength steel bolts, nuts and washers shall be used for all bus bar joints and supports. The hot spot temperature of bus bars including joints at design ambient temperature shall not exceed 95° C for normal operating conditions.

6.12.5 The current rating as defined for switchboard and components in Data Sheet/Job Specification are for design ambient temperature at site conditions and for being inside

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the cubicle at fully loaded condition. The Vendor shall suitably Derate the nominal rating to suit the above condition.

- 6.12.6 All bus bars shall be insulated with heat shrunk PVC sleeves of 1100 V grade. Red, yellow and blue colour shall be used for phase bus bars and black colour shall be used for neutral bus bars, Removable type shrouds shall be provided for joints.
- 6.12.7 Minimum clearance between live parts, between live parts/neutral to earth shall be 19 mm, However clearances between terminals at components shall be as per applicable individual standards for components.
- 6.12.8 Interconnections between the main bus bars and individual units shall be made by using aluminium bus bars of adequate rating. These interconnections of the vertical bus bars shall be in separate compartment and fully shrouded.
- 6.12.9 Vertical bus bars for circuit breaker panels shall be sized depending upon the rating and number of breakers per vertical panel. However Vertical bus bars of all other panels shall be of uniform cross section, Size of vertical bus bars shall not be less than 500 mm² aluminium per phase or equivalent copper for panels rated above 25kA.

6.13 WIRING AND TERMINALS

- 6.13.1 Inside the cubicles, the wiring for control, signalling, protection and instrument circuits shall be done with BIS approved, PVC insulated, flame retardant type, copper conductor wire. The insulation grade shall be 660 V. The wiring shall preferably be enclosed in plastic channels or neatly bunched , together.
- 6.13.2 PVC insulated copper conductor of cross section 1.5 mm² may normally be used provided the control fuse rating is 10 amps or less. For 16 amps control fuse circuit 2.5mm² copper conductor shall be used. Each wire shall be terminated at a separate terminal. C.T. Circuit wiring shall be done with 2.5mm² Copper conductor.
- 6.13.3 Shorting links/suitable-shortening arrangement for shorting CT. secondary shall be provided. Each wire shall be identified at both ends by PVC ferrules.
- 6.13.4 Inter panels wiring within each shipping section shall be switchboard Vendor's responsibility. For wiring between shipping sections, Vendor shall provide terminal blocks on adjoining shipping sections and supply suitable jumpering wires. Interpanel wiring shall be taken thorough PVC sleeves or rubber grommets.
- 6.13.5 A minimum of 10% spare terminals shall be provided on each terminal block.
- 6.13.6 Conductors shall be terminated with adequately sized compression-type lugs for connection to equipment terminals and strips. Stranded conductors shall be soldered at the ends before connections are made to the terminals. Sufficient terminals shall be provided on each terminal block to ensure that not more than one outgoing wire is connected per terminal.
- 6.13.7 Terminal strips shall preferably be separated from power circuits by metal barriers or enclosures. All spare contacts of auxiliary relays, timers, etc shall be wired up to the terminals.

6.14 EARTHING

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- 6.14.1 All panels shall be connected to a tinned copper / GI earth bus bar running throughout the length of the switchboard.
- 6.14.2 The minimum earth bus size shall be 30x6 mm² copper for fault level up to 31.5kA and 50x6 mm² copper for fault level above 31.5kA,
- 6.14.3 All doors and movable parts shall be earthed using flexible copper connections to the fixed frame of the switchboard. Provision shall be made to connect the earthing bus bar to the plant earthing grid at two ends.
- 6.14.4 All non current carrying metallic parts of the mounted equipment shall be earthed. Minimum 4 nos, 10 mm diameter bolts with nuts shall be provided on the earth bus for termination of fourth core of cable per vertical panel.

6.15 NAME PLATE

- 6.15.1 A nameplate with the switchboard designation shall be fixed at the top of the central panel. A separate nameplate giving details for each feeder compartment of all panels shall be provided.
- 6.15.2 The nameplates for feeder compartments shall be in two parts. One part shall have necessary details pertaining to the compartments number of vertical panel of the switchboards, The other parts shall be removable and shall contain all details regarding the feeder number for drives/equipment controlled by the particular module as per approved single line diagram.
- 6.15.3 Blank nameplates shall be provided for all spare and vacant modules.
- 6.15.4 Nameplate or polyester adhesive stickers shall be provided for each equipment mounted inside the switchboard, Special warning plates shall be provided on removable covers or doors giving access to cable terminals and bus bars.
- 6.15.5 Special warning labels shall be provided inside the switchboards also, wherever considered necessary. Identification tags shall be provided inside the panels matching with those shown on the circuit diagram.
- 6.15.6 Engraved nameplates shall preferably be of 3 ply (Black-White Black) lamicoid sheets or anodised aluminium. However back engraved Perspex sheet nameplates may also be acceptable. Nameplates shall be fastened by screws and not by adhesives.

6.16 PAINTING

- 6.16.1 All metal surfaces 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 surface shall be prepared by applying a coat of phosphate paint and coat of yellow zinc chromate primer, The under surface shall be made free from all imperfections before undertaking the finishing coat.
- 6.16.2 After preparation of the under surface, the switchboard shall be spray painted with two coats of epoxy based final paint or shall be powder coated.
- 6.16.3 Colour shade of final paint shall be 631 as per IS:5 unless otherwise specified.

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6.16.4 The finished panels shall be dried in stoving ovens in dust free atmosphere. Panel finish shall be free from imperfections like pinholes, orange peels, runoff paint etc. Vendor shall supply final paint (1 litre per switchboard) in non-returnable container for final touch up at site.

6.16.5 All unpainted steel parts shall be cadmium plated or suitably treated to prevent rust formation. If these parts are moving elements then they shall be greased.

7.0 INSPECTION AND TESTING

7.1 During fabrication, switchgear shall be subject to inspection by Consultant / Owner or by an agency authorised by the Owner. Manufacturer shall furnish all necessary information concerning the supply to Consultant / Owners inspectors.

7.2 All routine and acceptance tests shall be carried out at Manufacturer's work under his care and expense.

7.3 Type tests, if specified shall be performed. Short circuit test shall be performed at CPRI or equivalent approved testing agency and heat run test may be performed at manufacturer's works. Heat run test shall be performed at least on one incomer and two outgoing vertical panels of the ordered switchboard.

7.4 Type and shop tests shall be witnessed by an inspector of Consultants / Owner or of an agency authorised by the Owner. Prior notice of minimum 4 weeks shall be given to the Inspector for witnessing the tests.

7.5 ACCEPTANCE TESTS

Acceptance tests shall be as follows:

7.5.1 A general visual check shall be carried out. This shall cover measurement of overall dimension, location, number and type of devices, location and connection of terminals etc,

7.5.2 Manual and electrical operation of Circuit Breakers. / Relays shall be checked under the worst conditions of auxiliary supply voltage.

7.5.3 Dry insulation test with power frequency voltage shall be conducted for the main and auxiliary circuits.

7.5.4 Insulation resistance of the main and auxiliary circuits shall be checked before and after power frequency voltage withstand test.

7.5.5 Operation check shall be carried out for every control function /interlocks as per the schematic diagrams by manually simulating fault conditions and operation of control switches/relays etc.

7.5.6 For equipment bought from other sub-suppliers, certified test reports of tests carried out at the manufacturers works shall be submitted. Normally all routine tests as specified in the relevant standards shall be conducted by the sub-supplier at his works.

7.5.7 Interchangeability of similar modules shall be checked on a random basis. This may be done on one module of each size.

8.0 MARKING, PACKING AND SHIPMENT

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- 8.1.** All the equipment shall be divided into several shipping sections for protection and ease of handling during transportation .The equipment shall be properly packed for selected mode of transportation i.e. by ship/rail or trailer. The panels shall be wrapped in polyethylene sheets before being placed in
- 8.2** 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.
- 8.3** 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 agree.

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ABBREVIATION

BIS/IS:	Bureau of Indian standards
IEC:	International Electro-Technical Commission
BS:	British Standards
IEEE:	Institute of Electrical and Electronics Engineers
NEMA:	National Electrical Manufacturers Association
OISD:	Oil Industries Safety Directorate
CCE:	Chief Controller of Explosive
DGMS:	Director General Mines Safety
IE Rules:	Indian Electricity Rules
CPRI	Central Power Research Institute
PVC	Polyvinyl chloride
XLPE	Cross Linked Poly Ethylene

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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 PVC/XLPE cables and cable jointing / terminating accessories for medium and high voltage systems.

2.0 REFERENCE DOCUMENTS

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

IS: 1554	PVC insulated (heavy duty) electric cables.
IS: 7098	Cross linked polyethylene insulated PVC sheath
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
IS 10810 (Part 41)	Methods of testing cables: Mass of zinc coating on steel armour.
IS: 209	Specification of zinc
IS: 3961	Recommended current ratings for cables: part-2 PVC insulated and PVC sheathed heavy duty cables.
IS: 10418	Drums for electric cables
IS: 10462(Pt-1)	Fictitious calculation method for determination of dimension 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 bunched cables.
IS: 13573	Joints and termination for polymeric cables for working voltages from 6.6 KV up to and including 33 KV.
IEC: 60332-3	Test 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	Thermoplastic insulated wire and cable for transmission and Distribution of electrical energy
NEMA-WCS	Distribution of electrical energy
ICEA. S-66-S24	Cross-linked thermosetting polyethylene insulated wire
NEMA-WC7	Cable for transmission of electrical energy.

2.2 The cables and accessories shall also conform to the provisions of Indian electricity rules and other statutory regulations as applicable.

2.3 In case of any contradiction between various referred Standard/Specification/Data sheet and statutory regulations, the following order of priority shall govern:

- a. Statutory regulations
- b. Data Sheets

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- c. Job specifications
- d. Standard specification
- e. Codes and standards

3.0 DEFINITIONS

- 3.1** For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

OWNER / COMPANY	OWNER of the particular Project (Project Specific).
CONSULTANT	The party which is doing engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
BIDDER / SUPPLIER / VENDOR	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.

4.0 MATERIALS

4.1 PVC CABLES

- 4.1.1 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.

4.2 XLPE CABLES

- 4.2.1 The core insulation shall be with cross linked polyethylene insulating compound dry cured, applied by extrusion it shall be free from voids and shall withstand all mechanical and thermal stresses under steady state and transient operating conditions.

5.0 DESIGN

5.1 PVC CABLES

- 5.1.1 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.
- 5.1.2 The conductors shall be solid for conductor of nominal area up to and including 6mm² and stranded beyond 6mm². Conductors of nominal area less than 16 mm² shall be circular only. Conductors of nominal area 16 mm² and above may be circular or shaped as per IS 8130. Cables with reduced neutral conductor shall have sizes as per Table 1 of IS 1554 (Part-1).
- 5.1.3 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-1). Control cables having 6 cores and above shall be identified with prominent and indelible numerals on the outer surface of the insulation. Colour of the

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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 Standards.

- 5.1.4 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-1). Single core cables shall have no inner sheath.
- 5.1.5 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.
- 5.1.6 For mining cables, the size and type of armour shall be such that the combined conductance of armour shall be equivalent to 75 percent of the conductance of the largest conductor of the cable.
- 5.1.7 The outer sheath for the cables shall be applied by extrusion and shall be of PVC compound conforming to the requirements of type ST-I 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-I).
- 5.1.8 If Heat Resisting PVC cables are specified in the Data Sheet, the following shall be the requirements:
- a. 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:
 - i. Conductor insulation Type C
 - ii. Inner sheath Type ST 2
 - iii. Outer sheath Type ST 2

5.2 XLPE CABLES

- 5.2.1 Power cables for 3.3kV up to and including 33kV systems shall be aluminium/copper conductor, XLPE insulated, sheathed, armoured and overall PVC sheathed.
- 5.2.2 The conductors shall be stranded and compacted circular for all cables.
- 5.2.3 All cables rated 3.8/6.6kv and above shall be provided with both conductor screening and insulation screening. The conductor shall be provided with non-metallic extruded semi conducting screen.
- 5.2.4 The core insulation shall be with cross linked polyethylene insulating compound dry cured, applied by extrusion it shall be free from voids and shall withstand all mechanical and thermal stresses under steady state and transient operating conditions. It shall conform to the properties given in Table-I of IS 7098-(Part 2).

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- 5.2.5 The insulation screen shall consist of non metallic extruded semi conducting compound in combination with a non magnetic metallic copper screen. Unless specified otherwise, the copper screen for all the three cores together shall be capable of carrying the single line to ground fault current value and the duration specified in the Data Sheet.
- 5.2.6 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 by coloured strips or by printed numerals.
- 5.2.7 The inner sheath shall be applied over the laid up cores by extrusion and shall conform to the requirements of type ST 2 compound of IS: 5831. The extruded inner sheath shall be of uniform thickness. In case of single core cables, there shall be extruded inner sheath between insulation metallic screen and armouring.
- 5.2.8 For multicore cables, the armouring shall be by galvanized steel strips as per method (b) of IS7098 (Part-2). 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.
- 5.2.9 The outer sheath of the cables shall be applied by extrusion over the armouring and shall be of PVC compound conforming to the requirements of Type ST 2 compound of 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: 7098 (Part-2)
- 5.2.10 The thickness of the insulation, inner sheath shall be governed by values given in IS: 7098 (Part -2).
- 5.2.11 Where specified, 1100V grade power cables shall also be XLPE insulated and shall meet the requirement specified in IS-7098 (Part-1).

6.0 FABRICATION

- 6.1 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.
- 6.2 Outer sheath of all PVC and XLPE cables shall be black in colour and the minimum value of oxygen index shall be 29 at $27 + 2^{\circ}\text{C}$. In addition suitable chemicals shall be added into the PVC compound of the outer sheath to protect the cable against rodent and termite attack.
- 6.3 All cables covered in this Specification shall be flame retardant (FR) 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-I0810 (Part-62) category AF.
- 6.4 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.
- 6.5 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 $\pm 2\text{ mm}$, up to overall diameter of 60mm and $\pm 3\text{mm}$ for beyond 60mm.
- 6.6 PVC / Rubber end caps shall be supplied free of cost for-each drum with a minimum range of eight per thousand meter length. In addition, ends of the cables shall be properly sealed with caps to avoid ingress of water during transportation and storage.

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- 6.7** 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.

7.0 INSPECTION AND TESTING

- 7.1** 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 Consultant /Owner Manufacturer shall furnish all necessary information concerning supply to Consultant/ 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.

7.2 CABLES

- 7.2.1 After completion of manufacture of cables and prior to dispatch, the cables shall be subjected to type, routine, acceptance and special tests as detailed below. Consultant/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 dispatch of the cables.
- 7.2.2 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 1), and IS:1098 (Part 2) on PVC and XLPE insulated cables respectively.
- 7.2.3 The test requirements for PVC insulation and sheath of cables shall be as per latest revision of IS: 5831.
- 7.2.4 Test for Resistance to Ultra Violet Radiation: This test shall be carried out as per DIN 53387 or ATM-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 Consultant before dispatch 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 dispatch clearance of cables. Sampling for this test is to be done randomly once for each order, provided outer sheath remains same.
- 7.2.5 Acceptance tests as per IS-1554 (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 Consultant/owner before dispatch 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 Consultant before dispatch clearance of cables. In case test certificates are not available, test is to be conducted by Vendor at

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his own cost in any recognized test laboratory or in house testing laboratory, before dispatch 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 recognized testing laboratory to be furnished for review by Consultant before dispatch 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 dispatch 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.
- 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.
 - i. Part-61-The cable meets the requirement if there is no visible damage on the test specimen within 300 mm from its upper end.
 - ii. 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.

7.3 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 dispatch.

8.0 MARKING, PACKING AND SHIPMENT

8.1 Cables shall be dispatched 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.

8.2 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 meters, 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.

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

8.2.1 MV CABLES

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a. Multicore power cables upto 6mm ²	:1000m
b. Multicore power cables from 10mm ² up to 300mm ²	: 500m
c. Single core power cables upto 630 mm ²	: 1000m
d. Control cables upto 61 cores	:1000m

8.2.2 HV POWER CABLES – UPTO 11KV (E) GRADE

a. Three core cables upto 400 mm ²	:500m
b. Single core cables upto 400 mm ²	:1000m
c. Single core cables above 400 mm ² and upto 630 mm ²	:750m

8.2.3 HV POWER CABLES – ABOVE 11KV (E) GRADE AND UPTO 33KV (E)

a. Three core cables upto 300 mm ² grade	:350 m
b. Single core cables upto 400 mm ²	:1000m
c. Single core cables above 400 mm ² and upto 1000 mm ²	:500m

8.2.4 A tolerance of plus or minus 3 % shall be permissible for each drum. However overall tolerance on each size of cable shall be limited to $\pm 2\%$. 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.

9.0 SPARES & ACCESSORIES

- 9.1** 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.
- 9.2** The accessories shall be supplied in kit form. Each component of the kit shall carry the manufacturer's mark of origin.
- 9.3** 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.
- 9.4** 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.

9.5 TERMINATING KITS

- 9.5.1 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 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.

9.6 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

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FOR
MEDIUM AND HIGH VOLTAGE CABLES**

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 mentioned in the Data Sheet.

**STANDARD SPECIFICATION
FOR
FLAME PROOF LIGHTING ND POWER PANELS**

**STANDARD SPECIFICATION
FOR FLAME PROOF LIGHTING AND
POWER PANELS**

ABBREVIATION

BIS/IS	Bureau of Indian standards
IEC	International Electro-Technical Commission
BS	British Standards
IEEE	Institute of Electrical and Electronics Engineers
NEMA	National Electrical Manufacturers Association
OISD	Oil Industries Safety Directorate
CCE	Chief Controller of Explosive
DGMS	Director General Mines Safety
IE Rules	Indian Electricity Rules
CPRI	Central Power Research Institute
TPN	Triple Pole Neutral
SPN	Single Pole Neutral
FRP	Fiber Reinforced Concrete
SS	Stainless Steel
GI	Galvanized Iron

**STANDARD SPECIFICATION
FOR FLAME PROOF LIGHTING AND
POWER PANELS**

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**STANDARD SPECIFICATION
FOR FLAME PROOF LIGHTING AND
POWER PANELS**

1.0 SCOPE

This Specification covers the requirements of design, manufacture, testing, packing and supply of flameproof Lighting and Power panels/ accessories suitable for installation in locations handling flammable liquids and gases.

2.0 REFERENCE DOCUMENTS

2.1 The equipment shall comply with the requirements of latest revision of the following standards issued by BIS (Bureau of Indian Standards), unless otherwise specified:

IS-5: Colours for ready mixed paints and enamels.

IS-1248 (Parts 1 & 2): Direct acting indicating analogue measuring instruments and their accessories.

IS-2148: Flameproof enclosures for electrical apparatus.

IS-5571: Guide for selection of electrical equipment for hazardous areas

IS-8828: Specifications for Circuit breakers for Over current protection for household and-similar installations

IS-12640: Residual current operated circuit breakers.

IS-13346: General requirements for electrical apparatus for explosive gas atmosphere.

IS-13408 (Part-1): Code of practice for the selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres (other than mining applications or explosives processing and manufacture).

IS-13947 (Parts 1 & 5): L.V. Switchgear and Control gear.

2.2 Imported equipment shall conform to the International Standards such as IEC/ BS/ VDE/ NEMA or equivalent.

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/ NEMA or equivalent agency shall be applicable.

2.5 In case of any contradiction between various referred Standards/ Specifications/ at a Sheet and statutory regulations, the following order of decreasing priority shall govern:

a. Statutory Regulations

**STANDARD SPECIFICATION
FOR FLAME PROOF LIGHTING AND
POWER PANELS**

- b. Data Sheets
- c. Job Specification
- d. Standard Specification
- e. Codes and Standards.

3.0 DEFINITIONS

3.1 For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

OWNER / COMPANY	OWNER of the particular Project (Project Specific).
CONSULTANT	The party which is doing engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
BIDDER / SUPPLIER / VENDOR	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.

4.0 MATERIALS

4.1 The enclosures of the lighting and power panels shall be made of cast light metal alloy and shall be free from frictional sparking hazard. The magnesium content in the alloy shall be as per IS-13346.

5.0 DESIGN

5.1 GENERAL REQUIREMENTS

5.1.1 The offered equipment shall be brand new with state of art technology and proven field track record. No prototype equipment shall be offered.

5.2 POWER SUPPLY

5.2.1 Unless otherwise specified, lighting and power panels shall be suitable for 415V, 50Hz, three phase and neutral (TPN) incoming supply and outgoing circuits for 240V, single phase and neutral (SPN).

5.2.2 For lighting and power panels falling under the jurisdiction of DGMS, the following additional requirements shall apply:

- a. The phase-to-phase voltage shall not exceed 250 volts.
- b. The panels shall have 415V, three phase, 4-wire system.
- c. Earth leakage protection shall be provided for all outgoing circuits, which shall isolate both poles.

5.3 TECHNICAL REQUIREMENTS

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FOR FLAME PROOF LIGHTING AND
POWER PANELS**

5.3.1 COMPOUND SPECIFICATION

- a. Busbars in the lighting and power panels shall be made of high-conductivity copper and shall be supported by non-hygroscopic insulators. Busbars shall be colour coded for identification of phases and neutral.
- b. Unless otherwise specified, the incomer shall have one no. 4 pole 40A MCB isolator (without overload and short-circuit release) and one no. 4 pole ELCB. ELCB's shall have a maximum sensitivity of 30mA.
- c. Unless otherwise specified, the outgoing feeders shall be provided with double pole 10A MCBs having overload and short-circuit releases.
- d. Unless otherwise specified, all MCBs (except isolators) and ELCBs shall be with 9kA (M9. category) interrupting capacity.
- e. The ELCB. shall be hand reset type one no. door mounted reset push button shall be provided.
- f. The operating knobs (ON/ OFF/ RESET) shall be. provided with a suitable rack and pinion arrangement for operating them smoothly from outside.

5.3.2 TERMINAL & WIRING

- a. The panels shall be provided with sufficient number of terminals. More than 2 wires per terminal shall not be permitted. If required, additional terminal with shorting link may be used. Unless otherwise specified, the terminals for termination of incoming and outgoing external cables shall be suitable for termination of upto 70 mm² and 6 mm² copper conductors respectively. Terminals shall be suitable for termination of solid conductors upto 6 mm² and stranded conductors above 6 mm². Wherever lugs are required for cable termination, tinned copper type lugs shall be provided.
- b. All internal wiring in lighting and power panels shall employ adequately sized, 660V grade, PVC insulated copper conductor wires, colour coded for phase, neutral and earth, with minimum conductor sizes as below:
 - i. Incomer 16 mm²
 - ii. Outgoing 2.5 mm²

6.0 FABRICATION

- 6.1** The enclosures of the lighting and power panels shall be made of cast light metal alloy and shall be free from frictional sparking hazard. The magnesium content in the alloy shall be as per IS-13346. The temperature of external surfaces shall be limited to 200°C, unless otherwise specified. The enclosures shall be sized to facilitate easy maintenance and heat dissipation.
- 6.2** The panels shall be suitable for use in outdoor open locations and shall have IP-55 degree of protection. They shall preferably be provided with integral canopy. However, where the enclosure has been certified without integral canopy, a separate canopy can be accepted. The separate canopy shall be made of at least 14 SWG (2mm) galvanised sheet steel or FRP. The canopy shall be suitable for providing protection against rain from top and two sides.

**STANDARD SPECIFICATION
FOR FLAME PROOF LIGHTING AND
POWER PANELS**

6.3 The lighting and power panels shall be provided with gaskets made of non-inflammable and self-extinguishing material.

6.4 The enclosures shall be treated and prepared for painting with two coats of epoxy paint with final colour shade (both internal and external) as below:

Flame proof (Gas group IIA/IIB) : Dark admiralty grey shade 632 of IS-5

Flame proof (Gas group IIC) : Light yellow shade 355 of IS-5

6.5 A warning inscription "Isolate power supply elsewhere before opening" shall be provided on each enclosure. The warning inscription shall be embossed on the enclosure or a separate warning plate with above inscription shall be fixed to the enclosure with screws. The warning shall be of nickel plated brass or stainless steel. accessories like nuts, bolts, washers etc. shall be made of stainless steel SS-304.

6.6 All the non-current carrying metallic parts of the panel shall be inherently bonded together. Each lighting and power panel shall be provided with two earthing studs with lugs on the exterior of the panel enclosure suitable for termination of 10 mm dia GI wire rope.

6.7 Each outgoing feeder shall be provided with distinct terminals for phase, neutral and earth. The terminal block enclosures shall be adequately sized to properly terminate the cables by taking into account the required bending radii of cable cores and shall have the following minimum gland to terminal distances.

Conductor size	Up to 2.5mm ²	Above 2.5mm ² & up to 10mm ²	Above 10mm ² & up to 35mm ²	Above 35mm ² & upto 70mm ²
Distance	40 mm	60 mm	100 mm	150

6.8 The panels shall be provided with suitably sized cable entries at the bottom/sides, for incoming and outgoing cables. Panels shall be complete with double compression type nickel plated brass flameproof cable glands. Flameproof nickel plated brass sealing plugs shall be supplied, for plugging the unused cable entries. The quantity of sealing plugs shall be equal to 20% of the total number of outgoing cable entries.

6.9 The panels shall have external fixing lugs for mounting on wall or column. The holes, provided on these lugs shall be of oblong type.

6.10 A nameplate indicating TAG No. shall be provided on each panel Nameplates shall also be provided for each incoming and outgoing feeder Separate nameplate shall also be provided to indicate the details of testing agency (CIMFR or equivalent), test certificate no. with date, statutory approval no. with date and agency (PESO/ CCE/ DGFASLI/ DGMS), BIS license number and date, applicable gas group etc.

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The nameplates shall be engraved on 3 ply black white black lami cold Sheds using square cutters. Black engraved per spex sheet nameplate shall also be acceptable. Nameplates shall be fixed by screws and shall not be pasted. In case the standard details given above are embossed on the enclosures, the same need not be repeated on the name plate.

7.0 INSPECTION AND TESTING

7.1 During fabrication, the equipment shall be subjected to inspection by Consultant/ Owner -or by an agency authorised by the Owner, if specified/ agreed in Inspection Test Plan. Manufacturer shall furnish all necessary information concerning the supply to Consultant / Owner's inspector. All routine/ acceptance tests shall be carried out at manufacturer's works under his care and expense.

7.2 Type test certificates from CIMFR or equivalent test house, applicable PESO/ CCE/ DOFASLI/ DGMS approval, certificates, BIS license and original drawings referred in type test Certificates shall be shown to the inspection agency on demand during inspection. The certificates and BIS license must be valid at the time of despatch.

7.3 Test certificates of bought out components shall be shown to the inspection agency on demand during inspection.

7.4 All equipments shall be subjected to various acceptance tests as per standards but not limited to the following:

- a. General visual inspection
- b. Dimensional inspection
- c. Verification of electrical operations
- d. Dielectric tests
- e. Routine pressure test as per IS-2148
- f. Any other routine and acceptance test as per applicable Standards.

7.5 Type tests shall be carried out if specified in Data Sheet/ job Specification.

7.6 CERTIFICATION

7.6.1 The equipment shall have test certificates issued by recognised independent test house (CIMFR/ CPRI/ ERTL/ Baseefa/ LCIE/ UL/ FM or equivalent). All indigenous equipment shall conform to Indian standards and shall be certified by Indian testing agencies. All equipment (indigenous & imported) shall also have valid statutory approvals as applicable for the specified location. All indigenous flameproof equipment shall have valid BIS license and parking as required by statutory authorities.

8.0 MARKING, PACKING AND SHIPMENT

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FOR FLAME PROOF LIGHTING AND
POWER PANELS**

- 8.1** All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for the selected mode of transportation, i.e. by ship/ rail-or trailer and shall be wrapped in polythene sheets before being placed in crates/ cases to prevent damage to finish. The crates/ cases shall have skid bottom for handling. Special notations such as `Fragile', This side up, `Center of gravity', `Weight', `Owner's particulars', `PO no.' etc, shall be clearly marked on the packages together with other details as per Purchase Order.
- 8.2** The equipment may be stored in a covered shed for long periods before installation. The packing should be suitable for such storage.

**STANDARD SPECIFICATION
FOR
LIGHTING FITTINGS FOR HAZARDOUS LOCATION**

**STANDARD SPECIFICATION
FOR
LIGHTING FITTINGS FOR HAZARDOUS LOCATION**

ABBREVIATION

BIS/IS	Bureau of Indian standards
IEC	International Electro-Technical Commission
BS	British Standards
IEEE	Institute of Electrical and Electronics Engineers
NEMA	National Electrical Manufacturers Association
OISD	Oil Industries Safety Directorate
CCE	Chief Controller of Explosive
DGMS	Director General Mines Safety
IE Rules	Indian Electricity Rules
CPRI	Central Power Research Institute
CIMFR	Central Institute of Mines and Fuel Research
MSL	Mean Sea Level

**STANDARD SPECIFICATION
FOR
LIGHTING FITTINGS FOR HAZARDOUS LOCATION**

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**STANDARD SPECIFICATION
FOR
LIGHTING FITTINGS FOR HAZARDOUS LOCATION**

1.0 SCOPE

- 1.1** The intent of this specification is to define the requirements of lighting fixtures and accessories suitable for installation in classified hazardous locations.

2.0 REFERENCE DOCUMENTS

- 2.1** In general the equipment covered by this Specification shall, unless otherwise specified, conform to the latest edition of Indian Standards/International Standards but not limited to the following:

a.	IS-2148	Flameproof enclosures for electrical apparatus
b.	IS-5572 (Part-1)	Classification of hazardous area (other than mines) for electrical installation.
c.	IS-5571	Guide for selection of electrical equipment for hazardous areas.
d.	IS-8239	Classification of maximum surface temperature of electrical equipment for use in explosive atmosphere.
e.	IS-6381	Construction and testing of electrical apparatus with type of protection
f.	IS-8289	Electrical equipment with type of protection 'n'.
g.	IS-2206 (Part 1 to 4)	Flameproof electric lighting fittings (well glass and bulk head type, fittings using glass tubes).
h.	IS-8224	Electrical lighting fitting for division 2 areas.
i.	IS-1913 (Part-I)	General and safety requirements for Luminaires.

Wherever the requirements in this specification are in conflict with any of the above Standards, the requirements under this specification shall be binding.

3.0 DEFINITION

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

OWNER / COMPANY	OWNER of the particular Project (Project Specific).
CONSULTANT	The party which is doing engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
BIDDER / SUPPLIER / VENDOR	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.

4.0 DESIGN

4.1 GENERAL

4.1.1 The equipment shall be suitable for installation and satisfactory operation in classified hazardous locations in tropical, humid and corrosive atmosphere as prevalent in refineries/petrochemical plants or as specified in Material Requisition/ Data Sheet. If not specifically mentioned therein, design ambient temperature of 40°C and altitude not exceeding 1000 m above MSL shall be considered.

4.1.2 Unless otherwise specified, equipment shall be suitable for 220 - 250 volts, single Phase and neutral, 50Hz. +3% power supply.

4.1.3 All equipment shall be tested and certified by independent authority for use in specified gas group locations. Certification number/data and gas group/temperature classification must be indicated on the manufacturer's name plate on each item. All flameproof equipment shall have BIS marking which must be indicated on the manufacturer's name plate. All equipment for use in hazardous area shall be approved by CCE/DGMS as applicable.

4.1.4 POWER SUPPLY

Unless otherwise specified, equipment shall be suitable for 220 – 250 volts, single phase and neutral, 50Hz $\pm$ 3% power supply.

5.0 FABRICATION (TECHNICAL REQUIREMENT)

5.1 All equipment shall be suitable for use in outdoor open locations and shall have IP55 degree of protection.

5.2 The body of the lighting fixtures, control gear box and junction boxes shall be of cast aluminium LM-6 alloy and shall be free from frictional sparking hazard. The temperature rise of external surfaces shall be limited to 200°C, unless otherwise specified.

5.3 LIGHTING FIXTURES

5.3.1 The construction of lighting fixture shall be such that replacement of lamp or any normal maintenance of fixture shall not affect their suitability for use in classified area.

5.3.2 Glass used for lighting fixture shall be clear suitable for use under conditions involving exceptional risk of mechanical damage.

5.3.3 Well glass lighting fixture for zone-2 classified area shall meet requirement of IS-6381. Mechanical strength of well glass shall satisfy requirement of IS-2206 (for type A glass) for flame proof lighting fixtures and IS-6381 for Div.2 lighting fixtures. All well glass fixtures shall be provided with a galvanised steel wire protective cage having mesh dimensions not exceeding 50mm.

5.3.4 Glass used for aviation and navigational lighting fixture shall be coloured in itself. Painted glass shall not be accepted.

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- 5.3.5 Glass shall be of approved make or as specified in Material Requisition.
- 5.3.6 The fixing parts of the enclosure which is to be opened for replacement of bulb shall be so fastened that they can be unfastened only with special tools. All fixtures shall carry a special warning inscription in English "Isolate supply elsewhere before opening".
- 5.3.7 All lighting fixtures which are not certified as flameproof construction but approved for use in Zone-2 area shall have approved enclosed break lamp holder and complete enclosure certified as having restricted breathing type construction. Lamp holder shall be screw type.
- 5.3.8 All lighting fixtures suitable for discharge lamps shall be provided with one 3/4 "ET threaded entry and supplied with approved type double compression nickel plated brass cable gland.
- 5.3.9 All lighting fixtures suitable for incandescent lamps shall be provided with two 3/4 "ET threaded entry. Two entries shall be used 'for looping of circuit 'wherever required. The fixtures shall be supplied with approved type two double compression nickel plated brass cable glands and one threaded plug for sealing unused entry.
- 5.3.10 The top of all well glass lighting fixtures shall be identically drilled / threaded to facilitate the installation on pole/column or ceiling.
- 5.3.11 All flood lighting fixtures shall be supplied with adjustable mounting arrangement both in horizontal and vertical plane.

5.4 CONTROL GEAR BOX

- 5.4.1 Lighting fixtures suitable for discharge lamps shall be provided with power factor, correction capacitor, choke starter to be housed .in separate control gear box. The choke shall be copper wound. The complete control gear shall have power factor not less than 0.9. All components shall be of approved make or as specified in Material Requisition.
- 5.4.2 Control gear box shall be provided with three 3/4 ET threaded entry (Incoming supply to lighting fixture and for looping to other Fixture/Control gear box). The control gear box shall be supplied with approved type three double compression nickel plated brass cable glands and one threaded plug for sealing unused entry.
- 5.4.3 Control gear box for flame proof fixtures shall be flameproof type and for div.2 or increased safety fixtures shall be increased safety type unless specified otherwise in the material requisition.

5.5 JUNCTION BOXES

- 5.5.1 The junction boxes shall be 3 way or 4-way type as specified in material requisition. All junction boxes for looping of single phase lighting circuits using cables upto 4mm shall be minimum 100mm diameter in size. Each junction box shall be complete with requisite number of ET threaded cable entries and with approved type double compression nickel plated brass cable glands and one threaded plug for sealing unused cable entry.

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FOR
LIGHTING FITTINGS FOR HAZARDOUS LOCATION**

5.6 TERMINALS & WIRING

- 5.6.1 All equipments shall be provided with sufficient number of terminals. More than 2 wires per terminal shall not be permitted. If required, additional terminal with shorting link may be used. Each terminal for external cable connection shall be suitable for termination of 4mm² copper conductor or as specified in material requisition using crimped type tinned copper lugs. All terminals shall be of non-sparking, anti-loosening design such that they do not produce any arc or spark in normal operation.
- 5.6.2 Flexible wires used for internal wiring shall be minimum 1.5mm² copper conductor and connections, shall be done using crimped type tinned copper lugs.
- 5.6.3 Terminals shall be of approved make or as specified in Material Requisition.
- 5.6.4 All equipments on single phase supply shall be provided with an independent earth terminal inside the enclosure for connecting the earth core of the cable and shall have facility for looping.
- 5.6.5 All the hardware shall be cadmium plated whereas clamps and supporting brackets shall be hot dip galvanised. The galvanising shall be 610gms/m for clamps and 900gms/m² for supporting brackets. All gaskets shall be of neoprene.
- 5.6.6 External surfaces of all the equipments shall be treated and prepared for painting with two coats of epoxy paint to shade 632 as per IS-5.

6.0 INSPECTION, TESTING & ACCEPTANCE

- 6.1 During fabrication, the equipment shall be subjected to inspection by Consultant / Owner or by an agency authorised by the Owner. Manufacturer shall furnish all necessary information concerning the supply to Consultant /Owner's inspector. Tests shall be carried out at manufacturer's works under his care and expense. 4 weeks prior notice shall be given before date of commencement of test for witnessing by Consultant /Owner's authorised representative. The test certificate indicating test result shall be furnished.
- 6.2 CMRS test certificates along with CCE/DGFASLI/DGMS approval certificates as applicable shall be furnished for each type of fixture. All equipments shall be routine tested as per applicable Indian standards.
- 6.3 During inspection, facility shall be provided for impact testing of random sample. One well glass of each fixture type from each lot shall be tested for impact strength

7.0 PACKING & SHIPMENT

- 7.1 The equipment shall be shipped to site packed in wooden crates. They shall be wrapped in polyethylene sheets before being placed in crates to prevent damage to the finish. The crates shall have skid bottoms for handling.

**STANDARD SPECIFICATION
FOR
ELECTRICAL EQUIPMENT INSTALLATION**

**STANDARD SPECIFICATION
FOR
ELECTRICAL EQUIPMENT INSTALLATION**

ABBREVIATION

BIS/IS	Bureau of Indian standards
IEC	International Electro-Technical Commission
BS	British Standards
IEEE	Institute of Electrical and Electronics Engineers
NEMA	National Electrical Manufacturers Association
OISD	Oil Industries Safety Directorate
CCE	Chief Controller of Explosive
DGMS	Director General Mines Safety
IE Rules	Indian Electricity Rules
CPRI	Central Power Research Institute
AC	Alternating Current
DC	Direct Current
CP	Cathodic Protection
SCADA	Supervisory Control And Data Acquisition
HV	High Voltage
MV	Medium Voltage
LV	Low Voltage
ACDB	Alternating Current Distribution Board
DCDB	Direct Current Distribution Board
CT	Current Transformer
PT	Potential Transformer
IR	Insulation Resistance
CTC	Carbon Tetra Chloride
MMI	Man Machine Interface

**STANDARD SPECIFICATION
FOR
ELECTRICAL EQUIPMENT INSTALLATION**

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**STANDARD SPECIFICATION
FOR
ELECTRICAL EQUIPMENT INSTALLATION**

1.0 SCOPE

- 1.1** Specification defines the requirements for the installation, field inspection, testing and commissioning of electrical equipment, forming part of electrical power distribution and utilization system, including communication and fire alarm system.

2.0 REFERENCE DOCUMENTS

- 2.1** The work shall be carried out in the best workmanlike manner in conformity with this specification, Consultant Installation Standards, layout drawings and to the following specifications/ codes of practice of Bureau of Indian Standards and OISD standards.

SP-30(BIS)	National Electrical Code.
IS-7816	Guide for testing Insulation resistance of rotating machines.
IS 10028(Part-2)	Code of practice for selection, Installation and maintenance of transformers; Part 2: Installation.
IS 10118(Part-3)	Code of practice for selection, installation and maintenance of switchgear and control gear Part 3 Installation.
OISD 137	Inspection of Electrical Equipment.
OISD 147	Inspection and safe practices during electrical installations

- 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).
- e. Any other regulations laid down by central/state/local authorities and Insurance agencies.

3.0 INSTALLATION

- 3.1** Prior to start of installation of the electrical equipment contractor shall verify that equipment and complete materials have been received. Handling, shifting to required site location, installation, testing and commissioning of all electrical equipment shall be done by contractor with utmost care. Manufacturer's instructions and the requirements given in their technical manuals shall be strictly adhered. The substation/switchgear room wherein the equipment shall be installed shall be kept clean, dry and-free from all debris. Panel floor cutouts not in immediate use shall be suitably covered to avoid any mishap. When handling the switchboard panels, care shall be taken to observe the correct lifting arrangements and to make sure that slings are attached to the manufacturer's designated lifting

**STANDARD SPECIFICATION
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points. No parts shall be subjected to undue strains or sudden stresses which could cause damage to the equipment.

- 3.2** The lifting position mark indicated on packing casing shall be adhered to strictly, for keeping it in required vertical position.
- 3.3** Contractor shall check and report to the Engineer-in-charge about any damaged item and / or missing component for getting the same replaced as per Specifications. During installation, all accessories and loose items shall also be inspected by the contractor before their assembly/mounting.

3.4 SWITCHBOARDS AND BUS DUCTS

- 3.4.1** The term switchboard here includes all HV / MV/ LV switchboard panels, motor control centers, power and lighting distribution boards, UPS panels, ACDB, charger panels, DCDB etc. The switchboard panels shall be handled with care, avoiding any impact to the equipment. Dragging of the panels directly on floor shall be avoided. Roller bars may be used for shifting of panels. Use of a crane and trailer shall be made for handling of equipment. The switchboard panels shall be properly supported on the truck or trailer by means of ropes to avoid any chance of tilting. The switchboards shall be lifted after ensuring that panel supports, nuts and bolts are all intact and tightened. While lifting the panels in packed conditions utmost care shall be taken to avoid any damage to insulators, bushings, metering and protective equipment. The panels shall be preferably kept inside the packing cases till foundations are ready.
- 3.4.2** The switchboard panels shall be installed on prepared foundations or floor cutouts. Steel base channels shall be welded to inserts provided in floor slab. Cross members shall be provided at the junctions of each shipping section and other places as required. Alternatively, when the floor is being laid, base channel frame of panels supplied by the Vendor shall be grouted and leveled in cement concrete. It shall be ensured that the base plate level of HV switchboard shall match with the finished floor level. The foundation pockets and the grouted bolts shall be cured for a minimum period of 48 hours.
- 3.4.3** The switchboard panels shall be taken out from the packed cases and shifted one by one to its proper place. All the panels shall be assembled, aligned and leveled. Alignment of panels shall be checked in both longitudinal and lateral directions. It shall be ensured that panel to panel coupling bolts, bus bar links etc. fit properly without any strain on any part. No new holes for jointing of the panels other than those recommended by the Vendor shall be drilled. No gaps shall be left between the panels. The lifting, racking in and out operation of the breaker and all other motions shall be free from any obstruction.
- 3.4.4** The panels shall be checked for correct vertical position using pendulum weight and spirit levels. The switchboard panels shall be tack welded at suitable intervals at base channel.
- 3.4.5** After erection of switchboard panels, all uncovered portions of floor cutouts shall be covered with 6 mm thick removable chequered plates finished with floor level. The design of the chequered plates shall be such that the maximum allowable

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deflection is $L/200$ (where L is the span of the checkered plates in meters) for alive load of 500 kg/sq. meters. Suitable lifting arrangements shall be provided for checkered plates. The checkered plates shall be painted with a coat of red oxide zinc chromate primer after proper surface preparation as per specifications. Where specified, panel's cutouts provided for future use shall be filled with lean concrete.

- 3.4.6 After completion of erection of switchboards, all the cubicles, switchboard components such as switches, starters, C.T. and P.T. chambers, bus bar chamber shall be cleaned and checked for tightness of all the components. Vacuum circuit breakers shall be checked for integrity of bottle seals. All loosely supplied items shall be fitted up. Bus bar sections or links shall be inserted and where specified, of high voltage equipment shall be insulated. Interconnection wiring between shipping sections shall be made by contractor. All the wiring connections shall also be checked. Phase sequence and polarity of PTs and CTs shall be checked. Contact resistance of all bus bar joints and contactors shall be checked. Insulator shall be checked for any damage. All the starters, switches, contacts shall be cleaned with C.T.C. where required. All the moving parts shall be checked for easy and free movement. Hinges of panel doors shall be lubricated to give free and noise free movement. All -openings shall be kept completely closed to avoid ingress of any foreign particles inside the panel.
- 3.4.7 Functional scheme verification of individual feeder shall be carried out and minor wiring modifications in the panel wiring, if required shall be done as per the directions of Engineer-in-charge. Special attention shall be paid to CT circuits polarity, wiring continuity and correctness in the protection as well as measurement circuits. Auto transfer scheme shall be simulated and verified. During the course of scheme verification tests, defective components if any shall be taken out, after bringing to the notice of Engineer-in-charge. The same shall be replaced by component supplied by Owner.
- 3.4.8 Where switchboard is damp or having a low IR value due to damaged insulators/ bushings/any other insulated parts, or any other reason, the entire-switchboard shall be dried up according to the instruction of the Engineer-in-charge for the IR value-to improve to a safe level for commissioning. Care shall be taken to protect the surrounding insulation from direct local heating during the drying up process.
- 3.4.9 All the metering instruments, protective relays and other relays and contactors shall be tested as per manufacturer's recommendations and according to the instructions of the Engineer-in-charge. Protection relays shall be inserted and connected and settings adjusted as required by the Engineer- in- charge.
- 3.4.10 All moving parts, of closing/tripping mechanism racking in and racking out mechanism, spouts and shutter closing mechanism shall be checked for proper

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operation. All the auxiliary contacts of breaker shall be checked-up cleaned and contact pressure measured.

3.4.11 All the control wiring, PTs, bushings, bus bars other live parts of switchgear, incoming and out going cables shall be megger tested.

3.4.12 Electrical simulation tests shall be named out for all the protective alarm and annunciation relays and external interfaces to ascertain proper functioning.

3.4.13 Safety insulation mats of approved make and of required voltage grade shall be provided in the sub-station.

3.4.14 Pre-Commissioning Checklist

Before commissioning any switchboard, following points shall be checked and ensured for safe energizing of the switchboard:

- a. That the installation of equipment to be commissioned is complete in all respects with its auxiliaries and all other mounting including earthing. Openings in floor within and outside panels have been sealed off. All cover and door gaskets are intact to-make the enclosure ever min proof.
- b. That all the metering instruments have been checked and found in working order. Indicating lamps are healthy and are in correct position. All power and control fuses are of proper rating.
- c. That the polarity test and ratio test of all the PT s and CT s is complete and phase sequence of CTs conforms to the correct vector group connections. Wiring continuity and correctness are ensured in the protection and measurement circuits. Polarity of D.C. supply for all the circuits-is correct.
- d. That the high voltage tests of incoming and outgoing cables have been conducted and results are satisfactory.
- e. That all the protective relays including both conventional and microprocessor based numerical relays and thermal overload relays have been tested for secondary injection tests. (Primary injection tests shall be carried out for differential protection, Restricted Earth fault protection at full / reduced current to ensure correctness of complete wiring). Relay settings, status indications, fault annunciations, data logging, and display of switchboard SLDs shall be verified from MMI in case the same is provided.
- f. That I.R. Value have been recorded for bus bars, circuit breaker, incoming and outgoing cables, control wiring and potential transformers. Where required joint resistance of bus bars have been recorded and found to be satisfactory. All the surroundings and panels have been cleaned and temporary earth leads have been removed.

3.4.15 Bus Ducts:

The bus ducts as per issued drawings will be supplied in parts and all the parts shall be assembled and the bus bar connections shall be made at site. The insulators in

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bus ducts shall be inspected for any possible damage during transit and the defective ones shall be replaced. The insulators shall be cleaned. Contact surface of bus bars, bus bar bolts and nuts shall be thoroughly cleaned. Petroleum jelly shall then be applied and bolted connection made. The bus duct enclosure shall be checked for earth continuity and then earthed at two places. The bus duct shall be properly supported between switchgear and transformer. The opening in the wall where the bus duct enters the switchgear room shall be completely sealed to avoid rain water entry. Expansion joints, flexible connections etc. supplied by the manufacturer of the bus duct shall be properly connected. The bus duct leveling shall be checked with spirit level and pendulum weight.

3.5 TRANSFORMERS

- 3.5.1 Transformers on receipt at site shall be unloaded by means of crane or lifting devices of adequate capacity. All lifting lugs shall be used to avoid unbalanced lifting and undue stresses on lugs. Lifting lugs if any provided for partial lifting (e.g. for. active part, conservator) etc. shall not be used for lifting complete transformer. Parts other than those identified for lifting of the transformer shall not be used for lifting. While slinging, care shall be taken to avoid slings touching other parts.
- 3.5.2 Before lifting transformer, it shall be ensured that all cover bolts are tightened fully. In case when it is necessary to use jacks for lifting, projections provided for the purposes of jacking shall be used. Lifting jacks shall not be used under the valves or radiator tubes. For transporting transformers from stores to site, the transformers shall be loaded on a suitable capacity truck or trailer. The transformers shall be properly supported by steel ropes and stoppers on the trailer to avoid tilting of the transformers in transit due to jerks and vibrations. At no instance the transformer shall be kept on bare ground. Where it is not possible to unload the transformer directly on a foundation, it shall be unloaded on a properly built wooden sleeper platform. A transformer shall never be left without putting stoppers to the wheels.
- 3.5.3 Transformers shall be examined, for any sign of damage in transit Particular attention shall be given to the following in this regard.
- a. Dents on tank wall or cooling tubes.
 - b. Damage to protruding parts like valves, sight glass etc.
 - c. Loosening of bolts due to vibration in transit.
 - d. Cracked or broken bushings.
 - e. Oil leakage particularly along welds.

Anything adverse is noted the same shall be brought to the notice of Engineer- in-charge.

- 3.5.4 Contractor shall examine the transformer base, oil pit, fire walls and foundations laid by the civil contractor. It shall be ensured that oil spills cannot propagate along cable trenches. Any discrepancy noted will be brought to the notice of Engineer- in- charge. Transformers shall be placed on channels or rails over concrete foundation. The transformers shall be leveled, aligned and checked for free movement on the channels or rails. Stoppers shall be provided to the transformer

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immediately to prevent any movement. Normally transformers up to 1000 kVA rating shall be received duly fitted-with radiator tubes, conservator tanks, valves, wheels and other accessories. While the transformers of above 1000 kVA rating may be supplied with loose accessories. All the accessories like radiators, cooling fans, valves, conservator tanks, explosion vent pipe, bushings and other devices which are supplied indifferent packages shall be checked for any transit damage and cleaned thoroughly before fixing on the transformer. All loosely supplied parts shall be assembled as per manufacturer's instruction manuals/ drawings and documents. All the connections for C.T.s bushings and other wiring shall be checked for tightness and correctness before replacing the lid or tightening all the bolts.

3.5.5 TOPPING OF TRANSFORMER WITH OIL

Before topping up with oil, transformer shall fitted with all accessories such as valves, gauges, thermometers etc. Oil samples shall be taken from each drum and tested for determination of dielectric strength. Any sign of leakage of the barrel or of its having been opened shall be recorded and reported. It is necessary to filter the oil before the transformers are filled. It shall be ensured in oil filling operation that no air pockets are left in the tank and that no dust or moisture enters the oil. All air vents shall be opened. Oil shall be filled through a Streamline oil filter using metal hose. To prevent aeration of the oil, the transformer tank shall be filled through the bottom drain valve. In a transformer with conservator tank, the rate of oil flow shall be reduced when the level is almost up to the bottom of the main cover to prevent internal pressure from rupturing the pressure relief-pipe diaphragm. Sufficient time shall be allowed for the oil to permeate the transformers and also for the locked -up air bubbles to escape. Any air accumulation in the Buchholz relay shall be released.

3.5.6 TRANSFORMER OIL

- a. Sample of oil from the transformer shall be taken from the bottom of the tank.
- b. Testing of oil:

For dielectric test, the oil shall be tested as described in IS: 335. The oil shall also be tested for acidity in accordance with methods prescribed.

3.5.7 Drying out of the transformer's if required shall be carried out and record maintained in accordance with IS: 10028. Normally a streamline filter shall be used for drying-up. I.R. value versus time of both windings shall be recorded during the drying up process.

Precaution when drying:

- a. The maximum sustained temperature to which transformer oil may be subjected shall be limited to 80° C.
- b. The transformer shall be carefully monitored throughout the drying out process and all observations shall be carefully recorded
- c. Drying out shall be continued so that the insulation resistance as prescribed in the standard code of practice is attained and the value remains constant for more than 12 hours. However, a minimum number of cycles shall be done for each transformer as found necessary by the engineer-in-charge. Generally a megger

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reading of 2 mega ohms / KV at 60° C temp. with a 5 KV megger may be a rough indication for stopping the dehydration.

- 3.5.8 The following work on transformers shall be performed by the contractor if specifically called for:

Before finally commissioning the transformer it may sometimes be desired to run it for a few hours on short-circuit, applying a low voltage, approximately equal to the impedance voltage of the transformer. During this process, regular readings of the insulation resistance of the winding to earth and winding to winding and temperature against time shall be recorded.

Testing of radiator tubes for any leakage and rectifying these by welding / brazing.

- 3.5.9 PRE-COMMISSIONING CHECK LIST:

Before commissioning of any transformer, the following points shall be checked for safe energisation of the transformer:

- a. That all the accessories have been fixed properly and transformer body and neutral are properly earthed. The transformer dehydration is over and results are satisfactory and approved by the Engineer-in-charge. In case transformers are idle for more than one month after dehydration, transformer oil has been given at least two circulations.
- b. That the oil level, in the transformer conservator tank and all the bushings is up to the marked point and the oil have been tested for dielectric strength and acidity.
- c. That the silica gel is in reactivated condition. The breather pipe is clear from any blocking and contains oil up to the proper level.
- d. The explosion vent diaphragm does not have any dents. Accumulation of any oil and air had been released.
- e. That the operation of off-load and on-load tap changers on all the tap positions is satisfactory. The mechanical parts of the on-load tap changer are lubricated. Motor IR value has taken and found satisfactory. Tap position mechanical indicator on the transformer and tap position indication meter on the control panel are reading the same tap positions. Tap changer limit switches are operating satisfactorily on the maximum and minimum tap positions. On-load tap changer contact pressure and resistance is as per manufacturers recommendations. Oil level of tap changer tank is up to the required level and oil has been tested for dielectric strength. The tap setting on which the off-load tap switch is locked shall be recorded. Generally, the off-load tap switch shall be kept on nominal tap.
- f. That the Buchholz relay has been tested and checked up for any friction in the movement, and floats are free. All the other protective relays, alarm and annunciation relays have been tested.
- g. That all the metering equipment have been tested and polarity test of PT's and transformer winding is satisfactory. Phase sequence and connections have been checked for proper vector group.
- h. That the ratio test and winding resistance on all the tap positions is satisfactory.

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- i. That gaps of arcing horns for the bushings where provided are in order and earth connections for the surge diverters have been checked.
- j. That the winding and oil temperature thermometer -pockets contain oil and the winding and oil temperature settings on dial gauges are in order.
- k. That the transformers fitted with fans for forced air cooling have been checked up for automatic starting and stopping of the fans and air-displacement has been verified.
- l. That the simulation tests for all external interface connection alarm, annunciation and trip circuits have been checked and are order.
- m. That the insulation resistance of all the control circuits and IR value of the transformer windings and all the incoming and outgoing cables have been checked.
- n. That all the valves in the codling system and valve between the Buchholz relay and the conservator tank is in open position.
- o. That the setting of all the protective relays is at the desired value and D.C. Trip supply is healthy.

3.5.10 Observations after Commissioning:

After switching on-the transformer the following points shall be observed and recorded.

- a. The inrush magnetizing current and no load current.
- b. Alarm if any, or if any relay flag has operated.
- c. Voltage and current on all the three phases
- d. Transformer hums or abnormal noise.
- e. Circulation of oil and leakages.
- f. Record current, voltage, cooling air temperature, winding temperature and oil temperature readings, hourlyfor24hours.
- g. Cable end boxes for any overheating.

3.6 H.V. AND M.V. MOTORS

3.6.1 All the motors generally would be erected by the mechanical contractor.

3.6.2 Electrical contractor shall keep the, motor space heater energized, as per the directions of Engineer-in-charge. Electrical contractor shall measure the insulation resistance of motor windings. Insulation resistance of the motors shall be measured between the winding the machine and its frame by means of a 500/1000 V megger in case of 415 V motors. A minimum value of 1 mega ohm for415Vmotors shall be considered a safe value. In case of lower I.R. Value, the insulation value shall be improved by any of the following methods as directed by the Engineer-in-charge.

- a. Blowing hot air from external source.
- b. Putting the motor in oven.
- c. Placing heaters or lamps around and inside after making suitable guarding and covering arrangements so as to conserve the heat.

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- 3.6.3 In case the insulation is low, the following method of drying has to be adopted, after consultation with Engineer-in-charge. During drying the temperature rise of winding shall not exceed the permissible value for the class of insulation used.
- a. By locking the motor so that it cannot rotate and then applying such a low voltage to the stator terminals so as to pass full load current in the stator keeping the stator winding temperature below 90° C . In this case a close watch shall be kept for any possible overheating and I.R. Values vs. temperature shall be plotted and heating continued till I.R. value becomes steady.
 - b. By blasting hot air from external source, Maximum temperature of winding while drying shall be 70° C to 80° C (thermometer) or 90° C to 95° C by resistance method. Heating shall be done slowly first till steady temperature of winding is reached after 4 to 5 hours, and for large machines after 10 hours. A record has to be kept for drying process, with half an hourly readings and, till steady temperature is reached. In case it is essential, the drying process can be supplemented by blower.
- 3.6.4 It shall be ensured that the motor leads are correctly connected in the terminal box, as indicated in the 'Name Plate'. The covers of all terminal boxes shall be properly fixed, the gaskets intact. The control circuit shall be tested for proper functioning as per circuit diagram.
- 3.6.5 In case of synchronous machines, slip rings and brush gear shall be polished and brushes shall be fixed in their holders with clearance and pressure as recommended by the manufacturers.
- 3.6.6 Before commissioning, the ventilation and cooling system of the motor must be inspected. In case of motor with forced ventilation the air inlet shall be examined to ensure that it is free from moisture and any foreign material. It shall also be ensured that recommended flow and pressure of air is available to produce the required cooling effect.
- 3.6.7 The motor control gear shall also be carefully examined, the over-load settings may be reduced or time lags bypassed from protective gear to ensure rapid tripping of switchgear in event of faults. The direction of rotation of a new motor especially of large capacity, and phase sequence of supply shall be kept in view while joining and connecting to the motor terminals.
- 3.6.8 Finally, the motor shall be started on no-load after decoupling, and shall be allowed to run for a minimum period of 4 hours, or for a time as instructed by Engineer-in-charge. Attention shall be given to the proper running of the bearings, vibration or unusual noises if any. Voltage, starting current, no-load current, stator winding and bearing temperature shall be recorded after every 1 hour during this test. Direction of rotation shall be checked and recorded. Normally the motors run in clockwise direction as viewed with reference to the phase sequence R, Y, B.
- 3.6.9 After switching off the motor, the insulation resistance of the motor shall be recorded under hot and cold conditions.
- 3.6.10 If the no load test run is found satisfactory, the motor shall be allowed to run for 8 hours and all readings shall be recorded.

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3.6.11 The following work on motors may be performed by the contractor if specifically called for.

- a. The proper level of bearing oil has to be checked. The condition of grease in bearings shall be checked and in case it is necessary, complete replacement of bearing with specified grade of grease after proper cleaning of the bearing shall have to be done. Wherever external greasing facility exists, the condition of grease may be checked by pumping some new grease of specified grade at start. If the grease coming out is deteriorated grease shall be replaced.
- b. All the motors, motor exciter set and induction generators directly coupled or coupled through reduction gears shall be checked for abnormal vibration, if any Large rated HV motors with journal type bearings are liable to get damaged from shock, rough handling during transit. Any minor defect in a race or roller may give rise to considerable amount of vibration and noise. Contractor shall check and bring to the attention of Engineer-in-charge any defect noticed in this regard.
- c. Due care shall be taken to avoid any damage to bearing insulation wherever provided.

3.7 BATTERIES

3.7.1 Battery (Lead acid, Nickel Cadmium or VRLA type as specified) shall be erected on stands and insulators supplied by the manufacturer of the batteries. The installation shall be done as per the layout drawings and manufacturer's instructions. Electrolyte if required / as applicable shall be filled as per manufactures instructions. Inter row connections shall be made with the leads supplied by the manufacturer.

3.8 NEUTRAL EARTHING RESISTOR

3.8.1 The neutral earthing resistor shall be inspected for any damage to the resistor grid and other components. The resistor shall be leveled and installed. All covers etc. shall be checked for lightness to ensure that the enclosure of the resistor is dust, vermin acid weatherproof. Earthing conductors shall be taken from the out end terminal of the resistor for connection to earth electrodes and to the main grid.

3.9 WELDING RECEPTACLES

3.9.1 The welding receptacles shall be erected on steel/concrete structures as per the drawings, in isolated places a separate support shall be fabricated and installed.

3.10 PUSH BUTTON/CONTROL STATIONS

3.10.1 The push buttons / control stations shall be installed near to the motors to be controlled. Individual channel support shall be installed as per standard installation drawings. If control stations for hazardous areas are to be supplied by contractor. These shall be of Ex(d) type tested by CMRI and approved by CCE or other applicable certifying authorities. All outdoor push buttons / control stations shall preferably have integral canopies for additional weather protection. The canopy shall be made of 2 mm thick galvanized sheet steel or FRP where these are not integral with the equipment.

3.11 GANG OPERATED ISOLATORS/OUTDOOR DISCONNECTORS

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- 3.11.1 The isolators shall be transported to site in the dismantled condition. All the insulators may be also supplied loose. The contractor shall inspect, clean assemble and install the isolator on the base structure previously fabricated erected and leveled by him. The operating mechanism shall be installed on the structure and connected to the isolator poles. The operating mechanism shall be tested by slowly bringing the isolator to the closed position and carrying out the necessary adjustment as per the manufacturer's instructions. The earthing switches, frames and operating handle etc. shall be earthed.
- 3.11.2 Contractor shall provide the following items in substation as per Indian Electricity Rules:
- a. Fire buckets filled with clean dry sand and ready for immediate use for extinguishing fires and fire extinguisher (carbon dioxide, dry chemical extinguisher etc.) suitable for dealing with electric fires shall be conspicuously marked and kept.
 - b. First aid boxes containing ointments and medicines for immediate treatment of injuries (As prescribed by Indian Red Cross Society or equivalent).
 - c. Instructions of restoration of persons suffering from electric shock in English, Hindi and local language of the district shall be affixed in a conspicuous place.
 - d. Danger boards (H.V, M.V.) shall be provided on transformer gate, switchboards, entrance to switchgear room and at other places as required by Engineer-in-charge.
 - e. The Communication system and Fire alarm system panels and equipment shall be installed complying to manufacturer's instructions. The location of field station (call back station unit, break glass unit, telephone set etc.) shown on, the drawing are indicative. The exact location shall be decided at site by contractor in consultation with Engineer-in-charge. Correct type of equipment with regard to hazardous protection as specified on drawing shall be adhered to by contractor, for installation.

4.0 INSPECTION, TESTING AND COMMISSIONING

- 4.1.1 Field inspection, testing and commissioning of the complete electrical installation shall be carried out as per consultants Specification.
- 4.1.2 After the equipment is installed properly in accordance with drawings and Specifications, Contractor shall carry out all pre-commissioning checks and tests as per company format in the presence of Engineer-in-charge and test readings shall be recorded and furnished to Consultant/Owner in triplicate.
- 4.1.3 All equipment layout drawings shall be marked by the Contractor for "AS BUILT STATUS" and two sets of copies shall be submitted to Consultant/Owner.

5.0 SPARES AND ACCESSORIES

- 5.1.1 The Contractor shall have all necessary construction equipment, tools and tackles and testing instruments to carry out the erection works and to commission the system as specified. These shall include but not be limited to the following, and these shall be brought to site by Contractor before the start of work.

Equipment:

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- a. Portable grinder.
- b. Portable welding machine.
- c. Portable gas cutting / welding set.
- d. Pipe threading machine.
- e. Pipe bending machine (hydraulic).
- f. Portable drill machine suitable to take up drilling for different sizes as per requirement.
- g. Dewatering pumpsets (diesel driven).
- h. Power Hacksaw.
- i. Conduit dye set.
- j. Hydraulic crimping machine.
- k. Hand crimping tool.
- l. Portable electric blowers, vacuum cleaners.
- m. Miscellaneous items such as slings, pulleys, tarpaulins, wooden sleepers, ladders. etc. as required.
- n. Safety belts, safety goggles, and gloves.
- o. Separate tool kit for each Electrician.
- p. Insulation tester 1000 V hand driven.
- q. Insulation tester 2500 V motor/hand driven.
- r. Insulation tester 5000 V motor/hand driven
- s. Phase sequence indicator.
- t. Earth Resistance tester.
- u. Single phase variac
- v. 3 phase variac of adequate capacity.
- w. Secondary injection testing kit.
- x. Multimeter both analogue and digital
- y. Portable Ammeters, Wattmeter, P.F. meters.
- z. Portable Voltmeters.
- aa. Clip on meters of different ranges.
- bb. Tacho-meter.
- cc. Kelvin's double bridge for measurement of very low resistance.
- dd. D.C. high pot test kit.
- ee. D.C. high pot test kit.
- ff. Oil filtration machine of adequate capacity.
- gg. Lux meter to measure illumination levels.

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ABBREVIATION

BIS/IS	Bureau of Indian standards
OISD	Oil Industries Safety Directorate
CCE	Chief Controller of Explosive
CEA	Central Electrical Authorities
GI	Galvanised Iron
MS	Mild Steel
FLP	Flam Proof
RCC	Reinforced Concrete Cement
PV	Poly Vinyl Chloride

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1.0 SCOPE

- 1.1** This Specification defines the requirements for supply of materials, wherever applicable, installation, testing and commissioning of cable installation.

2.0 REFERENCE DOCUMENTS

- 2.1** The work shall be carried out in the best workman like manner in conformity with this Specification, 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:1255 Code of practice for installation and maintenance-of power cables upto and including 33 KV rating.

IS:10810 Method of Test for cables; Part 43 Insulation resistance. (Part 43)

IS:10810 Method of Test for cables ; Part 45 High voltage test. (Part45)

OISD 147 Inspection and safe practice during electrical installation

OISD I 73 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/DGFASLI (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 DEFINITION

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

OWNER / COMPANY CONSULTANT	OWNER of the particular Project (Project Specific). The party which is doing engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
BIDDER / SUPPLIER / VENDOR	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.

4.0 DESIGN

4.1 MATERIAL SPECIFICATIONS

All materials and hardware 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.

4.2 CABLE TRAYS

These shall be ladder type trays either prefabricated hot dip galvanized sheet steel trays or site fabricated angle iron painted trays as specified in job Specification.

4.3 PRE-FABRICATED HOT DIPPED GALVANISED TRAYS

The cable trays shall comply with the requirements specified in Installation standard drawings.

4.4 SITE FABRICATED ANGLE IRON TRAYS

4.4.1 Angle iron cable trays shall be fabricated from standard rolled angle iron sections of size 75x75x8 mm 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.

4.4.2 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.

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

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

4.4.4 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 hardware.

4.5 CABLE GLANDS

4.5.1 Cable glands shall be of nickel-plated brass unless otherwise specified. The single compression type cable glands shall be used for indoor-panels/equipment, (e.g. substation, control room etc).

4.5.2 The cable glands for outdoor terminations shall be weather protected, double compression type and shall have PVC shroud for additional weather protection.

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- 4.5.3 Cable glands forming a part of relevant FLP enclosure shall be FLP type, tested by CMRI or any other recognized independent testing laboratory and approved by CCE/DGMS or any other statutory authority as applicable.
- 4.5.4 Indigenous FLP glands shall have valid BIS license as per the requirements of statutory authorities. The size of the cable glands supplied shall be appropriate to the size of cable so that integrity of the "Ex" equipment is maintained.
- 4.5.5 Entry thread of cable gland shall be compatible to the entry thread provided in the equipment (BS, ET, NPT, and PG as applicable). If required, suitable reducers/adapters shall be used.

4.6 CONNECTORS

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

4.7 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.

5.0 INSTALLATION

5.1 CABLE LAYING (GENERAL)

- 5.1.1 Cable installation shall include power, control, lighting, fire alarm, telephone and communication 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, air-conditioning duct etc. Any change in routing shall be -done to suit -the field conditions wherever deemed necessary, 'after obtaining approval of Engineering-charge.
- 5.1.2 High voltage, medium voltage 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.
- 5.1.3 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.
- 5.1.4 If straight through joints are required to be provided on single core cables, armour shall be broken at joints as per manufacturer's recommendations. For single core cables armour shall be earthed at one end for the cable run length as per manufacturer's recommendation.

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- 5.1.5 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 600mm from power, and control cables but in any case such separation shall not be less than 300mm.
- 5.1.6 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.
- 5.1.7 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.
- 5.1.8 Cables shall be laid in directly buried trench or in RCC trench (underground trench) or in cable tray along pipe sleepers or in overhead trays as shown on cable layout drawings.
- 5.1.9 Overhead trays shall be installed 2700-mm (minimum) above grade level. At road crossings overhead trays shall be installed at 7000mm (minimum) above grade level or cables shall be routed cable tray culvert/ Electrical road crossings as per layout drawings. Sufficient care shall be taken while laying cables to avoid formation of twist, sharp bend etc. in order to avoid mechanical injuries to cables. Rollers shall be used for pulling of cables.
- 5.1.10 Cable installation shall provide minimum cable bending radii as recommended by cable manufacturer.
- 5.1.11 Cables shall be neatly arranged in the trenches / trays in such a manner that crisscrossing 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.
- 5.1.12 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.

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- 5.1.13 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. These 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.
- 5.1.14 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.
- 5.1.15 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:
- 5.1.16 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.
- 5.1.17 Cables for road crossings shall be taken through ERC (Electrical Road Crossing) as shown in the cable layout drawings.
- 5.1.18 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.
- 5.1.19 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.
- 5.1.20 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.

5.2 CABLES LAID DIRECT IN GROUND

- 5.2.1 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.
- 5.2.2 Minimum depth of cable trench shall be 750 mm for medium voltage and 900 mm for H.V. Cables. The depth and the width of the trench shall vary depending upon the number of layers of cables as per Installation Standard.
- 5.2.3 Cables shall be laid in buried trenches 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

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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 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.

5.3 CABLES LAID IN CONCRETE TRENCH

- 5.3.1 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 cover soft 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.
- 5.3.2 All wall openings/pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water.

5.4 ABOVE GROUND CABLES

- 5.4.1 Cables installed above grade shall run in cable trays, clamped on walls, ceiling or structures and shall be run parallel or at right angles to beams, walls or column. 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 shall contain only one layer of cables as far as possible for power cables. However control may be laid in double layer in the cable trays.
- 5.4.2 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 300mm for cables upto 25 mm diameter and maximum 450 mm for cables larger than 25 mm dia. To prevent the sagging of cables.
- 5.4.3 Cable laid on supporting angle in cable trenches structures, columns and vertical run of cable trays shall be suitably clamped by means 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.
- 5.4.4 All cable trays (other than galvanized trays) and supporting steel structures shall be painted before laying of cables. The under surfaces shall be properly degreased, de rusted, descaled and cleaned. The painting shall be done with one coat of red oxide zinc chromate primer. Final painting shall be done with two coats of approved bituminous aluminum paint unless otherwise specified.
- 5.4.5 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.

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5.4.6 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.

5.4.7 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) And above cables in a pipe - 40% of pipe cross-sectional: area occupied by cables.

5.4.8 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 shall be employed for the purpose of sealing

5.5 TERMINATIONS

5.5.1 All PVC 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 aluminum 2mm thick and securely fastened to the cable, Wrapped around it) and also along the, route at recommended intervals, by cable tag numbers.

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

5.5.3 Power cables cores wherever colour coding is not available shall be identified with red, yellow and blue PVC tapes. Where copper to aluminum connections are made, necessary bimetallic washers shall be used.

5.5.4 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

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- 5.5.5 Contractor shall drill holes for fixing glands wherever necessary. Gland plate shall be of nonmagnetic material/ aluminium sheet in case of single core cables. All unused cable entries on equipment/panels shall be plugged /sealed.
- 5.5.6 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 manufacturer's instructions. Cable armour shall not be exposed after termination is complete.
- 5.5.7 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 settings compound.
- 5.5.8 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.
- 5.5.9 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.
- 5.5.10 The cable joints in-power and control tables shall be avoided as far as possible. In case a joint is unavoidable, the following shall be insured:
- a. The number of joints shall be restricted to minimum as far as possible,
 - b. The location of joints shall be identified with permanent markers.
 - c. No joints shall be allowed in hazardous areas without the approval of Engineer-in charge
- 5.5.11 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 jointer duly approved by Engineer-in-charge. Only type tested termination kits of approved make shall be used.
- 5.5.12 No unauthorized repairs modifications shall be carried-out on the hazardous area equipment terminal boxes and junction boxes. Damaged enclosures of hazardous area equipment shall bring 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.
- 5.5.13 Where required, cable sealing boxes intended to be used with the apparatus shall be filled with solid setting type bituminous compound unless otherwise specified.

6.0 TESTING AND COMMISSIONING

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- 6.1** Field testing and commissioning of electrical installation shall be carried out as per Standard Specification XX-XX-XXX.
- 6.2** Before energising the insulation resistance of every-circuit-shall-be measured from phase to phase, phase to neutral and from phase/neutral to earth.
- 6.3** Where splices or terminations are required in circuits rated above 650 volts, insulation resistance of each length of cable shall be measured before splicing and or /terminating. After completion of splices and /or terminations measurements shall be repeated.
- 6.4** The insulation resistance of directly buried cables shall be measured before cable trenches are backfilled. Measurements shall be repeated after back filling.
- 6.5** For cables up to 1.1 kV grade 1000VMegger and for H.V. Cables 2.5 kV / 5 kV Megger shall be used.
- 6.6** D.C. High Voltage test shall be conducted on cables given below after installation.
.
- 6.7** All 1100 volts grade cables in which straight through joints have been made.
- 6.8** All cables above 1100 V grade.
- 6.9** The D.C. High Voltage test shall be performed as detailed below in the presence of the Engineer in charge or his authorised representative only,
- 6.10** Cables shall be installed in final position with all the straight through joints complete. During the high voltage test, all other electrical equipment related to the cable installation, such as switches, instrument transformers, bus bars, etc., must be earthed and adequate clearance shall be maintained from the other equipment and framework to prevent flash over.
- 6.11** In each test, the metallic sheath/screen/armour shall be connected to earth.
- 6.12** All checks and tests shall be made as per Consultant standard test Performa available with site engineer.
- 6.13** All test readings shall be recorded and submitted to Consultant / Owner in triplicate sets.

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

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ABBREVIATION

BIS/IS	Bureau of Indian standards
IEC	International Electro-Technical Commission
BS	British Standards
IEEE	Institute of Electrical and Electronics Engineers
NEMA	National Electrical Manufacturers Association
OISD	Oil Industries Safety Directorate
CCE	Chief Controller of Explosive
DGMS	Director General Mines Safety
IE Rules	Indian Electricity Rules
CPRI	Central Power Research Institute
GI	Galvanized Iron
MS	Mild Steel

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1.0 SCOPE

- 1.1** This specification defines the requirements for the supply of earthing and lightning protection materials and installation of the earthing and lightning protection systems.

2.0 REFERENCE DOCUMENTS

- 2.1** The work shall be carried out in the best workman like manner in conformity with this specification, consultant 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:

- 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).
- e. Any other regulations laid down by central/state/local authorities and Insurance agencies.

3.0 DEFINITIONS

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

OWNER / COMPANY	OWNER of the particular Project (Project Specific).
CONSULTANT	The party which is doing engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.

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BIDDER / SUPPLIER
/ VENDOR

The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.

4.0 MATERIALS

4.1 MATERIAL SPECIFICATIONS

- 4.1.1 All materials and hardware 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.
- 4.1.2 The main earth grid conductor shall be hot dip galvanized M.S. flat unless otherwise specified. Sizes for main conductors shall be as indicated on the earthing layout drawing. Amount of galvanizing shall be 610gm per sq meter. Earth electrodes and Earth plate shall be as per job specification.

5.0 DESIGN

5.1 EARTHING NETWORK

- 5.1.1 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.
- 5.1.2 The earth conductor shall be laid along cable trays/cable trench/pipe racks as indicated on the earthing layout drawing. Where lined cable trenches are available, the earth conductor shall be laid in the 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 500mm below finished grade level.
- 5.1.3 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 two coats of bitumen to avoid oxidation and insulation film formation of the strip surface. When two earth strips are to be joined by means of welding, lap welding with an overlapping of strip equivalent to double the width of the strip and all four sides

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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.

6.0 INSTALLATION

6.1 INSTALLATION OF EARTH ELECTRODE

- 6.1.1 Earth Electrode shall be installed as shown on installation standard and layout drawings. The location shown on the layout drawings are indicative.
- 6.1.2 The exact location of earth electrodes in the field shall be determined by contractor in consultation with the Engineer-in-charge, depending on the soil strata and resistivity. Earth electrodes shall be located avoiding interferences with road, building foundation, column, pipelines etc. The civil area drawings shall be referred for this. The distance between two electrodes shall not be less than twice the depth of electrode.
- 6.1.3 Electrodes shall preferably be located in a moist soil which has a fine texture, grain size and distribution. Wherever practicable the soil shall be dug up, all lumps broken and stones removed from the immediate vicinity of the electrodes and soil packed by watering and ramming as tight as possible.
- 6.1.4 The electrodes shall have a clean surface, not covered by paint, enamel, grease or other materials of poor conductivity.
- 6.1.5 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.
- 6.1.6 The disconnect facility shall be provided for the individual earth electrode to check its earth resistance periodically.
- 6.1.7 Location of earth electrodes shall be marked by permanent markers for easy identification. All earth Electrodes shall be serial numbered and also marked on 'As Built' drawing for future reference.
- 6.1.8 Individual earth electrodes shall be provided for each lightning arrestor and flood light mast.
- 6.1.9 Earthing system provided for concrete paved area by other agency where applicable; shall be connected to the plant earthing system below ground by minimum two earth connections.

6.2 CONNECTION

- 6.2.1 The earth system connections shall generally cover the following:
 - a. Equipment earthing for personnel safety
 - b. System neutral earthing
 - c. Static and lightning protection

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- d. System neutral
 - e. Current and potential transformer secondary neutral
 - f. 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.
 - g. Steel structures/columns, rail loading platforms etc.
 - h. Cable trays and racks, lighting mast and poles
 - i. Storage tanks, spheres, vessels, columns and all other process equipment.
 - j. Fence and Gate for electrical equipment (e.g., transformer, yard etc.)
 - k. Cable shields and armour.
 - l. Flexible earth provision for Wagon, Truck
 - m. Shield wire
- 6.2.2 Conductor size for branch connection to various equipment shall be as per consultant Installation Standards unless otherwise stated on earthing layout drawings.
- 6.2.3 All process pipelines shall be bonded and earthed at the entry and exist points of battery limit of hazardous area. Earth continuity conductors across pipe line flanges shall not be provide das per OISD 110.
- 6.2.4 Steel pipe racks in the process units and offsite area shall be earthed at every 24 meters.
- 6.2.5 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.
- 6.2.6 Lightning protection shall be provided for the equipment, structures and buildings as shown on layout drawing. Self-conducting structures shall not require separate aerial rod and down conductors. These shall however be connected to the earthing system at two or more points as shown on layout drawing. An independent earthing network shall be provided for lightning protection and this shall be bonded at least at two points with the main earthing network below ground. Lightning down conductor shall be brought to earth electrode in shortest straight path as feasible to minimize surge impedance.
- 6.2.7 The main earthing network shall be used for earthing of equipment to protect against static electricity.
- 6.2.8 All medium and high voltage equipment (above 250V) shall be earthed by two separate and distinct connections with earth.
- 6.2.9 Plant instrument system clean earthing, UPS system clean/safety earth shall be separate from the electrical earthing system.
- 6.2.10 All paint, scale and enamel shall be removed from the contact surface before the earthing connections are made.

- 6.2.11 All earthing connections for equipment earthing shall be preferably from the earth plate mounted above ground wherever provided.
- 6.2.12 Equipment foundation bolts shall not be used for earthing connection.
- 6.2.13 Earth connections shall be made through compression type cable lugs/by welded lugs.
- 6.2.14 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.
- 6.2.15 Lighting fixtures and receptacles shall be earthed through the extra core provided in the lighting circuit/cable for this purpose.
- 6.2.16 The reinforcements of sub-station building and the sub-station floor shall be connected to main earth grid.

7.0 REQUIREMENTS FOR MAINTENANCE FREE EARTHING

- 7.1.1 The components of earthing & bonding system are earth electrode, earth enhancement material, earth pit, equipotential earth busbar, connecting cable & tape/strip and all other associated accessories.

7.1.2 EARTH ELECTRODE

- The earth electrode shall be made of high tensile low carbon steel circular rods, molecularly bonded with copper on outer surface to meet the requirements of Underwriters Laboratories (UL) 467-2007 or latest. Such copper bonded steel cored rod is preferred due to its overall combination of strength, corrosion resistance, low resistance path to earth and cost effectiveness.
- The earth electrode shall be UL listed and of minimum 17.0mm diameter and minimum 3.0mtrs. long.
- The minimum copper bonding thickness shall be of 250 microns.
- Marking: UL marking, Manufacturer's name or trade name, length, diameter, catalogue number must be punched on every earth electrode.
- Earth electrode can be visually inspected, checked for dimensions and thickness of copper coating using micron gauge. The supplier shall arrange for such inspection at the time of supply, if so desired.

7.1.3 EARTH ENHANCEMENT MATERIAL

Earth enhancement material is a superior conductive material that improves earthing effectiveness, especially in areas of poor conductivity (rocky ground, areas of moisture variation, sandy soils etc.). It improves conductivity of the earth electrode and ground contact area. It shall have following characteristics-

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- shall mainly consist of Graphite and Portland cement. Bentonite content shall be negligible.
- shall have high conductivity, improves earth's absorbing power and humidity retention capability.
- shall be non-corrosive in nature having low water solubility but highly hygroscopic.
- shall have resistivity of less than 0.2 ohms-meter. Resistivity shall be tested by making a 20cm. cube of the material and checking resistance of the cube at the ends. The supplier shall arrange for such testing at the time of supply, if so desired. Necessary certificate from National/ International lab for the resistivity shall also be submitted.
- shall be suitable for installation in dry form or in a slurry form. • shall not depend on the continuous presence of water to maintain its conductivity.
- shall be permanent & maintenance free and in its "set form", maintains constant earth resistance with time.
- shall be thermally stable between -100 C to +600 C ambient temperatures.
- shall not dissolve, decompose or leach out with time.
- shall not require periodic charging treatment nor replacement and maintenance.
- shall be suitable for any kind of electrode and all kinds of soils of different resistivity.
- shall not pollute the soil or local water table and meets environmentally friendly requirements for landfill.
- shall not be explosive.
- shall not cause burns, irritation to eye, skin etc.
- Marking: The Earth enhancement material shall be supplied in sealed, moisture proof bags. These bags shall be marked with Manufacturer's name or trade name, quantity etc.

7.1.4 BACKFILL MATERIAL

The excavated soil is suitable as a backfill but should be sieved to remove any large stones and placed around the electrode taking care to ensure that it is well compacted. Material like sand, salt, coke breeze, cinders and ash shall not be used because of its acidic and corrosive nature.

7.1.5 EARTH PIT

Refer typical installation drawing attached in tender documents

- A hole of 100mm to 125mm diameter shall be augured /dug to a depth of about 2.8 meters.
- The earth electrode shall be placed into this hole.
- It will be penetrated into the soil by gently driving on the top of the rod. Here natural soil is assumed to be available at the bottom of the electrode so that min. 150 mm of the electrode shall be inserted in the natural soil.
- Earth enhancement material (minimum approx. 30-35 kg) shall be filled into the augured/dug hole in slurry form and allowed to set. After the material gets set, the diameter of the composite structure (earth electrode + earth enhancement material) shall be of minimum 100mm diameter covering entire length of the hole.
- Remaining portion of the hole shall be covered by backfill soil, which is taken out during auguring /digging.
- A copper strip of 150mmX25mmX6mm shall be exothermically welded to main earth electrode for taking the connection to the main equipotential earth busbar in the equipment room and to other earth pits, if any.
- Exothermic weld material shall be UL listed and tested as per provisions of IEEE 837 by NABL/ ILAC member labs.
- The main earth pit shall be located as near to the main equipotential earth busbar in the equipment room as possible.
- The distance between two successive earth electrodes shall be min. 3mtrs.and max. upto twice the length of the earth electrode i.e. 6 mtrs. approx.

7.1.6 INSPECTION CHAMBER

- A 300X300X300 mm (inside dimension) concrete box with smooth cement plaster finish shall be provided on the top of the pit. A concrete lid, painted black, approx. 50 mm. thick with pulling hooks, shall be provided to cover the earth pit.
- Care shall be taken regarding level of the floor surrounding the earth so that the connector is not too deep in the masonry or projecting out of it.
- On backside of the cover, date of the testing and average resistance value shall be written with yellow paint on black background.

8.0 INSPECTION AND TESTING

8.1.1 Field inspection, testing and commissioning of electrical installation shall be done as per specification no.00004-PL-EL-SP-21-R0.Earthing systems/connections shall be tested as follows:

8.1.2 Resistance of individual earth electrodes shall be measured after disconnecting it from the grid by using standard earth test meggar.

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- 8.1.3 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:
- a. For the electrical system and equipment a value that ensures the operation of the protection device in the electrical circuit but not in excess of 4 ohm. However for generating stations and large sub-systems the value shall not be more than 1 ohm.
 - b. For lightning protection, the value of 5ohms as earth resistance shall be desirable, but in no case it shall be more than 10 ohms.
- 8.1.4 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 each 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.
- 8.1.5 All earthing layout drawing shall be marked by contractor for 'AS BUILT STATUS' and two sets of copies shall be submitted to consultant.

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**STANDARD SPECIFICATION
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ABBREVIATION

BIS/IS	Bureau of Indian standards
IEC	International Electro-Technical Commission
BS	British Standards
IEEE	Institute of Electrical and Electronics Engineers
NEMA	National Electrical Manufacturers Association
OISD	Oil Industries Safety Directorate
CCE	Chief Controller of Explosive
DGMS	Director General Mines Safety
IE Rules	Indian Electricity Rules
CPRI	Central Power Research Institute
DC	Direct Current
Ah	Ampere hour
PVC	Poly Vinyl Chloride
VRLA	Valve-regulated lead-acid

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1.0 SCOPE

The intent of this Specification is to define the design, manufacture, testing & supply of stationary SEALED MAINTENANCE FREE VRLA batteries for DC power system /AC UPS application.

2.0 REFERENCE DOCUMENTS

2.1 The equipment shall comply with the requirements of the latest revision of the following Standards issued by BIS (Bureau of Indian Standards) unless otherwise specified.

IS-15549	Stationary SEALED MAINTENANCE FREE VRLA batteries
ANSI T1 330	SEALED MAINTENANCE FREE VRLA Batteries used in the telecommunication Environment.
ASTM D2863	Test method for measuring the minimum oxygen concentration to support candle like combustion of plastics (Oxygen Index).
IEC 60896-21	Stationary lead-acid batteries - Part 21: VRLA types -Methods of test
IEC 60896-22	Stationary lead-acid batteries - Part 22: VRLA types- Requirements
IEC-60068-2	Environmental testing

2.2 The equipment shall also conform to the provisions of CEA regulations with latest amendments and other statutory regulations currently in force in the country.

2.3 In case of imported equipment, Standards of the country of origin shall be applicable if these Standards are equivalent or more stringent than the applicable Indian Standards.

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

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

2.6 In case of any contradiction between various referred Standards / Specifications / Data Sheets and statutory regulations, the following order of priority shall govern:

- a. Statutory regulations.
- b. Data Sheets.
- c. Job Specification.
- d. Standard Specification.
- e. Codes and Standards.

3.0 DEFINITIONS

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

OWNER / COMPANY	OWNER of the particular Project (Project Specific).
CONSULTANT	The party which is doing engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
BIDDER / SUPPLIER / VENDOR	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.

4.0 MATERIALS

- 4.1** The terminal posts shall be suitable for acidic condition operation. The terminals shall be suitable for short circuit current and specified discharge current without damage to the cell as a result of terminal heating.
- 4.2** Stationary SEALED MAINTENANCE FREE VRLA cells shall be designed to withstand the mechanical stresses encountered during normal transportation and handling.

5.0 DESIGN

5.1 General Requirements

- 5.1.1 The offered equipment shall be brand new with state-of-the-art technology and proven field track record. No prototype equipment shall to be offered.
- 5.1.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least 3 years from the date of supply.
- 5.1.3 Vendor shall give a notice of at least one year to the end user of equipment before phasing out the product/ spares to enable the end user to place order for spares and services.

5.2 Technical Requirements

- 5.2.1 The standard rated ampere hour capacity of the cell/ battery shall be at a reference temperature of 27°C, constant current discharge at 10 hours rate (C10) and an end cell voltage of 1.85V/cell.
- 5.2.2 The SEALED MAINTENANCE FREE VRLA cell/battery shall be suitable for float duty operation with a constant voltage permanently applied to its terminals which is sufficient to maintain it in a state close to full charge and shall be designed to

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supply load in the event of normal power supply failure. Type of plate construction for batteries shall be as per the Data Sheet.

- 5.2.3 The components such as containers, lids, covers and seals used in manufacture shall meet the Fire, flame and smoke resistance rating as defined in IS 15549 and have an oxygen Index of at least 28 in accordance with ASTM D-2863.
- 5.2.4 Each cell/battery shall have a separate container of 2.0V (nominal voltage). The cell container shall be made of high strength acid resistant material and designed to withstand mechanical stresses, shocks, vibrations and shall be consistent with the life of the battery.
- 5.2.5 The design of SEALED MAINTENANCE FREE VRLA cell shall be such that regulating valve shall not allow the gas (air) to enter into the cell but shall allow the gas to escape from the cell above certain internal pressure which shall not lead to deformation or cause container to crack or cause failure of seals or shall not cause bulging/ cracking of cell cover.
- 5.2.6 The hydrogen released from SEALED MAINTENANCE FREE VRLA cells shall be sufficiently low to make these cells suitable for use in office, control rooms and equipment environments. The gas leakage rate of the cell shall not exceed 0.05cm³/hr at 27°C and 101.3kpa
- 5.2.7 SEALED MAINTENANCE FREE VRLA stationary cells/battery shall be designed to withstand the mechanical stresses encountered during normal transportation and handling.
- 5.2.8 The terminal posts shall be casted of lead alloy with copper/brass insert for enhancement of conductivity. The terminals shall be suitable for maximum discharge current and short circuit current without damage to the cell as a result of terminal heating. The temperature of the SEALED MAINTENANCE FREE VRLA cells shall be sufficiently low to prevent thermal runaway (critical condition arising due to constant voltage charging).
- 5.2.9 On float, the cell/battery shall be suitable for being recharged to 90% of ampere hours within 24 hours and to 100% within 4 days
- 5.2.10 Ampere hour of the battery shall be selected based on the following:
- a. Minimum site ambient temperature of 10°C or as defined in the Data Sheet.
 - b. Discharge duty cycle.
 - c. End cell voltage.
 - d. Ageing factor of 0.8
 - e. Design margin of 10%, if not defined in the Data Sheet
 - f. Capacity rating factor.

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- 5.2.11 Number of cells and end cell voltage shall be decided by the Vendor on the basis of maximum permissible voltage to the load when batteries are float charged while feeding the Load and minimum DC system voltage. However, the number of cells and end cell voltage shall be as per the Data Sheet, unless otherwise specified.
- 5.2.12 The battery shall be suitable for being boost charged to fully charged condition from fully discharged condition within 10 hours, unless otherwise specified.
- 5.2.13 Battery assembly shall be supplied fully charged condition.
- 5.2.14 The following information shall be permanently marked on the cell.
- a. Nominal voltage
 - b. Name of manufacturer/model reference
 - c. Rated capacity in ampere hours (Ah) with End Cell Voltage
 - d. Voltage for float operation at 27°C with tolerance of $\pm 1\%$, Month and year of manufacture
 - e. Polarity Marking.
- 5.2.15 Each set of battery shall be supplied with all the accessories, including, but not limited to the following:
- a. Battery stands in formation as per Data Sheet. Mild steel stand pretreated and epoxy painted /PVC coated.
 - b. Inter cell, inter row and interbank connectors and end take offs. These shall be of tin plated copper/flexible-insulated copper cable.
 - c. Stand insulator & Portable voltmeter for cell voltage measurements.
 - d. Cell number plates, Lugs for cable termination.
 - e. Other accessories and their quantity as per Data Sheet.

5.3 Performance

SEALED MAINTENANCE FREE VRLA Stationary batteries shall have been type tested to meet the performance requirements for each design and Ah rating of cells as per the relevant Indian standard referred in clause 2.1 above.

5.4 Site condition

SEALED MAINTENANCE FREE VRLA stationary cell/battery shall be suitable for operating satisfactorily in humid and corrosive atmosphere found in fertilizer plants, refineries, CNG stations, petrochemical and gas processing plants, metallurgical plants and other industrial plants. Service conditions shall be as specified in the data sheets/job specification. If not specifically mentioned therein, a design ambient temperature of 45°C and an altitude not exceeding 1000m above MSL shall be considered, with minimum temperature of 10°C for battery sizing.

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6.0 FABRICATION

- 6.1** Flame arrestor shall be mounted on the cell so that all the vented gases diffuse through the arrestor to the outside environment. The construction of the arrestor shall be such that hydrogen burning on the external surface of the arrestor shall not propagate back into the cell to cause explosion.
- 6.2** Each cell shall have a separate container. The cell container shall be of high strength alkali resistant material and designed to withstand mechanical stresses, shocks and vibrations. The cell container shall be translucent /transparent.

7.0 INSPECTION AND TESTING

- 7.1** Batteries shall be subject to inspection by Consultant/Owner or by an agency authorized by the Owner to assess the progress of work. The manufacturer shall furnish all the necessary information concerning the supply to Consultant/Owner's representative.
- 7.2** Consultant/Owner's Representative shall be given free access in the works from time to time for stage wise inspection and progress reporting. Four weeks advance notice shall be given to witness the final routine tests and other tests as agreed upon.
- 7.3** The routine, acceptance & type testing shall be carried out as per Inspection & test plan for stationary SEALED MAINTENANCE FREE VRLA battery. Routine tests shall be conducted on each cell/battery. Acceptance tests & Type tests shall be conducted on few Cells/batteries as per relevant Indian standard. Battery load test shall also be performed at site after installation as part of commissioning
- 7.4** Following tests shall be carried out as a minimum for each Ah rating of cells/battery:

a. Routinetest

- i. Physical examination test.
- ii. Polarity and absence of short circuit.
- iii. Dimension, Mass and layout.
- iv. Marking and packing.

b. Acceptancetest

- i. Marking and packing.
- ii. Verification of dimensions.
- iii. Test for Ah capacity
- iv. Test for voltage during discharge
- v. Internal resistance test.

c. Typetest

- i. Verification of constructional requirement.
- ii. Test for voltage during discharge.
- iii. Test for Ah capacity.
- iv. Test for charge retention/loss of capacity if specified in the data sheet.

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- v. Air pressure test.
- vi. Ampere hour and Watt-hour efficiency test.

7.5 Battery duty cycle test to meet the load cycle requirement shall also be performed at site after installation as part of commissioning unless otherwise defined in the Data Sheet.

8.0 MARKING, PACKING AND SHIPMENT

8.1 All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for transportation by ship/rail or trailer. The equipment shall be wrapped in polythene sheets before being placed in crates/cases to prevent damage to finish. Crates/cases shall have skid bottom for handling. Special notations such as 'Fragile', 'This side up', 'Centre of gravity', 'Weight', 'Owner's particulars', 'PO nos.' etc., shall be clearly marked on the package together with other details as per purchase order.

8.2 The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains/high ambient temperature, unless otherwise agreed.

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FOR
LIGHTING INSTALLATION**

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ABBREVIATION

BIS/IS	Bureau of Indian standards
IEC	International Electro-Technical Commission
BS	British Standards
IEEE	Institute of Electrical and Electronics Engineers
NEMA	National Electrical Manufacturers Association
OISD	Oil Industries Safety Directorate
CCE	Chief Controller of Explosive
DGMS	Director General Mines Safety
IE Rules	Indian Electricity Rules
CPRI	Central Power Research Institute
AC	Alternating Current
DC	Direct Current
CP	Cathodic Protection
SCADA	Supervisory Control And Data Acquisition
FRP	Fiber Reinforced Plastic
TPN	Triple Pole Neutral
MCB	Miniature Circuit Breaker
ELCB	Earth Leakage Circuit Breaker
MDB	Main Distribution Board
HPMV	High Pressure Mercury Vapor
HPSV	High Pressure Sodium Vapor
PVC	Poly Vinyl Chloride
GI	Galvanized Iron
HRC	High Rupturing Capacity
MS	Mild Steel
CFM	Cubic Flow Meter

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LIGHTING INSTALLATION**

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**STANDARD SPECIFICATION
FOR
LIGHTING INSTALLATION**

1.0 SCOPE

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

2.0 REFERENCE DOCUMENTS

- 2.1** The work shall be carried out in the best workmanlike manner, in conformity with this specification, 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. 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).
 - e. Any other regulations laid down by central/state/local authorities and Insurance agencies.

3.0 DEFINITION

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

OWNER / COMPANY	OWNER of the particular Project (Project Specific).
CONSULTANT	The party which is doing engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
BIDDER / SUPPLIER / VENDOR	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.

4.0 FABRICATION (EQUIPMENT SPECIFICATION)

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.

4.1 LIGHTING AND POWER PANELS

- 4.1.1 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 632 of IS 5. 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.
- 4.1.2 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 covers plates for ease of operation. A hinged door to cover the operating knobs shall be provided. In addition, a circuit diagrams indicating incomer details and outgoing details viz. Circuit number, circuit rating, and 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.
- 4.1.3 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.
- 4.1.4 All MCBs shall be of M9 category as per IS 8828 and sensitivity of ELCBs shall be 100 mA unless otherwise specified.
- 4.1.5 Wherever the size of incoming cable to lighting, power panels/MDB is more than 35 sqmm 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.

4.2 LIGHTING FIXTURES

The types, Makes and catalogue numbers of various types of 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.

4.3 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.

4.4 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.

4.5 OUTLET BOXES

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 back elite/PE sheet. The colour shall suit the shade of the walls or shall be white if the shade of the walls is not finalized. The sheet shall extend at least 2 cm 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.

4.6 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 1.6mm. Generally PVC conduits shall be used in concealed wiring and for surface wiring GI conduit (in plant buildings) and black enameled steel conduit (in-non plant buildings) shall be used.

4.7 LIGHTING POLES

Lighting poles shall be fabricated from ERW steel tubular pipes of specified section, with joints, swaged together when hot and beveled 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 near the bottom to contain HRC fuses, a neutral link earth stud and terminal block.

4.8 LIGHTING MAST

Lighting masts (Lattice tower) where used. 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 bus bars 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 basecoat of red oxide.

Unless otherwise specified the flood lighting high masts shall be telescopic type.

4.9 WIRES

Wires shall be PVC insulated and shall be of 660 Volts grade as per IS694. Conductor shall be of stranded copper and size shall be minimum 1.5 Sq. mm for lighting, 2.5 Sq. mm for 15A power socket circuits and 4 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.

4.10 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 diameter. and air CFM shall be as specified in job specification. Exhaust fans for battery room shall be with anticorrosive blades suitable for use in acidic fumes.

4.11 DECORATIVE SWITCHES AND SOCKETS

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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.

5.0 INSTALLATION

Lighting system installation shall be as per follows.

5.1 GENERAL

- 5.1.1 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 PVC insulated 3core (phase, neutral and earth) copper conductor armoured cable for hazardous areas. Wiring in the building shall be done by means of 3core copper, conductor. PVC insulated, un-armoured cables, or 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.
- 5.1.2 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 location of each fixture in order to avoid interference with the 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.
- 5.1.3 On walkways, platforms and other outdoor area, lighting fixtures shall be located nearer to landing of stairs or ladders, gauges, flow meters, panel boards and other equipment to provide proper illumination.
- 5.1.4 The minimum height of any lighting fixture shall be preferably not less than 2.5 meters above the floor level.
- 5.1.5 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.
- 5.1.6 Mounting height of equipment shall be as under: -

a. Top of Switch Box	1200 mm from FFL(Finished floor level)
b. Top of Lighting/Power Panel	1800mm from FFL

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c. 5/15 Amp. Receptacle	a. 300mm from FFL unless otherwise specified b. (1200 mm for process areas and industrial sheds)
d. Lighting fixture	As indicated in layout drawing
e. Exhaust fan	In the cutout provided / as indicated in Layout drawings.

- 5.1.7 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.
- 5.1.8 Circuit cables in a group shall be cleated to structure by using galvanized 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 galvanized or zinc passivated. Underground lighting cables (in paved areas), shall be taken in suitable G I sleeves buried at a minimum depth of 300 mm from FFL. GI pipe sleeves shall be extended to 300mm above. FFL Exact termination/layout of pipes (for protection of cables) shall be decided at site as per site convenience in consultation with Engineer-in charge.
- 5.1.9 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.
- 5.1.10 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.
- 5.1.11 The cable shall be straightened after unwinding it from the drum. All cables be clamped/laid in straight run without any sag and link.
- 5.1.12 For location where fan points are shown, fan hooks with junction box during concreting.
- 5.1.13 Where fan hooks and JB's are provided separately JB shall be located within a distance of 300mm from hook for mounting of ceiling rose.
- 5.1.14 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.
- 5.1.15 Socket outlets and plugs for installation in Substation building, DG shed, workshop, and maintenance shop etc. shall be of industrial metal clad type.
- 5.1.16 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.

5.2 CONDUIT SYSTEM

- 5.2.1 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.
- 5.2.2 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.
- 5.2.3 Conduit shall be of minimum 25mm diameter. Maximum number of wires permissible in a conduit shall be seven/nine for wire size of 2.5 sq mm/1.5 sq mm. respectively.
- 5.2.4 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.
- 5.2.5 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.
- 5.2.6 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.
- 5.2.7 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 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.

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- 5.2.8 All junction boxes, bends and other accessories shall be of the same material as that of conduit and shall have the same protective coatings.
- 5.2.9 After erection, the entire 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.

5.3 HAZARDOUS AREA INSTALLATION

- 5.3.1 Wiring in hazardous area shall be done by using minimum 2.5mm copper conductor armoured cable. Circuit wiring feeding hazardous areas shall be controlled by two pole switches/MCBs (for phase as well as neutral isolation).
- 5.3.2 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 1, Zone 2 etc.
- 5.3.3 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 hard wares 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 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.
- 5.3.4 Circuit cables shall be firmly cleated in a group along, columns/ beam/ladders/side channels/platform using 1.6 mm 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 direction 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.
- 5.3.5 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 suitable steel mounting frame/distance bracket, thereby direct contact with the concrete used for fire proofing.
- 5.3.6 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.

5.4 BUILDING LIGHTING

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- 5.4.1 The type of wiring system shall comprise surface/concealed conduit system or cable/wiring as specified on layout drawings.
- 5.4.2 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 (Met sec 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.
- 5.4.3 Wiring in areas above false ceiling shall be done in Surface Conduit (25mm diameter GI conduit) suitably clamped to the true ceiling. Vertical drops from true ceiling for panels, switches, receptacles etc. shall be taken in 25mm diameter PVC conduit concealed in walls upto 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.
- 5.4.4 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.
- 5.4.5 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 up to various fixtures or fan outlets/ceiling roses.
- 5.4.6 In no case, two different sources or two different phases of supply shall be combined in one switchboard.
- 5.4.7 Switches for light fixtures/exhaust fans in battery room shall be provided outside the Battery room.
- 5.4.8 Lighting layouts for non-plant buildings (such house, cement go down, gate house, workshop, service building, rest room, etc.) shall be prepared by installation contractor.
- 5.4.9 The following basic data/document for layouts will be provided to the contractor.
- f. Architectural drawings
 - g. Illumination level required

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- h. Type of lighting fixture
- i. Type of wiring (concealed/surface conduit/cable wiring etc.)

5.4.10 Based on the above input, contractor shall prepare and submit lighting layout drawings, panel schedules, conduit layout drawings for concealed wiring, design calculations wherever required, for review by purchaser before erection work is started. The lighting layout drawing shall show the location, type and mounting details of lighting fixtures, receptacles, junction boxes, layout of circuit indicating number of wires etc. The number of points in a circuit shall not exceed ten and the load in each circuit shall be less than 1000 Watts.

5.4.11 The panel schedule shall include rating of incoming and outgoing feeders, number of outlets, load for each outgoing circuit, etc.

5.4.12 All drawings shall be prepared preferably in AO and AI size. Panel schedules shall be in A4 size drawings (Final submission of drawings shall be in soft copies and in bound volumes together with one transparency of each document).

5.5 STREET LIGHTING

5.5.1 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 (road berm). Size of wires from marshalling box up to fixture shall be 1.5mm²/2.5mm², copper conductor PVC insulated.

5.5.2 Each pole shall be earthed at two points by connecting to the plant earth grid as shown on Installation standards.

5.5.3 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.

5.5.4 The poles shall be numbered as per the drawings/ directions of Engineer-in-charge.

5.6 MAST LIGHTING

5.6.1 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.

5.6.2 The main feeder upto the distribution board of lighting Mast shall be through PVC insulated 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 3core 2.5sqmm, copper conductor PVC insulated armoured cable. All the cables shall be neatly clamped to the structure at interval not exceeding 25 cms.

5.6.3 Exact orientation of flood lighting fixtures shall be decided at site to achieve optimum utility of these fixtures.

5.7 TELEPHONE WIRING

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- 5.7.1 Conduits for telephone wiring in buildings shall be of 1.6mm thickness. 25mm diameter black enameled steel conduit/PVC as per IS 9537, installed on wall surface or concealed or as specified in job specification.
- 5.7.2 Conduit installation system shall comply to the requirements given in conduit system. Required number of pull boxes shall be provided at interval for easy drawing of wires. The telephone wiring shall be done with 0.63mm diameter annealed copper conductor PVC insulated 660V grade, twin flat wire, unless otherwise specified in Job Specification. One telephone socket outlet shall be provided for connection to telephone instrument.

6.0 INSPECTION & TESTING

- 6.1** Lighting installation shall be tested and commissioned by installation contractor as per Specifications. Pre commissioning checks and tests shall include but not be limited to the following:
 - 6.1.1 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).
 - 6.1.2 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 require load shall be balanced on the three phases.
 - 6.1.3 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.
 - 6.1.4 After inserting all the lamps and switching on all the circuits, minimum and maximum illumination level shall be measured in the area and recorded.
 - 6.1.5 It shall be ensured that switch provided for ON/OFF control of point (light/fan/socket) is only on LIVE side.
 - 6.1.6 Operation of ELCB's shall be checked
- 6.2** Contractor shall duly fill in all the above test results and submit the test reports to Engineer-in-Charge in triplicate.
- 6.3** All lighting layout drawings shall be marked by contractor for 'AS BUILT STATUS' and two sets of copies shall be submitted to the consultant.

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FOR
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ELECTRICAL INSTALLATION**

**STANDARD SPECIFICATION
FOR
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ELECTRICAL INSTALLATION**

ABBREVIATION

CEA	Central Electricity Authority
CCE	Chief Controller of Explosive
DC	Direct Current
DGMS	Director General Mines & Safe
GI	Galvanised Iron
OISD	Oil Industries Safety Directorate
AFC	Approved For Construction
DCS	Distributed Control System
ECS	Emergency Control System
HV	High Voltage
MV	Medium Voltage

**STANDARD SPECIFICATION
FOR
FIELD INSPECTION, TESTING AND COMMISSIONING OF
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**STANDARD SPECIFICATION
FOR
FIELD INSPECTION, TESTING AND COMMISSIONING OF
ELECTRICAL INSTALLATION**

1.0 SCOPE

- 1.1** This Specification covers the requirements for the field inspection, testing and commissioning of electrical equipment and installation, forming part of electrical power distribution and utilisation system.

2.0 REFERENCE DOCUMENTS

- 2.1** The field inspection, testing and commissioning of electrical equipment shall be carried out in line with this Specification and the latest edition of following Indian Standards and OISD standards.

SP-30(BIS)	National Electrical Code
IS-7816	Guide for testing Insulation resistance of rotating machines.
IS 1255	Code of practice for installation and maintenance of power cables up to & including 33 kV rating.
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 137	Inspection of Electrical Equipment.
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:

- a. Indian Electricity Act and Rules.
- b. Regulations laid down by CEA / Electrical Inspectorate.
- c. Regulations laid down by Tariff Advisory Committee/Loss prevention council.
- d. Regulations laid down by CCE/DGMS (as applicable).
- e. The petroleum rules (Ministry of Industry Government of India).
- f. Any other regulations laid down by central / state / local authorities / insurance agencies.

3.0 DEFINITIONS

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

OWNER / COMPANY CONSULTANT	OWNER of the particular Project (Project Specific). The party which is doing engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
BIDDER / SUPPLIER / VENDOR	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.

**STANDARD SPECIFICATION
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FIELD INSPECTION, TESTING AND COMMISSIONING OF
ELECTRICAL INSTALLATION**

4.0 FIELD INSPECTION, TESTING AND COMMISSIONING

- 4.1** Contractor shall carry out complete field inspection, testing and commissioning of electrical equipment as per Inspection Test plans.
- 4.2** Before the completed installation or an addition to the existing installation is put into service, inspection / pre-commissioning checks and tests shall be carried out by contractor. In the event of defects being found out, the same shall be rectified and the installation retested as applicable.
- 4.3** The pre-commissioning inspection among other requirements shall include visual inspection, checking the workmanship of the installation, the rating of equipment, safety clearances, sizes of cables installed, conformance to the AFC document, soundness of switchgear bus connections, wiring properly dressed and labeled, sealing of unused cable entries, checking of all safety interlocks, control/interface functions as per requirement etc.
- 4.4** Visual inspection for soundness of bus bar connections of bus ducts, terminal connections of equipment/motor shall be carried out. It shall be ensured that no foreign materials are present inside bus duct and equipment terminal boxes. After the visual inspection, all the covers of terminal boxes, inspection chambers shall be refitted with gaskets, bolts & nuts as per equipment manufacturer's instructions.
- 4.5** Pre-commissioning tests shall include but not be limited to the following:
- a. Continuity test for each winding and power and control circuits.
 - b. Insulation test for each winding and power and control circuit
 - c. High voltage test for cables
 - d. Dielectric strength test on transformer oil.
 - e. Checking the correctness of wiring schemes, control circuit interlocks for intended functioning.
 - f. Verification of phase sequence.
 - g. Testing of all types of relays/releases for required operation. Testing of measuring instruments for proper functioning Earth continuity test for all circuits.
 - h. Checking of safety features for correctness of operation etc.
 - i. Checking of all wired interface contacts (analog, digital input/output contacts) for, DCS and ECS interface, at panel and equipment terminal chambers as applicable.
 - j. (Electrical contractor shall co-ordinate with other agencies involved for the above and, provide support services for checking interfaces of electrical equipment and the intended functioning)
 - k. Earth resistance measurement for each earth electrode, and the earthing system as a whole.

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- I. Lighting installation shall be tested for correct illumination levels, with the fittings installed. Fittings shall be operated only with specified type of a lamp or tube.
- 4.6** After the above tests and inspection are completed, control circuits shall be tested for correct operation under all operating combinations and proved correct before applying power to main circuits.
- 4.7** Plant Communication, Fire alarm, telephone and security system shall be checked for correct operation and intended function.
- 4.8** A close visual inspection of electrical equipment in hazardous areas shall be made to ensure that equipment is suitable for the classified zone and gas group and correctly installed, with all covers, bolts, nuts and hardwares intact and there is no physical damage mark seen on the enclosure.
- 4.9** Site Acceptance Test procedure for specific equipment shall be furnished by the respective equipment Vendor. The contractor shall provide necessary assistance to the equipment Vendor to perform site acceptance testing to enable the equipment Vendor to perform the same.
- 4.10** All pre-commissioning checks and tests shall be carried-out as per the directions of Engineer in-charge. In addition to the equipment manufacturer's instructions, pre-commissioning check requirements shall also be complied. All tests shall be carried out by contractor in the presence of Consultant /Owner's representatives
- 4.11** The contractor shall bring to site all required tools, tackles, and testing instruments for carrying out field testing. Contractor shall use only calibrated measuring and test instruments and shall maintain calibration records.
- 4.12** The Insulation Resistance test values for various electrical equipment shall be as below.

4.12.1 CABLES

The insulation resistance test values for cables shall be as per following table:

Rated voltage of the Cable	DC Test Voltage in Volts	Minimum Insulation resistance in Mega ohms
Lighting and power circuit Wiring	250	1
650/1100 V grade cables	1000	1
1,900/3,300V grade cables	1000	200
3,800/6,600V grade cables	1000	200
6,350/11,000V grade cables	5000	200
8,700/115,000V grade cables	5000	200
12,700/22 000V grade cables	5000	200
19,000/33000V grade cables	5000	200

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4.12.2 HV, MV AND MISCELLANEOUS SWITCHBOARDS

The insulation resistance test values for the switchboards shall be as per following table:

Rated voltage of the Switchboard	DC Test Voltage in Volts	Minimum Insulation resistance in Mega ohms
33,000V	5,000	200
11,000V	5,000	200
6,600V	1,000	200
3,300	1,000	200
415V	1,000	100
240V	500	10
110V	500	10

4.12.3 GENERATORS AND MOTORS

The insulation resistance test values for the Generators and Motors shall be as per following table:

Rated voltage of the Generator sand Motors	DC Test Voltage in	Minimum Insulation resistance in Mega 40 °C
11,000V	5,000	120
6,600V	1,000	80
3,300V	1,000	50
415V	1,000	15
240V	500	12

4.12.4 TRANSFORMERS

The insulation resistance test values for the Transformers shall be as per following table:

Rated Voltage of the Transformer	DC Test Volt in volts	Minimum Insulation resistance in Mega ohms at 40°C
Up to 600V	1,000	100
601 to 5000V	2,500	1,000
5001 to 15,000V	5,000	5,000

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15001 to 35,000V	5,000	10,000

It shall be ensured that during insulation tests; electronic devices and components that are liable to get damaged on applied test voltage shall be disconnected from circuit. The instructions of equipment/panel manufacturer shall be followed strictly in this regard.

4.12.5 HIGH-VOLTAGE TESTING

D.C. high voltage test shall be conducted as per following table on all H. V. feeder cables and also on 1100 V grade cables where straight through joints have been made.

Rated Voltage	TEST VOLTAGE (kV) BETWEEN		Duration (Minutes)
U₀ / U*	Any Conductor and Metallic	Conductor to Conductor	
0.65/1.1	3	3	5
1.9/3.3	5	9	5
3.3/3.3	9	9	5
3.8/6.6	10.5	18	5
6.6/6.6	18	18	5
6.35/11	18	30	5
11/11	30	30	5
12.7/22	37.5	-	5
19 / 33	60	-	5

* U₀: Phase Voltage

U: Line Voltage

The cable cores must be discharged on completion of DC high voltage test and cable shall be kept earthed until it is put into service.

DC test voltage for old cables shall be 1.5 times rated voltage or less depending on the age of cables, repair work or nature of jointing work carried out, etc. In any case, the test voltage shall not be less than the rated voltage.

All protective relays including thermal overload relays shall be tested by secondary injection current. Primary injection tests shall be carried out for differential protection, restricted earth fault protection at full/reduced current to ensure correctness of complete wiring.

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Before energizing any equipment, 'COMMISSIONING CLEARANCE FORM' as per standard format shall be, duly filed in by contractor and submitted to Consultant / Owner.

It shall be ensured that the electrical inspectorate approval is available before energizing the equipment.

5.0 RECORDS

Contractor shall keep up-to-date records of all activities carried out and test results. Field inspection / test reports shall be submitted to Consultant / Owner by the contract in bound volume (triplicate copies).

**STANDARD SPECIFICATION
FOR
UNINTERRUPTED POWER SUPPLY**

**STANDARD SPECIFICATION
FOR UNINTERRUPTED POWER
SUPPLY**

ABBREVIATION

BIS/IS	Bureau of Indian Standards
IEC	International Electro-Technical Commission
BS	British Standards
IEEE	Institute of Electrical and Electronics Engineers
NEMA	National Electrical Manufacturers Association
OISD	Oil Industries Safety Directorate
CCE	Chief Controller of Explosive
DGMS	Director General Mines Safety
IE Rules	Indian Electricity Rules
CPRI	Central Power Research Institute
CRCA	Cold rolled cold annealed
UPS	Uninterrupted Power Supply
DCS	Distributed Control System
IGBT:	Insulated Gate Bipolar Transistor
SMPS	Single Mode Power Supply
RMS	Root Mean Square
LCD	Liquid Crystal Display

**STANDARD SPECIFICATION
FOR UNINTERRUPTED POWER
SUPPLY**

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**STANDARD SPECIFICATION
FOR UNINTERRUPTED POWER
SUPPLY**

1.0 SCOPE

- 1.1** The scope of this Specification is to define the requirements of design, manufacture, testing, packing and dispatch of static Uninterrupted Power Supply (UPS) system.
- 1.2** Deviation from this specification shall be acceptable only when the manufacturer shall inform the deviation in quotation before placing the order & shall take the necessary written approval for deviation from the Consultant / Owner. In absences of a list of deviation, it will be assumed that the Manufacturer complies fully with this specification.

2.0 REFERENCE DOCUMENTS

- 2.1** The equipment shall comply with the requirements of latest revision of following Standards issued by BIS (Bureau of Indian Standards) unless otherwise specified:

IS: 5:	Colours for ready mixed paints and enamels
IS: 1248:	Direct acting indicating analogue electrical measuring (Part1,2, 4 and 9) instruments and their accessories
IS: 2147:	Degree of protection provided by enclosures for low voltage Switchgear and control gear.
IS: 3700:	Essential ratings and characteristics of semi-conductor (Part I to 11) devices.
IS: 3715:	Letter symbols for semi-conducting devices. (Part 1 to 4)
IS: 4411:	Code for designation of semi-conductor devices.
IS: 5001:	Guide for preparation of drawings of semi-conductor devices (Part I & 2) and integrated circuits.
IS: 5469:	Code of practice for the use of semi-conductor junction (Part 1 to 3) devices
IS: 7204:	Stabilized power supplies D.C. output (Part 1 to 4)
IS: 12021:	Control transformers for switchgear and control gear for voltages not exceeding 1000V AC
IS: 13314:	Solid state inverters run from storage batteries
IS: 13703:	Low voltage fuses for voltage not exceeding 1000V AC or (Part 1 to 4) 1500V DC
IS: 13947:	Specification for low voltage switchgear and control gear (Part-4 / Sec-1)

- 2.2** In case of imported equipment's Standards of the country of origin shall be applicable 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:

- a. Local Statutory Regulations
- b. Data Sheets
- c. Job Specification
- d. This Specification
- e. Codes and Standards

3.0 DEFINITIONS

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

OWNER / COMPANY	OWNER of the particular Project (Project Specific).
CONSULTANT	The party which is doing engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
BIDDER / SUPPLIER / VENDOR	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.

4.0 MATERIALS

4.1 UPS panels, ACDB and cell booster enclosures shall be fabricated from Structural/CRCA sheet steel. The frames shall be fabricated by using minimum 2mm thick CRCA sheet steel while the doors and covers shall be made from 1.6mm thick CRCA sheet steel. Wherever required suitable stiffeners shall be provided.

4.2 The panels shall be free standing, fitted with suitable louvers for ventilation and cooling fans as required. Hinged doors shall be provided at the front and back with dust tight gaskets. Inter panel sheet steel barriers shall be provided. The enclosure shall provide minimum IP-42 degree of protection, if not specified otherwise in the Data Sheet. The maximum and minimum operating height of the switches shall be 1800 mm and 300 mm respectively.

5.0 DESIGN

5.1 GENERAL REQUIREMENTS

- 5.1.1 The offered equipment shall be brand new with state of art technology and proven field track record. No prototype equipment shall be offered.
- 5.1.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least 15 years from the date of supply.

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- 5.1.3 Vendor shall give a notice of at least one year to the end user of equipment before phasing out the product/spares to enable the end/user for placement of order for spares and services.
- 5.1.4 The UPS system shall be an integrated system comprising static rectifiers, battery, static inverters, static switches, auto / manual by pass switch, AC distribution board, voltage stabilizer in bypass, isolating and protection devices and all other equipment/ accessories required for completeness of the system whether specifically mentioned herein or not, but necessary for completeness and satisfactory performance of the system.
- 5.1.5 The UPS system shall be suitable to feed all loads connected to the output which are primarily instruments, (DCS), computers, disc drives and other SMPS equipment leading to high crest factor of the load.
- 5.1.6 The inverter shall be thyristor / transistorised (IGBT) type or with the latest proven technology. All components shall be of a high quality and reliability that satisfy with the requirements of a secure AC power to vital equipment with respect to performance, controlling, monitoring and safeguarding function in continuously operating petrochemical process units, petroleum refineries, gas processing facilities, utility and other miscellaneous industrial plants. Components shall be capable of withstanding the thermal and dynamic stresses resulting from internal and external short circuits and switching surges etc.
- 5.1.7 The design of the UPS shall be such as to minimize the risk of short circuits and shall ensure human and operational safety.
- 5.1.8 The vendor shall be responsible for design, engineering and manufacturing of the complete system to fully meet the intent and requirements of this specification and enclosed data sheets. Selection, sizing and suitability of all equipment and components used for UPS system shall be Vendor's responsibility.
- 5.1.9 The UPS shall be single phase or three phase system as indicated in the Data Sheets.
- 5.1.10 For the Batteries detail see technical requirement cl. no. 5.2.3.

5.2 TECHNICAL REQUIREMENTS

5.2.1 INPUT POWER SUPPLY

- a. The UPS shall be suitable for input power supply as defined in the Data Sheet. If not specified therein the UPS shall be suitable for the following input power supply.
Voltage 415V $\pm$ 10%
Frequency 50 Hz $\pm$ 3%
- b. In addition to above variations, the input voltage may be subjected to transient variations comprising voltage dip to 20% of normal voltage during motor start-up as well as voltage variations due to fault condition. UPS system shall be designed to operate satisfactorily while deriving the input power from an emergency diesel generator set.
- c. UPS system shall also operate satisfactorily on input power supply having:

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- i. the ratio of negative to the positive sequence components not exceeding 5% and
- ii. Total harmonic distortion of not more than 5%.
- d. Total Harmonic Distortion is the ratio in percentage of r.m.s. value of the harmonic content to the r.m.s. value of the fundamental component of alternating quantity.
- e. The incoming power supply to UPS will be provided by 2 Nos. feeders. one feeder shall feed the rectifier(s) while other shall supply power to stabilized bypass supply.

5.2.2 UPS CONFIGURATION AND OPERATIONAL REQUIREMENTS

The UPS system shall have one of the following basic configurations as specified in Data Sheet and drawings:

a. Single UPS with Bypass

- i. In UPS system having this configuration a single rectifier and inverter shall be provided. Under normal conditions when AC mains power is available, the rectifier shall simultaneously feed DC power to inverter as well as for float/rapid charging of the battery. The AC supply to loads shall be fed from inverter output. In case of any fault in the inverter, the load shall be automatically transferred to stabilized bypass supply and retransfer of load from stabilized bypass supply to the inverter shall be possible in auto as well as in manual mode.
- ii. In case of AC input power failure or battery charger failure, the battery shall supply power to inverter without any interruption. The charger shall be designed for simultaneously feeding complete inverter load and for float/rapid charging the battery to its rated capacity. Charger shall be equipped with 'On Line' automatic as well as manual charging facility.

b. Parallel Redundant UPS with bypass

- i. In UPS system having this configuration two sets of rectifiers and inverters shall be provided. Under normal conditions, when AC mains power is available, both the rectifiers shall operate in parallel and supply DC power for float/rapid charging the battery and simultaneously to inverters. In case of failure in one rectifier, the other rectifier shall feed the complete load and the battery without any interruption. In case of incoming supply failure or failure of both rectifiers the battery shall feed the inverters without any interruption. Each rectifier shall be designed for simultaneously feeding complete inverter load and float/rapid charging of the battery to its rated capacity. Each rectifier shall be equipped with 'On Line' automatic as well as manual charging facility.
- ii. Normally both inverters will be synchronized with each other and with stabilized bypass supply. Both inverters shall operate in parallel and share the load equally. When a disturbance/fault occurs in any one of the inverters, the faulty unit shall automatically get disconnected and the entire load shall be fed from the other inverter. In case both the inverters develop a fault, the complete load shall be transferred to stabilized bypass supply through the static switches and retransfer of load from stabilized bypass supply to the inverter shall be possible in auto as well as in manual mode.

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c. Parallel Redundant UPS

- i) In UPS system having this configuration two sets of rectifiers and inverters shall be provided. Under normal conditions, when AC mains power is available, both the rectifiers shall operate in parallel and supply DC power for float/rapid charging the battery and simultaneously to inverters. In case of failure in one rectifier, the other rectifier shall feed the complete load and the battery without any interruption. In case of incoming supply failure or failure of both rectifiers the battery shall feed the inverters without any interruption. Each rectifier shall be designed for simultaneously feeding complete inverter load and float/rapid charging of the battery to its rated capacity. Each rectifier shall be equipped with 'On Line' automatic as well as manual charging facility.
- ii) Normally both inverters will be synchronized with each other. Both inverters shall operate in parallel and share the load equally. When a disturbance/fault occurs in any one of the inverters, the faulty unit shall automatically get disconnected and the entire load shall be fed from the other inverter.

d. Hot stand-by Redundant UPS with bypass

- i. In UPS system having this configuration, the arrangement of rectifiers/inverters and the operating philosophy is same as described above, except that only one inverter shall be operating at one time. The other inverter shall not be sharing the load but shall be synchronized with the running inverter and stabilized bypass supply and remain ready to accept the load in case of fault in the running inverter. Retransfer of load from stabilized bypass supply to the inverter shall be possible in auto as well as in manual mode.
- ii. In all UPS configurations, the facility for uninterrupted manual transfer in either direction through static switches shall also be provided.
- iii. For ease of maintenance, it shall be possible to isolate inverters and static switches from load through manually operated make before break switches. In case of larger rating UPS, where it is not possible to provide one power switch with make before break feature, combination of breakers with the control scheme having make before break logic may be provided which ensures momentary paralleling before tripping of selected breaker.

5.2.3 UPS DESIGN AND PERFORMANCE REQUIREMENTS

- a. Incoming AC supply shall be converted to DC through three phases full wave-controlled rectifiers. The rectifiers shall operate according to the constant voltage current limiting principle and shall incorporate a "Soft Start" feature to gradually accept load on initial energizing.
- b. The rectifier section of the UPS system shall be capable of precise regulation to prevent damage to the battery. The output voltage of rectifier's DC bus without the battery shall be stabilized to within $\pm 1\%$ of set value during load variation between 0 to 100% of the rectifiers and specified mains input supply voltage variation.
- c. Suitable protection shall be provided in the control circuits to guard against instability of phase-controlled rectifiers due to electrical oscillations which may be present in the input supply as caused by emergency DG set.
- d. The UPS system including the stabilized by-pass shall be galvanically isolated from input power supply system by providing double wound transformers. All

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- transformers shall be natural air cooled, dry type suitable for location inside the panel. All rectifiers shall also have a double wound transformer at its input.
- e. An RFI filter shall be provided. The production of radio frequency interference voltage shall not exceed the value of suppression grade N' as defined in VDE-0875. The performance of UPS system shall not get affected or in any way be degraded by the use of portable radio transmitter receiver in the vicinity of the UPS system and or UPS room.
 - f. Transient/surge protection circuit shall be provided in the input circuit to rectifiers to protect the UPS from surges & voltage spikes.
 - g. The UPS system shall be designed to draw power from mains supply at a minimum power factor of 0.85 while working at rated load in normal operating UPS configuration.
 - h. The UPS shall be provided with automatic sequence and power walk in circuit(s) with time delay of up to 15 sec. such that the rectifiers and inverters can start operating automatically when incoming AC power is restored allowing the UPS to be loaded automatically.
 - i. Facility for initial charging of batteries shall also be provided. The inverters may be disconnected during initial charging of the battery.
 - j. For battery sizing, the following factors shall be considered unless specified otherwise in the Data Sheet:
 - i. Load Power Factor of 0.8.
 - ii. Minimum ambient temperature as specified in Data Sheet.

Inverter rated KVA x Rated load p. f.

- iii. Battery Current =
$$\frac{\text{Inverter rated KVA} \times \text{Rated load p. f.}}{\text{Inverter Efficiency} \times \text{End cell voltage No. of cells}}$$

*At 50 % load on each inverter for parallel redundant UPS.

- iv. Aging factor of 0.8.
- v. Back up time of 8 / 10 / 12 hours in case of mains power failure unless specified otherwise in Data Sheet.
- vi. Minimum end cell voltage for lead acid/VRLA battery 1.85 V per Cell and 1.0 V per cell for Ni-Cd battery.
- vii. Battery state of charge factor of 0.95.
- k. The rectifiers/chargers shall be designed to completely charge the Lead acid and Nickel cadmium batteries in a maximum time of 8 / 10 / 12 hours after complete discharge. Facilities shall be provided to initiate battery rapid charge operation by manual & automatic means. An auto charging sequence should be provided for the rapid and float charging based on current sensing. Battery charger for VRLA battery shall be sized to provide boost charging of the battery up to 90% of rated Ampere hours within duration of 24 hours and to 100% within 4 days. In addition to above, the charging shall be transferred from rapid to float mode after a preset time adjustable through 0-24 hours timer as back up protection against overcharging.

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- l. The rectifiers shall be sized based on the maximum inverter input load when inverter is delivering its rated output at 0.8 p.f. lagging and recharge the battery to nominal rated capacity of the battery. The DC load imposed by the inverters shall be considered under the most severe operating conditions where only one rectifier is operating but the UPS load is equally shared by all the inverters. The rating of each rectifier shall be not less than the value calculated as follows:

For Lead Acid Batteries = Inverter input current + 0.14Ah (10 hr. Rating of the battery)

For Nickel Cadmium Batteries = Inverter input current + 0.2Ah (5 hr. Rating of the battery)

For VRLA Batteries = Inverter input current + 0.2Ah (10 hr. Rating of the battery)

Rated KVA capacity of UPS x Load power factor

Where Inverter input current=
$$\frac{\text{Rated KVA capacity of UPS} \times \text{Load power factor}}{\text{Battery charging voltage} \times \text{Inverter efficiency}}$$

- m. The DC rectifiers shall sense the battery charging current and adjust the DC bus voltage to maintain the charging current to preset level. A separate current limit circuit shall also be provided for adjustment of battery current. The rectifiers shall be protected against reverse battery connection at DC link voltage bus. Subsequent to a discharge cycle when battery is connected to rectifier, the battery current shall be monitored, controlled and limited to set value automatically irrespective of the inverter input current.
- n. The battery may be taken out of service for maintenance, during which period it shall be possible for the inverter to continue operation by drawing power from the rectifier. Ripple content at the DC link shall not exceed 2% even with battery disconnected.
- o. Battery / D.C. link shall be provided with a sensitive earth leakage protection.
- p. The inverter shall be of the current limiting type (short circuit proof) and have nominal output voltage and frequency as specified in the data sheet. The inverter output voltage and frequency shall not exceed the operational tolerances, as measured at the output terminals of the unit during the following conditions of UPS loading:
- i. Load variations between 0-100% of the rated output of UPS
 - ii. Load power factor over the range of 0.7 lagging to unity.
 - iii. Load current waveform having a relative harmonic content varying between zero and 50% the latter waveform having a crest factor not exceeding 2.5 and individual harmonics not exceeding the following values:
 - 3rd harmonic- 44% of fundamental
 - 5th harmonic- 33 % of fundamental
 - 7th harmonic- 1.8 % of fundamental
 - 9th harmonic- 7% of fundamental
 - 11th harmonic-10% of fundamental
 - iv. The Relative harmonic content is the ratio of the r.m.s. value of the harmonic content to the r.m.s. value of the total non-sinusoidal periodic waveform i.e. relative harmonic content =
$$\frac{\text{Rms value of the fundamental component of the current or voltage}}{\text{Rms value of the total non-sinusoidal periodic waveform}}$$

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$$\sqrt{1 - \left(\frac{\text{Rms value of total waveform of current or voltage}}{\text{Rms value of total waveform of current or voltage}} \right)^2}$$

- v. The UPS output voltage waveform shall be pure sine wave under linear load conditions, and not exceeding 5% under the non-linear load conditions specified above.
- q. The inverter shall control the output voltage of the UPS such as to maintain synchronism with the mains bypass voltage during variations in mains frequency up to the limits specified.
During variations in mains frequency exceeding these limits, the inverter shall revert to internal frequency control.
- r. It shall be possible to vary the inverter output voltage steplessly within $\pm 5\%$ of the specified output voltage. This adjustment shall be possible to be made when the inverter is in operation.
- s. The steady state output voltage and frequency (free running) variation of inverters shall not exceed $\pm 1\%$ from the set value for specified input power supply conditions from no load to full load condition and load power factor variation from 0.7 lag to 1.0.
- t. The UPS system shall be able to operate satisfactorily on rated loads (in KVA) with power factors in the range of 0.7 lag to 1.0. The overall efficiency of the UPS system shall not be less than 80% at rated load and 0.8 p.f.
- u. The UPS shall have capacity to deliver a minimum overload of 125% for 10 minutes and 150% for 10 sec. UPS shall be provided with current limit circuit to avoid excessive loading beyond its permissible overload withstand capability.
- v. The inverters shall be 'phase locked' to the stabilized bypass power supply as long as stabilized bypass supply frequency remain within $\pm 4\%$ of nominal. When bypass supply frequency variation, exceeds the above limits, the inverters shall be delinked from mains. Free running frequency tolerance limit shall not exceed $\pm 1\%$. Facility shall also be provided for adjustment of range of synchronizing frequency.
- w. Unless otherwise specified, the UPS system output voltage variation shall not exceed $\pm 10\%$ and complete recovery to normal steady state shall be within 0.1 Sec. The above requirement shall be complied for following transient disturbances.
 - i. 100% step load and unload (For single UPS and hot stand by UPS)
 - ii. 50% step load (for parallel redundant UPS)
 - iii. Momentary interruption in power supply
 - iv. Load transfer to stabilized bypass supply
 - v. Complete load transfer to other healthy inverter when one of the two parallel inverters develop a fault.
- x. For 3 phase UPS system, the maximum output voltage and angle variation between the phases should not exceed 5% and 3 degrees respectively even under the condition of 100% unbalanced loading of the 3 phase output.
- y. UPS system shall be suitable for floating output in case of single phase system.
- z. The stabilized bypass supply shall be designed to regulate the output voltage within $\pm 2\%$ of the rated voltage over complete range of load from no load to full

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load and for specified input supply voltage variation. The type of Voltage stabilizer in stabilized bypass supply shall be as indicated in data sheet.

- aa. The stabilized bypass supply shall have a continuous current rating equivalent to the rated output of the UPS unit and be capable of conducting a current ten times the rated output for the duration more than the fault clearing time of the type of fuse provided. The load transfer devices shall comprise of continuously rated static elements in both inverter and stabilized bypass supply.
- bb. Adequately rated static switches in required number & configuration shall be provided in the inverter(s) output and stabilized bypass supply to ensure positive isolation of faulty inverter section such that the other inverter and bypass circuits do not feed into the fault leading to under voltage / trip. The short time rating of all the static switches shall be at least 10 times the rated output for the duration more than the fault clearing time of the type of fuse provided.
- cc. Facility shall be provided to manually and automatically initiate transfer of the load from inverters to the stabilized bypass supply and from stabilized bypass supply to the inverters. Under voltage and over voltage sensing levels to initiate transfer shall be adjustable. The maximum transfer time between inverters and bypass supply shall not exceed 4 msec and 20 msec in synchronous and asynchronous mode respectively.
- dd. The criteria for load transfer:
 - i. Load transfer from inverter to the stabilized bypass supply shall be as follows:
 - The load transfer shall only be possible when:
 - The stabilized bypass output voltage is within $\pm 5\%$ of rated UPS output voltage and the mains bypass frequency is within $\pm 4\%$.
 - Auto-transfer of the load from inverter to stabilized bypass supply shall be inverted when:
 - The inverter output voltage drops below 95% of nominal output voltage under steady state condition and/or if the inverter output voltage falls below 90% of the nominal value under transient conditions.
 - OR
 - The inverter output voltage exceeds 105% of the nominal output voltage under steady state condition and/or if the inverter output voltage reaches 110% of the nominal value under transient conditions.
 - OR
 - The inverter output current exceeds its tolerable limits.
 - ii. Retransfer of load from stabilized bypass supply to the inverter shall be as follows:
 - The load transfer shall be possible when:
 - The inverter output voltage is within $\pm 5\%$ of nominal output voltage for more than 5 sec. and
 - Inverter output and stabilized bypass supply are synchronized.

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Retransfer of load from stabilized by pass to the inverter shall be done manually only unless otherwise specified in the Data Sheet.

If automatic retransfer of load to the inverter is specified in the Data Sheet, then the retransfer of load to the inverter shall be inhibited following four automatic transfers of load to stabilize by pass within a period of 5 minutes.

- ee. All breakers shall be adequately rated for continuous rating as well as breaking capacity as applicable. Paralleling of breaker/ switch/ contactor poles to achieve the required current rating is not acceptable. All output isolating device shall be double pole type.
- ff. All electronic power devices including thyristors, transistors (IGBTs), diodes etc. shall be rated under operating conditions for approximately 200% of the maximum current carried by the device. All other electrical components such as transformers, reactors, breakers, contactors, switches, bus bars etc. shall be rated for at least 125% of the maximum required rating. No electronic device shall be subjected to PIV greater than 50% of its rated value.
- gg. All the thyristors, power transistors, diodes and other electronic devices of UPS shall be protected with high speed semiconductor fuses. I²t co-ordination between fuse and semi-conducting power devices shall be ensured.
- hh. The outgoing circuits of ACDB shall be protected by semiconductor fuses. Each inverter shall be designed to clear a fault in any of the branch circuits upto a maximum rating of 25 % of the system capacity without the assistance of the stabilized bypass supply. In case of any fault in branch circuits, the load connected to the healthy circuits shall not get affected. The fault clearing time shall be less than 4 msec.
- ii All PCBs shall be provided with a transparent epoxy coating for environmental protection and tropicalisation. They shall be suitably located away from heat sources.
- jj. All electronic control and monitoring printed circuit cards shall be installed in Standardized electronic equipment frames and shall be fitted with suitable means for easy removal. The frames shall incorporate guides for PCBs to facilitate correct insertion of PCB's and shall allow access to the wiring side of the connectors. All PCBs shall be placed in a manner to avoid replacement of a PCB by a wrong spare PCB. Monitoring points shall be provided on each of the PCBs and the PCB shall be firmly clamped in position so that vibration or long usage does not result in loose contacts. Failure of each PCB shall be indicated by visual alarms. Visual fault diagnostics shall preferably identify faults up to various sections in the card.
- kk. Forced ventilation of panel, if provided, shall be supplemented by 100% redundant fans. In normal operation, normal & redundant fans shall run together. The power supply for the fans shall be tapped from the inverter output. However, the rating of the UPS as specified in the Data Sheet shall be the net output of UPS after deducting power consumption for fans etc. However in case of non-operation of 50% of running fans the UPS output shall not be affected. The fans shall be arranged to facilitate removal of faulty fan for maintenance without requiring system shutdown.
- iii. Maximum noise level from UPS system at 1meter distance, under rated load with all normal cooling fans shall not exceed 75dBA.

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5.2.4 CELL BOOSTER

- a. Cell booster shall be suitable for charging one to six cells within a time duration as specified. It shall be suitable for charging not only the new cells before being introduced to the battery bank but also any treatment to be given to the individual weak cells. Quantity of such boosters shall be as defined in the MR. Cell booster shall be suitable for 240 V $\pm$ 10%, 50 Hz $\pm$ 3% SPN input power supply. Cell booster output voltage shall be in the range of 0-18V and 0-12V for Lead Acid and Nickel Cadmium batteries respectively. Cell booster shall be sized as under:
 - I. For Lead Acid battery = $0.14 \times \text{Ah of cell (10 hr. Rating of the cell)}$
 - II. For VRLA battery = $0.2 \times \text{Ah of cell (10 hr. Rating of the cell)}$
 - III. For Ni-Cd battery = $0.2 \times \text{Ah of cell (5 hr. Rating of the cell)}$
- b. Cell booster shall have heavy duty switch fuse or MCCB on AC incomer and DC output, AC voltmeter, DC ammeter and voltmeter, indicating lamp for AC/ DC power ON. The output voltage and current of cell booster shall have manual control using a suitably rated variac or a full wave-controlled rectifier bridge. Suitable interlock shall be provided so as to ensure that the variac/controlled rectifier is at its minimum position while switching on the cell booster. Cell booster shall be portable type with wheels. Each cell booster shall be supplied with 5 m long flexible copper conductor. PVC insulated and braided cable for AC incomer power supply and DC output connection to the battery.

5.2.5 A.C. DISTRIBUTION BOARD

- a. Sheet steel enclosed AC distribution board shall be provided as part of the complete UPS package. It shall accommodate AC feeders as indicated in the Data Sheet. The distribution board shall be floor mounted fixed type with compartmentalized construction unless otherwise indicated in the Data Sheet. It shall be possible to operate the switches without opening the doors. Switches shall be provided with door interlock. Vertical cable alley of minimum 200mm width with suitable supports shall be provided for the termination of outgoing cables. Suitable supports shall be provided for supporting incoming and outgoing cables. All outgoing switches shall be air insulated load break type. Fuses on outgoing feeders shall be fast acting semiconductor type and cable entry shall be from bottom. The gland plate of the distribution board shall be non-magnetic type where single core cables are used as specified in the Data Sheet. Cable glands shall be of brass and single compression type and cable lugs shall be of tinned copper.

5.2.6 ALARM, CONTROL, INDICATION AND METERING REQUIREMENTS

If not specified otherwise in the Data Sheets, following schedule shall be followed for alarm, control, indication and annunciation. Any additional devices/features considered necessary for reliable operation and maintenance shall also be included in various panels and same shall be highlighted separately.. An illuminated one line diagram indicating operational status shall be provided on the front of the panel, metering, indications, audio-visual alarm shall be provided. Parameters/ information indicated shall be available in LCD panel or by other means directly or indirectly.

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a. Metering

i. Rectifier

- Incoming line voltages (For all the three phases).
- Input line currents.(For all the three phases).
- D.C. voltage at each rectifier output.
- Battery current.

ii. Inverters

- AC voltage at each inverter output (AC voltages for 3 phase inverter).
- AC current at each inverter output (AC currents for 3 phase inverter).
- Frequency meter at each inverter output.

iii. Stabilised bypass supply

- Frequency meter for incoming supply.
- Voltmeter with selector switch for incoming supply.
- Ammeter with selector switch for incoming supply.

iv. ACDB

Following shall be provided for each of the ACDB incomers:

- Voltmeter (voltmeter selector switch shall also be provided for 3 phase inverter).
- Ammeter (ammeter selector switch shall also be provided for 3 phase inverter).
- Power factor meter.

b. Indications

All indication lamps shall be provided with series resistors. Clustered/Jumbo LED's of minimum 10mm dia. may be provided in place of lamps subject to their having at least equal illumination.

- AC mains 'ON' - Rectifier.
- AC mains 'ON' - Bypass.

i. Rectifiers (for each rectifier)

- Rectifier output 'ON'
- Battery on float charge
- Battery on rapid charge

ii. Inverters (for each inverter)

- DC input 'ON'
- Load on inverter
- Inverter synchronized with mains

iii. Load on bypass

c. Audio-Visual Alarm (separately for each circuit)

- Mains failure
- Battery charger failure
- Battery fault
- Inverter temperature high
- Low voltage from inverter
- Load on bypass
- Inverter overloaded
- All power Fuse failures

- i. 2 nos. changeover contacts shall be wired to the terminal strip, 1 no for common remote alarm of 'UPS fault' in owner's panel and 1 no. for load on bypass supply annunciation.

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d. Controls

- All the switches for starting, shut down and testing sequence.
- Primary input circuit breakers for feeding chargers, bypass line and dc bus from battery including backup protection.
- Inverter ON/OFF switch (to initiate inverter operation).
- Static switch transfer test Push Button.

5.2.7 RELIABILITY

All necessary care shall be taken in selection, design, manufacture, testing and commissioning of the equipment for ensuring high system reliability. Following design consideration shall be taken into account to ensure maximum availability of the system.

- a. There shall be no common device, between main and redundant units (e.g. master oscillators etc.) in order to ensure that the failure of the same does not cause shutdown of more than one unit.
- b. It shall be possible to take out any individual power circuit for maintenance without affecting the total UPS supply.
- c. Series-parallel combination of smaller devices to achieve required rating shall not be acceptable.
- d. Vendors shall offer their nearest higher Standard size that will meet the requirement of the specified UPS rating.

5.2.8 FAULT DIAGNOSTIC UNIT

- a. If specified in the Data Sheet, each UPS set shall have provision for adding microprocessor based 'ON line' fault diagnostic unit. This shall supervise the UPS operation continuously. It shall identify and locate faults immediately so that corrective action can be taken. Fault Diagnostic unit shall be compatible to hook up with Owner's PC through RS232/RS485 interface. The software shall be provided on a CD ROM.
- b. The fault diagnostic unit shall have provision for automatic print out facilities for time, input/output voltages, currents, frequency as a minimum under the following conditions.
 - UPS power source changeover from mains to battery.
 - UPS power source changeover from battery to mains.
 - Changeover from inverter to stabilized bypass supply and vice versa.
 - Changeover from one inverter to other inverter.
 - Changeover time in case of inverter to stabilized bypass supply and from one inverter to other inverter.
 - UPS failure.
 - Type of failure incident along with diagnostic report.
- c. In addition to the above, any other feature which vendor feels may be useful shall be provided and highlighted separately.
- d. If any additional equipment (e.g. bin connector, adaptor cards etc.) are required for connecting this unit with UPS system as well as with Owner's PC. The same are also to be included in the vendor's scope.

6.0 FABRICATION

- 6.1** Rectifier/charger and inverter, stabilized bypass supply and static switch sections shall be suitably housed in sheet steel panels complete with all interconnections.
- a. UPS panels, ACDB and cell booster enclosures shall be fabricated from Structural/CRCA sheet steel. The frames shall be fabricated by using minimum 2mm thick CRCA sheet steel while the doors and covers shall be made from 1.6mm thick CRCA sheet steel. Wherever required suitable stiffeners shall be provided.
 - b. The panels shall be free standing, fitted with suitable louvers for ventilation and cooling fans as required. Hinged doors shall be provided at the front and back with dust tight gaskets. Inter panel sheet steel barriers shall be provided. The enclosure shall provide minimum IP-31 degree of protection, if not specified otherwise in the Data Sheet. The maximum and minimum operating height of the switches shall be 1800 mm and 300 mm respectively.
- 6.2** Power cables shall be with aluminum / copper conductors and control cables shall be with copper conductors. All the cable connections shall be from bottom and front of the panel, if not specified otherwise in the Data Sheet. A removable bolted gland plate shall be provided along with single compression type nickel plated brass cable glands for external cable connections. Clamp type terminals shall be used for connection of all wires up to 10 mm². Bolted type terminals suitable for cable lugs shall be provided for wire size above this. Tinned copper lugs for all external connections shall be provided with the panels.
- 6.3** Bus bars shall be used in all power circuits which are rated minimum 100 Amp. Copper conductor PVC insulated cables or wires of 660V grade shall be used for power circuits rated less than 100 Amp. Bus bars shall be colour coded and live parts shall be shrouded to ensure complete safety to personnel intending routine inspection by opening the panel doors. All the equipment inside the panel and on the doors shall have suitable name plate and device tag numbers as per the schematic diagram. All wires shall be ferruled and terminals shall be numbered.
- 6.4** MCCBs and load break power switches shall be mounted inside the panel. The control switches shall be rotary type, mounted on the door and shall be externally operable. An 11 W CFL lamp controlled through a door switch shall be provided for illumination in each panel. All instruments shall be analogue/digital, switchboard type, back connected, (72x72) mm. square (Analogue type) of reputed make. Analogue instruments scale shall have red mark indicating maximum permissible operating rating. Separate test terminals shall be provided for measuring and testing of the equipment to check the performance.
- 6.5** A suitably sized earth bus shall be provided at the bottom of the panels including ACDB running through the panel's line up with provision for earth connection at both ends to purchaser's main earth grid. The minimum size of earth bus shall be (25x3) mm copper (or equivalent aluminum). All potential free metallic parts of various equipment shall be earthed suitably to ensure safety.
- 6.6** All panels shall be of same height so as to form a panel lineup which shall have good aesthetic appearance.

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- 6.7** Inside the panels, the controls connections shall be done with 660V grade PVC insulated wires having stranded copper conductors: 1.5 mm² size wire shall normally be used for circuits with control fuse rating of 10 Amp. Or less. For control circuit having fuse of 16 Amps., 2.5 mm² size wire shall be used. Control wiring for electronic circuits shall be through flat ribbon cable or through copper wire minimum of 0.5 mm dia.
- 6.8** All control wiring shall preferably be enclosed in plastic channels or otherwise neatly bunched together. Each wire shall be identified at both ends by PVC ferrules. Ferruling of wires shall be as per relevant IS.
- 6.9** All metal surfaces shall be thoroughly cleaned and de-greased to remove mill scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The undersurface shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc chromate primer. The under-surface shall be made free from all imperfections before undertaking the finished coat.
- 6.10** After preparation of the under-surface, the panels shall be spray painted with two coats of epoxy-based final paint or shall be powder-coated. Spray painted finished panels shall be dried in stoving ovens in a dust-free atmosphere. Panel finish shall be free from imperfections like pinholes, orange peels, runoff paint, etc. The vendor shall furnish the painting procedure along with the bids.

7.0 INSPECTION AND TESTING

- 7.1** During fabrication, the equipment shall be subjected to inspection by Consultant/Owner or by an agency authorized by the Owner. Manufacturer shall furnish all necessary information concerning the supply to Consultant's/Owner's inspector. Tests shall be carried out at manufacturer's works under his care and expense.
- 7.2** UPS system shall be tested in accordance with applicable Standards. The following acceptance tests shall be performed on each ups system as a minimum. All tests shall be witnessed by Owner or its authorized representative and 4 weeks prior notice shall be given before the date of commencement of tests. The tests certificates indicating test results shall be furnished.

Following system acceptance tests shall be conducted on each UPS system:

7.2.1 INSULATION TESTS

- a. Insulation tests shall be performed as per IEC 60146-1-1.
- b. The insulation tests shall be carried out using an AC power frequency voltage or by using DC Voltage at the choice of the vendor. In case of AC power frequency voltage test, the test voltage at the frequency available in the test facility or at the rated frequency, but not exceeding 100 Hz, of the full value starting at a maximum of 0.5 p.u. The unit on test shall withstand the specified voltage for 1 minute.
- c. In case DC voltage is used for the test, the value of DC voltage shall be equal to the crest value of the test voltage specified in the table.

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$V_p/\sqrt{2}$ (V^* , is the highest crest voltage to be expected between any pair of terminals)	Test Voltage (AC rms value)
≤ 60 V	500 V
≤ 125 V	1000 V
≤ 250 V	1500 V
≤ 500 V	2000 V

7.2.2 INTERCONNECTION CABLE CHECK

The interconnection cables are to be checked for correct wiring, insulation and quality of the terminations

7.2.3 A.C. INPUT FAILURE TEST

The test is performed with the test battery and carried out by tripping a.c. incoming circuit breakers or by switching off rectifiers and bypass supply at the same time. Output voltage and frequency variations are to be checked for specified limits.

7.2.4 A.C. INPUT RETURN TEST

The test is performed by closing A.C. incoming circuit breakers or is simulated by energizing rectifiers and bypass supply. Proper operation of rectifiers starting and voltage and frequency variations of output are to be checked.

7.2.5 SIMULATION OF PARALLEL REDUNDANT UPS FAULT

The test is applicable for UPS with parallel redundant configuration. Fault of rectifier or inverter are to be simulated and output transients are to be recorded.

7.2.6 TRANSFER TEST

Transients shall be measured during load transfer from inverter to bypass supply caused by simulated fault and load retransfer after clearing the fault.

7.2.7 REGULATION TEST

- a. This test shall be carried out by measuring input voltage, input current, output voltage, output current, DC link voltage, output distortion, input active power, output active power and frequency at no load, 50% load and 100% load at 0.7 and 0.8 p.f.
- b. Following parameters of rectifiers and inverters are to be measured:
 - i. Measurement shall be carried out in the rectifier float charge mode and in rapid charge mode. Measurement shall be at nominal A.C. voltage and at no load, 50% load and 100% of rectifier full load. Rectifier measurement shall comprise of : -

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- Input voltage, frequency, phase current and input power. D.C. output voltage and current.
- Ripple current at the DC link bus shall be recorded after isolating the test battery.
- ii. Inverter measurement shall also be at no load, 50% load and 100% load of inverter rated output current and shall be repeated for inverter D.C. input voltages corresponding to battery float charge operation as well as rated inverter maximum and minimum input D.C. voltage. Measurement shall comprise of:
 - Input voltage, input current.
 - Output voltage, frequency and waveform distortion, output power and current.

7.2.8 UPS EFFICIENCY

This shall be determined by the measurement of the active power input and output at rated p.f. for 50%, 75% and 100% load.

7.2.9 CURRENT DIVISION IN PARALLEL UPS

Load sharing between UPS units shall be measured with a dummy load under parallel redundant UPS configuration.

7.2.10 LIGHT LOAD TEST

The test is to verify that all functions of the UPS system operate properly. The load applied is limited to some percentage of rated loads. The following points are to be checked.

- a. Output voltage and frequency and correct operation of meters.
- b. Operation of all control switches and other means to put UPS system into operation.
- c. Functioning of protective and warning devices

7.2.11 BURN-IN TEST FOR PRINTED CIRCUIT BOARDS

PCB's and other electronic components sub assemblies shall undergo a burn- in test for 96 hours at 50°C at a voltage varied between the maximum and minimum supply voltage. In case of failure of any component during testing, the tests shall be repeated after replacement of the faulty component.

7.2.12 CONTINUOUS FULL LOAD TEST AT 0.8 POWER FACTOR WITH TEMPERATURE RISE MEASUREMENT

- a. The test is required to be performed by connecting resistive load or resistive and inductive load to the UPS system output. The load shall be placed outside the test room to avoid influences of its heat upon UPS ventilation.
- b. UPS system in this test shall undergo a complete full load test for 32 hours at 0.8 power factor. Out of these 32 hours, each inverter section shall be subjected to full load test for 8 hours. Both invertors sections operating in parallel shall be subjected to full load test for 8 hours and the for remaining 8 hours, the bypass

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section shall be subjected to full load test. Steady state temperature of rectifier transformer, Rectifier set, D.C. choke, inverter set, static switch etc. shall be recorded during the test. The temperature of all UPS panels is also to be recorded.

7.2.13 AUXILIARY EQUIPMENT AND CONTROL CIRCUIT TESTS

The correct functioning of all measuring instruments, alarms, indications, protection devices and controls are to be verified. The functioning of auxiliary devices such as lighting, cooling fans, annunciation etc. should be checked.

7.2.14 SYNCHRONIZATION TEST

Frequency variation limits of inverter are to be tested by feeding bypass supply incoming line by variable frequency generator and inverter synchronization limit is to be checked as specified.

7.2.15 UNBALANCED LOAD TEST (FOR 3 PHASE UPS ONLY)

Unbalance load at specified limits is applied to the UPS system. The specified voltage and phase angle variation may be checked for compliance with specified values.

7.2.16 OUTPUT VOLTAGE UNBALANCE (FOR 3 PHASE UPS ONLY)

Output voltage unbalance shall be checked under symmetrical load conditions and unbalance load conditions. Phase to phase and phase to neutral output voltage are to be observed. The voltage unbalance is the ratio of highest phase voltage minus lowest phase voltage to the average value. Phase angle variation may be measured for phase to phase and phase to neutral voltages

7.2.17 OVERLOAD CAPABILITY TEST

Specified values of short time overload are to be applied for specified time interval. Values of output voltage and output current are to be recorded.

7.2.18 SHORT CIRCUIT CURRENT CAPABILITY TEST

Specified short circuit current capability is to be tested by application of a short circuit to UPS output if necessary via a suitable fuse. Short circuit current is to be recorded.

7.2.19 SHORT CIRCUIT FUSE TEST

Fuse tripping capability of the UPS system is to be tested by short circuiting the UPS system output via a specified rating of fuse. The test is carried out at an appropriate UPS load under normal operation.

7.2.20 RESTART

Manual restart to be tested after complete shutdown of UPS system.

7.2.21 OUTPUT OVER VOLTAGE

Operation of output over voltage protection is to be checked.

7.2.22 DYNAMIC RESPONSE TEST

Output recording at different loads and operating condition to be done.

7.2.23 HARMONIC COMPONENTS

Harmonic components of output voltage are to be recorded at no load, 50% load and 100% load conditions. Harmonic voltages caused by UPS system components in the A.C. incomer side shall be recorded at site.

7.2.24 EARTH FAULT TEST

An earth fault is to be applied to the output terminal of UPS system. UPS output transients are to be measured. An earth fault is also to be applied to the battery terminal and UPS system output transient shall be measured.

7.2.25 AUDIBLE NOISE TEST

- a. The audible noise is required to be measured at 1meter distance from UPS system in at least 4 to 5 locations and its value shall be within permissible limit.
- b. The detailed test schedule and test procedure shall be formulated in line with above. Before giving call for the witness of the tests, vendor shall get Consultant approval on the test procedures. Vendor shall also indicate the max. Allowable tolerance for each test result along with the test procedures.
- c. If tests show that certain requirements of the specifications are not met, 'Vendor' shall make necessary corrections to the equipment so that it satisfies all the requirements before acceptance is made.

7.2.26 SITE ACCEPTANCE TESTS

Vendor shall furnish Site Acceptance Tests procedure to be followed. Final acceptance testing along with the batteries shall be done at site. It shall be Vendor's responsibility to arrange necessary instruments and tools as required by their commissioning engineer for these tests.

8.0 MARKING, PACKING AND SHIPMENT

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 equipment 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 notations such as Fragile', 'This side up', ' center of gravity', `weight', 'Owner's particulars', ` PO nos.' 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 shall be suitable for outdoor storage in areas with heavy rains and high ambient temperature unless otherwise agreed.

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ABBREVIATION

BIS/IS:	Bureau of Indian standards
IEC:	International Electro-Technical Commission
BS:	British Standards
IEEE:	Institute of Electrical and Electronics Engineers
NEMA:	National Electrical Manufacturers Association
OISD:	Oil Industries Safety Directorate
CCE:	Chief Controller of Explosive
DGMS :	Director General Mines Safety
IE Rules:	Indian Electricity Rules
CPRI:	Central Power Research Institute
DCDB:	Direct Current Distribution Board
CRCA:	Cold Rolled Cold Annealed
PCB:	Printed Circuit Board
VRLA:	Valve Regulated Lead Acid
LED :	Light Emitting Diode
MCCB:	Moulded Case Circuit Breaker

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1.0 SCOPE

This Specification covers the design, manufacture, testing at manufacturer's works, packing and supply to site of Battery Chargers and Distribution Boards.

2.0 REFERENCE DOCUMENTS

2.1 The equipment shall comply with the requirements of latest revision of the following Standards issued by BIS (Bureau of Indian Standards), unless otherwise specified:

IS 5:	Colours for ready mixed paints and enamels.
IS 1248:	Direct acting indicating analogue electrical measuring instruments and (Parts-1, 2, 8, 9) accessories.
IS 3700:	Essential rating and characteristics of semi-conductor devices (Parts-1 to 11).
IS 3715:	Letter symbols for semi-conductor devices (Parts-1 to 4).
IS 4411:	Code of designation of semi-conductor devices.
IS 5001:	Guide for preparation of drawings for semi-conductor devices and integrated (Parts-1, 2)accessories.
IS 5469:	Code of practice for the use of semi-conductor junction devices. (Parts-1 to 3)
IS 6619:	Safety code for semiconductor rectifier equipment.
IS 7204:	Stabilized power supplies dc output(Parts-1 to 4).
IS 12021:	Control transformers for switchgear and control gear for voltages not exceeding 1000VAC.
IS 13703:	Low voltage fuses for voltages not exceeding 1000VAC or 1500VDC. (Parts-1 to 4).
IS 13947:	Low voltage switchgear and control gear. (Parts-1, 3, 4, 5).
IEC 60146:	Semiconductor converters

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- 2.2** In case of imported equipment, the Standards of the country of origin shall be applicable if these Standards are equivalent or more 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.
- 2.5** In case of any contradiction between various referred Standards/ Specifications Data Sheets and statutory regulations, the following order of decreasing priority shall govern:
- a. Statutory Regulations
 - b. Data Sheets
 - c. Job Specifications
 - d. Standard Specification
 - e. Codes and Standards.

3.0 DEFINITIONS

For the purpose of this document, the words and expressions listed below shall have the meanings assigned to them as follows:

OWNER / COMPANY	OWNER of the particular Project (Project Specific).
CONSULTANT	The party which is doing engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
BIDDER / SUPPLIER / VENDOR	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.

4.0 MATERIALS

- 4.1** The Chargers, DCDB and Cell Booster enclosures shall be fabricated from structural/ CRCA sheet steel. The frames shall be fabricated by using minimum 2mm thick CRCA sheet steel while the doors and covers shall be made from minimum 1.6 mm thick CRCA sheet steel.
- 4.2** PCBs used in the chargers shall be made of glass epoxy material.
- 4.3** Power cables shall be with aluminum/ copper conductors and control cables shall be with copper conductors.

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5.0 DESIGN

5.1 GENERAL REQUIREMENTS

- 5.1.1 The offered equipment shall be brand new with state of the art technology and a proven field track record. No prototype equipment shall be offered.
- 5.1.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least 15 years from the date of supply.
- 5.1.3 Vendor shall give a notice of at least one year to the end user of equipment before phasing out the product/ spares to enable the end user to place order for spares and services.
- 5.1.4 The Battery Charger system shall be an integrated system comprising of static rectifiers, DC Distribution Board, isolating and protection devices and all other equipment/ accessories required for completeness of the system. whether specifically mentioned herein or not, but necessary for completeness and satisfactory performance of the system. The Battery Charger equipment shall be properly coordinated with the selected Battery to ensure complete compatibility.
- 5.1.5 All equipment and components shall be of excellent quality and reliability for providing secure DC power required for vital equipment performance, controlling, monitoring and safeguarding functions in continuously operating process units and utility installations of petroleum refineries, petrochemical and gas processing facilities and other industrial plants. Components shall be capable of withstanding the thermal and dynamic stresses resulting from internal and external short circuits and circuit switching operations etc. The design of the equipment shall be such as to minimize the risk of short circuits and shall ensure personnel and operational safety.
- 5.1.6 The Vendor shall be responsible for design, engineering and manufacturing of the complete system to fully meet the intent and requirements of this Specification and attached Data Sheets.
- 5.1.7 The Battery shall meet the requirements of Data Sheets and Specifications attached with the Material Requisition/ Bid document.

5.2 TECHNICAL REQUIREMENTS

5.2.1 INPUT POWER SUPPLY

- a. The Battery Chargers shall be suitable for input power supply as defined in the Data Sheet. If not specified therein, they shall be suitable for the following input power supply:
- | | |
|-----------|----------------|
| Voltage | 415V $\pm$ 10% |
| Frequency | 50 Hz $\pm$ 5% |
- b. In addition to the above variations, the input voltage may be subject to transient variations comprising of voltage dips up to 20% of normal voltage during motor start-up, voltage interruptions during short circuits as well as frequency variations due to large motor start-up. The Battery Chargers shall operate satisfactorily with a total harmonic distortion of up to 5% in the input power supply.

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- c. The Battery Chargers shall also be designed to operate satisfactorily while drawing input power from an emergency diesel generator set. The incoming power supply to the Battery Charger system shall be provided by 2 independent feeders. One feeder shall supply power to each rectifier.

5.3 BATTERY CHARGER

5.3.1 DESIGN BASIS

- a. The Battery Charger system shall have two chargers (Charger-1 & Charger-2). Both chargers shall be of identical design and rating. The battery to be connected to the chargers shall be of Nickel Cadmium/ flooded electrolyte Lead Acid/ VRLA type as indicated in the Data Sheet. Battery Chargers for flooded Lead Acid and Nickel Cadmium batteries shall be sized to provide quick charging of the battery within duration of 10 hours, unless specified otherwise. Battery Chargers for VRLA battery shall be sized to provide quick charging of the battery up to 90% of rated Ampere hours within duration of 24 hours and to 100% within 4 days. Each charger shall be sized for the most stringent of the following duty conditions, whichever is higher:
- i. Offline quick charging of the battery assembly. The charger shall be sized as under:
- $$\begin{aligned}\text{Charger rating in Amps.} &= 0.14 \text{ Ah (C10) of battery (for Lead Acid battery)} \\ &= 0.2 \text{ Ah (C10) of battery (for VRLA battery)} \\ &= 0.2 \text{ Ah (C5) of battery (for Nickel Cadmium battery)}\end{aligned}$$
- ii. Online float charging of the battery assembly while feeding the complete DC load. The charger shall be sized as under:
- $$\text{Charger rating in Amps.} = 1.15 \times \text{Average DC load} + \text{float charging current}$$
- (Average DC load = Area under the battery duty cycle/ battery duty cycle duration).
- iii. Initial charging of the uncharged battery assembly to fully charged condition.
- b. Each charger shall have a 3 phase full wave, controlled rectifier bridge with protective devices.
- c. Independent current limits shall be provided for charger load current and battery charging current. Subsequent to a discharge cycle and completion of quick charging, when battery is connected to charger under float mode, the battery current shall be monitored, controlled and limited to set value automatically irrespective of the value of load current. Fast acting semi-conductor fuses shall be provided for protection against internal short circuits. In case of external short circuits, the chargers shall be protected by rapid shutdown of the semi-conducting power devices. The high speed semi-conductor fuses used for rectifier protection shall be complete with trip indication.
- d. Filter circuits consisting of smoothing choke and condenser, complete with protection to limit the ripple content at the output, shall be provided.
- e. Silicon blocking diodes shall be provided in the charger output circuit to prevent back-feed from battery into the charger and filters.

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- f. Protection against reverse battery connection and DC earth fault relay for earth leakage protection shall be provided.
- g. Silicon blocking diodes (min. 4 nos.) connected to 80% tap of the battery bank shall be provided to maintain continuity in the DC supply to the load.
- h. Internal cooling of the charger unit shall preferably be by natural ventilation. If forced air cooling is necessary, a redundant air cooling fan shall be provided for each service. The charger components shall be capable of delivering their rated output with one forced air cooling fan out of service. Under this condition, maximum continuous temperature of components shall not exceed the permissible limits. In case of chargers with forced cooling, loss of ventilation alarm/ trip with override facilities shall be provided.
- i. Selection, sizing and suitability of all components used for various applications shall be Vendor's responsibility and the rating of components shall be increased, if required, to suit associated components during execution of the order without any claim for extra price or time. All electronic power devices including thyristors, transistors, diodes etc. shall be rated under operating conditions for at least 150% of the maximum current carried by the device. All electrical components such as transformers, reactors, contactors, switches, bus bars etc. shall be rated for at least 125% of the maximum required rating. No electronic device shall experience a PIV greater than 50% of its rated value.
- j. The DC system shall be unearthed, unless mentioned otherwise in the Data Sheet. However, a high impedance earth fault relay shall be provided for the protection of the battery.
- k. Each charger shall be galvanically isolated from the input power supply by providing a double wound transformer at its input. The transformer shall be natural air cooled, dry type suitable for location inside a panel.
- l. Suitable protection shall be provided in the control circuits to guard against the instability of the controlled rectifiers due to electrical oscillations which may be present in the input supply as caused by an emergency DG set.
- m. An R.F.I. filter shall be provided to suppress the radio frequency interference to permissible limits. The production of radio frequency interference voltages shall not exceed the value of suppression grade N'as defined in VDE-0875. The performance of the Battery Charger system shall not get affected or in any way be degraded by the use of portable radio transmitter receivers in the vicinity of the chargers.
- n. Transient/ surge protection devices shall be provided in the input circuit of chargers to protect them against surges & voltage spikes.
- o. The Chargers shall be designed to draw power from main supply at a minimum power factor of 0.85 lag while sharing the rated load in normal operating configuration.
- p. The chargers shall be designed to ensure that the harmonic component in the input currents are limited so as not to cause undue harmful effects on other sensitive equipment operating on the same supply bus. Suitable filters/ harmonic traps shall be provided, as required, for this purpose.
- q. All breakers shall be adequately rated for the required continuous rating and breaking capacity as applicable. Paralleling of breaker/ switch Contactor poles to achieve the required current rating is not acceptable. All output isolating devices shall be double pole type. The DC contactors shall be operated with a DC control supply using ON/ OFF selector switches and not push buttons. All DC

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contactors must have a tested/ published DC rating equal to or exceeding the most stringent current carrying and breaking requirements while considering adequate design margins.

- r. All the thyristors, diodes and other power electronic devices shall be protected with high speed semiconductor fuses. I²t co-ordination between fuse and semi-conducting power devices shall be ensured. The Battery Chargers shall be specifically designed to limit float and quick charging voltages to the battery to limits recommended by the battery manufacturer. Output voltage shall be limited to maximum +10% of nominal system voltage when the battery is float charged while feeding the load. Vendor shall specifically ensure that the charger output voltage does not exceed the recommended limits of operation under any conditions of internal/ external fault or operation, including:
- i. Filter capacitor fuse failure of either charger.
 - ii. DC output switch OFF of either charger.
 - iii. DC output fuse blown of either charger.
- s. Other specific current/ voltage limits during normal charging/ operation of the chargers shall also be incorporated in the design of the chargers.

5.3.2 OPERATION AND PERFORMANCE

- a. Operation
- i. Normal operation requires that the battery assembly shall be float charged simultaneously by both Chargers -1 & 2 while feeding the DC load, the chargers thus operating in parallel and equally sharing the total load.
 - ii. However in case of failure of either of the chargers, the other charger shall float charge the battery while feeding the complete DC load. Faulty charger shall automatically get disconnected from the healthy system.
 - iii. In case of AC mains failure, the battery shall continue to supply the load.
 - iv. The process of changeover from float to quick charging and reverting from quick to float charging shall be selectable in Automatic or Manual mode by means of an Auto/ Manual selector switch. In Automatic mode, the changeover from float to quick charging shall be initiated through a current sensor, set at a preset value. Similarly, the changeover from quick to float charging shall also be automatic based on current sensing. In Manual mode, both changeovers from float to quick charging and from quick to float charging shall be performed manually using push buttons. When quick charging mode is selected, the battery charger shall Initially charge the battery under constant current mode followed by constant voltage (finishing charging) mode or as per the battery manufacturer's recommendation. Changeover from constant current to constant voltage (finishing charging) mode shall be fully automatic. A backup synchronous or digital timer shall also be provided for initiating the changeover to float mode by default after a preset time period. The timer range shall be 0 to 24 hours or the nearest available as per manufacturer's standard range.
 - v. In the event of failure of the charger feeding the load, when battery is being quick charged by the other charger, continuity in DC supply shall be maintained from the battery to the load through 80% tap of the battery bank followed by full battery supplying the load through contactor.

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- vi. Interlock shall be provided to ensure that when either of the chargers is selected in quick charging mode, it will be disconnected from both the DC load and the other charger operating under float charging mode.
- vii. The chargers shall have facility for manual mode of operation in the event of failure of controller under closed loop control. The selection shall be done through Auto/ Manual selector switch.
- viii. Energisation of contactor for DC critical lighting shall be initiated by means of an AC mains failure relay complete with Auto/ Manual selector switch, on/ off push buttons etc.
- ix. Facility for initial charging of the uncharged battery shall also be provided
- b. Performance
 - i. Both chargers shall be of solid state design, constant voltage and current limit type. The output voltage shall be stabilized to within $\pm 1\%$ of set value in float charging mode for mains steady state voltage and frequency variation of $\pm 10\%$ and $\pm 5\%$ respectively, and load variation of 10 to 100% at any temperature up to the design ambient temperature specified in the Data Sheet. However, the variation in output voltage can be up to $\pm 2\%$ for chargers with rated output voltage up to 24V.
 - ii. Under constant current boost charging condition, the DC output current shall be maintained within $\pm 2\%$ of set value.
 - iii. The output voltage dynamic response of the charger unit with battery disconnected shall not vary more than $\pm 10\%$ of nominal output voltage in the event of step load of up to 50% of the rated output. The output voltage shall be restored to a value within the steady state limits within 250 msec. Voltage feedback shall generally be derived from charger output while current feedback from the DC ammeter.
 - iv. The maximum allowable RMS ripple voltage, with battery disconnected, shall be equal to or less than 2% of the nominal output voltage.
 - v. The maximum noise level from the chargers measured at 1 meter distance in any position, at any load between 0- 100% with all normal cooling fans running shall not exceed 75 dB(A).
- c. Controls
 - i. Controls shall include but not be limited to the following:
 - ON/ OFF control switch for AC supply to charger (push buttons are not acceptable).
 - Push buttons for float/ quick charging mode selection
 - Potentiometers under float mode for voltage and current adjustment
 - Potentiometers under quick mode for voltage and current adjustment
 - Auto/ Manual selector switch to select mode of operation
 - Others as required.
- d. Panel Metering and Indication

These shall include but are not limited to the following:

 - i. **Meters**
 - Charger-1**
 - AC input Voltmeter with selector switch
 - AC input Ammeter with selector switch

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- DC output Voltmeter
- DC output Ammeter
- DC Voltmeter with selector switch (battery voltage)
- DC Ammeter (battery)
- DC Earth Leakage Ammeter (mA).

Charger-2

- AC input Voltmeter with selector switch
- AC input Ammeter with selector switch
- DC output Voltmeter
- DC output Ammeter.

DC Distribution Board

- DC Voltmeter
- DC Ammeter.

ii. **Lamps**

Chargers-1 & 2

- AC power ON (1 lamp for each phase)
- Float charger ON
- Quick charger ON
- Charger fault.

DC Distribution Board

- DC power ON
- Outgoing feeder ON (for each outgoing feeder).

All indicating lamps shall be provided with series resistors. Clustered/ Jumbo LEDs of minimum 10mm diameter may be provided in place of lamps subject to their having at least equal luminance.

e. **Annunciation**

- i. Static type audio-visual enunciator with annunciation windows, acknowledge, test and reset push buttons and hooter shall be provided on each charger for the following annunciations. Any additional relays/Components, including DC under voltage relay and current sensors, required for this purpose shall be provided in the chargers. Facility for bypassing the audio alarm on each charger shall also be provided.

- DC under voltage
- DC overvoltage
- DC earth leakage
- AC incoming power supply failure
- AC input fuse blown-off
- Thyristor/ diode failure
- DC output fuse blown-off
- DC battery fuses blown-off
- Filter Capacitor fuse blown-off
- Load on Battery (using current direction sensing with time delay)
- Battery under voltage/ Disconnected during discharge (using zero current

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sensing)

-Cubicle fan failure/ cubicle temperature high (for chargers with forced cooling).

-One summary alarm potential-free contact each for Battery, Charger-1 and Charger-2 shall be wired to terminal block for remote annunciation.

f. Printed Circuit Boards (PCBs)

- i. PCBs used in the chargers shall be made of glass epoxy material. Components shall be properly mounted without undue stress, torsion, bends, twists etc. All PCBs shall be provided with a transparent epoxy coating on both sides for environmental/ anti-fungus protection and tropicalisation. Industrial grade components shall be used in the PCBs and electronic circuits. PCBs shall preferably be wave soldered. Copper strips/ prints on PCBs shall have smooth edges free from hair line cuts and shall be provided with tin coating. Plug-in PCBs shall preferably be mounted in a standard rack and shall be suitable for easy replacement. They shall be located away from heat sources. The rack shall have PCB guides which shall allow the insertion of PCBs smoothly without requiring undue force. The rack shall be mounted on hinged pivots to enable it to be turned for access to the back side terminals. The PCBs shall be firmly clamped in position so that vibration or continued usages do not result in loose contacts. All PCBs shall be fitted in a manner to avoid replacement of a PCB by a wrong spare card. The PCBs shall be provided with visual light emitting diode (LED) status indications, monitoring points/ test connections and setting potentiometers in a readily accessible location which is visible without removing the PCBs. Visual fault diagnostics shall preferably identify faults up to various sections in the card.
- ii. Vendor shall provide adequate protection to the system, even if not specifically mentioned.

5.3.3 CELL BOOSTER

- a. Cell booster shall be suitable for charging one to six cells within the time duration specified. It shall be suitable for charging not only new cells before being introduced to the battery bank but also for any treatment to be given to individual weak cells. Cell booster shall be suitable for 240 V $\pm$ 10%, 50 Hz $\pm$ 5% SPN input power supply. Cell booster output voltage shall be in the range of 0-18V and 0-12V for Lead Acid and Nickel Cadmium batteries respectively. Cell booster shall be sized as under:

For Lead Acid battery = $0.14 \times \text{AH (C10) of cell}$

For VRLA battery = $0.2 \times \text{AH(C 10) of cell}$

For Ni-Cd battery = $0.2 \times \text{AH (C}_5\text{) of cell.}$

- b. Cell booster shall have a heavy duty switch fuse or MCCB on both AC incomer and DC output sides, along with AC voltmeter, DC ammeter, DC voltmeter and indicating lamps for AC/ DC power ON. The output voltage and current of cell booster shall be manually controlled using a suitably rated variac or a full wave controlled rectifier bridge. Suitable interlock shall be provided so as to ensure that the variac / controlled rectifier is at its minimum position while switching on the cell booster. Cell booster shall be portable type with wheels. Each cell booster shall be supplied with 5 m long flexible copper conductor PVC insulated

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braided cables for both AC incoming power supply and DC output connection to the battery. An industrial type 3 pin 15A plug shall be provided on AC incoming cable end and lugs shall be provided on DC outgoing cable end.

5.3.4 RELIABILITY

- a. All necessary care shall be taken in selection, design, manufacture, testing and commissioning of the equipment for ensuring high system reliability. The following design considerations shall be taken into account to ensure maximum availability of the system. There shall be no common device between the two units, the failure of which could cause shutdown of more than one charger.
- b. It shall be possible to attend to any individual power circuit for maintenance without affecting the total DC supply. Series-parallel combination of smaller devices to achieve specified rating shall not be acceptable. All the components used shall be time tested and standardized. Vendor shall state the safety factors used in selecting such items as semi-conductors, electrolytic capacitors, transformers etc.

6.0 FABRICATION

- 6.1** Each Battery Charger and DC distribution board shall be housed in a separate free standing cubicle. All panels shall be of the same height so as to form a panel lineup which shall have good aesthetic appearance. Chargers-1 & 2 shall be installed side by side whereas DCDB may be located separately and interconnected to the charger through cables. The DCDB shall accommodate outgoing feeders as specified in the Data Sheet. Each panel shall be provided with an 11W CFL light with a door operated switch and a thermostatically controlled MCB protected space heater.
- 6.2** Unless specified otherwise in the Data Sheet, the DCDB shall be compartmentalized with each outgoing feeder housed in a separate compartment. Cable alley of minimum 200mm width with suitable supports shall be provided for the termination of cables for each vertical arrangement of outgoing feeders in DCDB.
- 6.3** The Chargers, DCDB and Cell Booster enclosures shall be fabricated from structural/ CRCA sheet steel. The frames shall be fabricated by using minimum 2mm thick CRCA sheet steel while the doors and covers shall be made from minimum 1.6 mm thick CRCA sheet steel. Wherever required, suitable stiffeners shall be provided. The panels shall be provided with suitable louvers for ventilation backed by wire mesh. They must be suitable for use in a tropical climate. Hinged doors shall be provided at the front and back as required. Inter panel sheet steel barriers shall be provided.
- 6.4** The charger panels and DC distribution board shall be provided with minimum IP-42 degree of ingress protection as per IS-13947 (Part-1).
- 6.5** Bus bars shall be colour coded and live parts shall be shrouded to ensure complete safety to personnel intending routine inspection by opening the panel doors. All the equipment inside the panel and on the doors shall have suitable nameplates and device tag numbers as per the schematic diagram. All wires shall be ferruled and terminals shall be numbered.

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- 6.6** The DCDB incomer and main bus bars shall be rated based on the maximum load current considering an additional 10% design margin for contingencies. The rating shall be selected from standard available ratings and shall be adequate for the expected short circuit current. The bus bar voltage shall be higher than the recommended boost voltage for the system. The insulation for all equipment where provided shall be heat resistant, moisture proof and tropicalised.
- 6.7** All power and control switches shall be rotary/ cam operated type. All power switches shall be air insulated load break type. Vendor shall ensure that all equipment/ components such as incomer switches, outgoing DC switches, MCCBs, push buttons, indicating lamps, charger mode selector switches, voltage control switches, annunciator windows etc. are suitably located on the charger and distribution board door such that they can be operated without opening the front door. Power switches shall be provided with a door interlock. In case of difficulty in installation on the charger front panel door, the AC incoming power switches, DC outgoing switches and MCCBs may be installed within the panel provided that they are operable after opening the front panel door. However, all other selector/ control switches, push buttons, indicating lamps, annunciators, meters etc. shall necessarily be installed on the front panel door as specified above.
- 6.8** All instruments shall be switchboard type, back connected and (72 x 72) mm square size. Accuracy class of all meters shall be 1%. Digital meters capable of displaying different parameters can be considered subject to Owner's/ Consultant approval. Analogue instrument scales shall have a red mark indicating maximum permissible operating rating.
- 6.9** All fuses shall be link type and shall be located inside the panel. Diazed fuses shall not be accepted.
- 6.10** All power and control wiring connections within the panels shall be carried out with 660V grade, PVC insulated, BIS marked wires having stranded copper conductors. However, copper strip connections shall preferably be used for currents exceeding 100A. Wires of 1.5mm² size shall normally be used for control circuits with fuse rating of 10 Amps. or less. For control circuits with fuse of 16 Amps. or more, 2.5 mm² size wire shall be used. Control wiring for electronic circuits/ components shall be through flat ribbon cable or copper wire of minimum 0.5mm diameter. All control wiring shall be enclosed in PVC channels or otherwise neatly bunched together. Each wire shall be suitably identified at both ends by PVC ferrules. Ferruling of wires shall be as per relevant IS.
- 6.11** For all cabling external to panels, power cables shall be with aluminum/ copper conductors and control cables shall be with copper conductors. All cable connections shall be from the bottom of the panel, unless specified otherwise in the Data Sheet. Removable bolted undrilled gland plates shall be provided along with single compression type nickel plated brass cable glands for all external cable connections. Clamp type terminals shall be used for connection of wires up to 10mm². Bolted type terminals suitable for cable lugs shall be provided for wire sizes above this. Separate test terminals shall be provided for measuring and testing the equipment to check performance. All panels shall be supplied complete with tinned copper cable termination lugs.
- 6.12** All potential free metallic parts shall be earthed using soft drawn copper conductor wire. A suitably sized earth bus shall be provided at the bottom of the

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panels running through the panel lineup with provision for earth connections at both ends to Owner's main earth grid. The minimum size of earth bus shall be (25 x 6) mm copper (or equivalent aluminum). All potential free metallic parts of equipment shall be suitably earthed to ensure safety.

- 6.13** The maximum height of the operating handles/ switches shall not exceed 1800 mm and the Minimum height shall not be below 300 mm.
- 6.14** All components/devices/ feeders shall be provided with screwed nameplates. Nameplates shall Be 3 ply white-black-whites 2 colour laminated plastic type. Lettering shall be of minimum 6 mm Height and edges shall be beveled at 45°.
- 6.15** 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 undersurface shall be prepared by applying a coat of phosphate paint and a coat of zinc oxide/ phosphate primer. The undersurface shall be free from all imperfections before undertaking the finishing coat. After preparation of the undersurface, the panels shall be either spray painted with two coats of epoxy paint or epoxy powder coated to a uniform thickness suitable for rugged industrial use.
- 6.16** Colour of final paint shall be shade 631 as per IS 5, unless specified otherwise. The finished panels shall be dried in stowing ovens in dust free atmosphere. Panel finish shall be free from imperfections like pinholes, orange peels, run off paint etc. All unpainted steel parts shall be cadmium plated or suitably treated to prevent rust corrosion.

7.0 INSPECTION AND TESTING

- 7.1** During fabrication, the equipment shall be subjected to inspection by Consultant / Owner or by an agency authorized by the Owner. Manufacturer shall furnish all necessary information concerning the supply to Consultant / Owner's inspector. Tests shall be carried out at manufacturer's works under his care and expense.
- 7.2** Each Battery Charger/ DCDB/ Cell Booster shall be tested in accordance with applicable standards. The following acceptance tests shall be performed on each Battery Charger and DCDB as a minimum. Detailed test schedule and procedures shall be formulated by the vendor and submitted for Consultant / Owner's approval. Vendor shall indicate the maximum allowable tolerance against each test parameter in line with applicable standards. All tests shall be witnessed by Owner or his authorized representative and 4 weeks prior notice shall be given before the date of commencement of tests. In case the equipment fails to meet any requirements of the Specifications, necessary modifications/ corrections shall be made by the Vendor to ensure compliance to the Specifications, and the equipment shall be retested before acceptance. Test certificates indicating the test results shall be submitted to Owner.

7.3 INSULATION TESTS

- 7.3.1** Insulation tests shall be performed as per IEC 60146-1-1.
- 7.3.2** The insulation tests shall be carried out using an AC power frequency voltage or a DC voltage at the choice of the manufacturer. In the case of AC power frequency voltage test, the test voltage at the frequency available in the test facility or at

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the rated frequency, but not exceeding 100 Hz, shall be increased to the full value shown in the following table in not less than 10 seconds continuously or in maximum steps of 0.05 p.u. of the full value starting at a maximum of 0.5 p.u. The unit on test shall withstand the specified voltage for 1 minute. In case DC voltage is used for the test, the value of DC voltage shall be equal to the crest value of the test voltage specified in the table.

$V_P / \sqrt{2}$ (VP is the highest crest voltage to be expected between any pair of terminals)	Test Voltage (AC RMS value)
$\leq 60V$	500V
$\leq 125 V$	1000 V
$\leq 250 V$	1500 V
$\leq 500 V$	2000 V

7.4 PRINTED CIRCUIT BOARDS

PCBs and other electronic circuits shall undergo a burn-in test for 96 hours at 50°C at a voltage varied between the maximum and minimum supply voltage. In case of failure of any component during testing, the tests shall be repeated after replacement of the faulty component.

7.5 HEAT RUN TEST

Prior to execution of functional tests, each of the two chargers of each Battery Charger set shall be subjected to a Heat Run test performed at rated load and voltage for a period not less than 8 hours. The other charger of the set shall be energized under zero load current condition throughout the test period. The temperature of electronic power devices shall be measured and the device junction temperature shall be calculated. The calculated value shall be at least 10-20°C lesser than the maximum rated junction temperature of the device with proper ambient temperature correction applied.

7.6 FUNCTIONAL TESTS

Functional tests shall be performed on each charger. If during execution of functional tests, an electronic component of the charger is required to be replaced, e.g. due to charger malfunction or failure of the unit to fulfill the performance requirements of the Specification, then the heat run test shall be repeated at rated current following which functional tests shall be carried out.

7.7 CHARGER TESTING AT CONSTANT OUTPUT VOLTAGE

Measurements shall be carried out in the float charging mode and in the quick charging mode. In each mode, measurements shall be carried out at nominal AC input voltage and at zero, 50% and 100% of rated output current. Measurements at 100% rated load current shall be repeated at 90% and 110% of nominal AC supply voltage. Measurements shall include input AC phase voltage, frequency, current and power and DC output voltage, current and output voltage ripple.

7.8 CHARGER TESTING AT CONSTANT OUTPUT CURRENT LIMIT

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Measurements shall be carried out both in the float charging and quick charging mode. In each mode, measurements shall be carried out when the charger is operating under DC current limiting conditions with DC output voltage between zero and set value corresponding to constant voltage operation. Measurements shall include DC output voltage and current.

7.9 AUXILIARY EQUIPMENT AND CONTROL CIRCUIT TESTS

The correct functioning of all measuring instruments, alarms, indications, protections and controls mentioned in the Specification shall be verified.

7.10 PARALLEL OPERATION

Parallel operation of both chargers, sharing of the load and automatic isolation of faulty charger shall be checked.

7.11 CHARGER EFFICIENCY

This shall be determined by measurement of the active power input and output at 50%, 75% and 100% load.

7.12 AUDIBLE NOISE TEST

Audible noise shall be measured around each charger at 1 meter distance in at least 4 to 5 positions and its value shall be within the permissible limits.

7.13 SITE ACCEPTANCE TEST

The Battery Chargers, DCDB and Cell Booster shall be tested at site along with the battery. Vendor shall furnish a Site Acceptance Test (SAT) procedure for Owner's approval and all tests shall be performed as per the approved SAT procedure.

8.0 MARKING, PACKING AND SHIPMENT

8.1 All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for transportation by ship/ rail or trailer. It shall be wrapped in polythene sheets before being placed in crates/ cases to prevent damage to finish. The crates/ cases shall have skid bottoms for handling. Special notations such as 'Fragile', 'This side up', 'Center of gravity', 'Weight', 'Owner's particulars', 'PO no.' etc., shall be clearly and indelibly marked on the packages together with other details as per purchase order.

8.2 The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains and high ambient temperature unless otherwise agreed.

**DATA SHEET
FOR
STORAGE BATTERY**

**DATA SHEET
FOR
STORAGE BATTERY**

GENERAL INFORMATION		
Applicable To ☐ Proposal ☐ Purchase ☐ As Built ☐ Vendor shall complete Data Sheet with information not otherwise provided by Buyer.		
Client: _____	Tag Number: _____	
Facility: _____	Manufacturer/Model No.: _____	
Location: _____		
Service: _____		
[TECHNICAL DATA SHEET]		
1.00	GENERAL	
1.01	Name of the manufacture	
1.02	Type of Battery	
1.03	Designation	
1.04	Ambient temperature	
1.05	a. Minimum	
1.06	b. Maximum	
2.00 GENERAL		
2.01	Site conditions	
2.02	Maximum Temperature	
2.03	Design Maximum Ambient Temperature	
2.04	Design Minimum Ambient Temperature	
2.05	Relative Humidity	
2.06	a. Minimum	
2.07	b. Maximum	
2.08	Site Elevation Above MSL	
2.09	Plant Atmosphere	
2.10	Maximum Rainfall	
3.00 CONSTRUCTION DETAILS		
3.01	Type of positive plate	*
3.02	Type of negative plate	*
3.03	Type of container	*
3.04	Type of Separator	*
3.05	No. of vent plugs	*
3.06	Spray Arrestors provided	☐ Yes ☐ No
3.07	Type of Battery racks provided	*
3.08	Method of connection between cells	*
4.00 TECHNICAL DETAILS		
4.01	Battery capacity for 10 hr rate	
4.02	a. At 27° C	*
4.03	b. At maximum ambient temperature	*
4.04	c. At minimum ambient temperature	*
4.05	Nominal voltage	
4.06	a. Cell V	*
4.07	a. Battery V	*
4.08	No. of cells	*

**DATA SHEET
FOR
STORAGE BATTERY**

4.09	Open circuit voltage / cell V	*
4.10	End cell voltage / cell V	*
4.11	Expected life of battery Yrs.	*
4.12	Internal resistance of cell Ohms	*
4.13	Ampere-hour efficiency %	*
4.14	Watt-hour efficiency %	*
4.15	Expected fault level at bus due to battery kVA	*
4.16	Intermediate tapping	
4.17	Terminal connections	
4.18	Max. allowable voltage variation	
4.19	Total resistance of Battery Ohms	*
5.00	CHARGING	
5.01	Mode of charging	☐ Float ☐ Boost ☐ Trickle
5.02	Recommended starting & finishing charging rates	*
5.03	Charging Voltage & Current	
5.04	a. Float charging V / Amps	*
5.05	b. Boost charging V / Amps	*
5.06	c. Trickle charging V / Amps	*
5.07	Charging period (Hrs.)	
5.08	a. Initial charging	*
5.09	b. Boost charging	*
5.10	c. Normal charging	*
5.11	Volume & Specific gravity of electrolyte per cell (at 27 Deg. C)	
5.12	a. For first filling	*
5.13	b. At the end of full charge	*
5.14	c. At the end of discharge at hrs rate	*
5.15		
5.16	Voltage of cell at the end of charge at the finishing rate	*
5.17	Hydrogen Emission cm ³ /hr/ Cell at ____ Deg. C	*
5.18	Amount of air to be introduced cm ³ /hr / Cell	*
5.19	Equalizing charge	
5.20	a. Voltage & Current V / Amps	*
5.21	b. Duration min.	*
5.22	c. Interval between successive	* Hrs Equalizing charge
6.00	MISCELLANEOUS	
6.01	Cell dimension (LxWxH) mm	*
6.02	Battery Bank dimensions (LxWxH) mm	*
6.03	Weight / Cell kg	

**DATA SHEET
FOR
STORAGE BATTERY**

6.04	a. Dry	*
6.05	b. Filled	*
6.06	Weight of battery with stand kg	*
6.07	Battery stand suitable for single tier / double tier	☐ Single tier ☐ Double tier
6.08	Level indicator provide	* ☐ Yes ☐ No
6.09	Battery bank layout furnished with offer	☐ Single tier ☐ Double tier
6.10	Recommended exhaust fans rating	* kW X Nos X Qty
6.11	Size of battery room required (L x W) mm	*
6.12	Ageing factor	
6.13	Charger to battery bank cable size sq.mm	*
6.14	Design margin	
6.15	Factor for rise of battery capacity after charge discharge	
6.16	List of spares / accessories enclosed	☐ Yes ☐ No
6.17	Discharge characteristics at various rates (at 27 Deg. C ambient) enclosed	☐ Yes ☐ No
6.18	Typical voltage curves enclosed	☐ Yes ☐ No
6.19	Ageing characteristic enclosed	☐ Yes ☐ No
6.20	Copies of test report enclosed	☐ Yes ☐ No
6.21	Copies of Installation, Commissioning, Operation and maintenance manual	☐ Yes ☐ No
6.22	Type test certificate enclosed	
6.23	Calculation for Battery sizing, cable sizing for battery enclosed	☐ Yes ☐ No
7.00 LIST OF MANDATORY SPARES		
7.01	Cell container with cover per set (5 Nos.)	☐ Yes ☐ No
7.02	Vent plugs per cell (5 Nos.)	☐ Yes ☐ No
7.03	Level indication (if applicable) (5 Nos.)	☐ Yes ☐ No
7.04	Inter cell connector per set (5 Nos.)	☐ Yes ☐ No
7.05	Nut, bolts and washer per set	☐ Yes ☐ No
NOTES:		
	*	Data to be filled by supplier with its bid in the supplier data column, those data shall be in accordance with standard specification
	#	Data to be defined during detailed engineering
	#	Data to be verified by supplier

DATA SHEET
FOR
UNINTERRUPTED POWER SUPPLY

**DATA SHEET
FOR
UNINTERRUPTED POWER SUPPLY**

GENERAL INFORMATION		
Applicable To: ☐ Proposal ☐ Purchase ☐ AsBuilt ☐ Vendor shall complete Data Sheet with information not otherwise provided by Buyer.		
Client: _____		
Facility: _____		Tag Number: _____
Location: _____		Manufacturer/Model No.: _____
Service: _____		
[TECHNICAL DATA SHEET]		
1.00	GENERAL	
1.01	Service / Application	Power Supply
1.02	Supplier	
1.03	Manufacturer	
1.04	Country of origin	
1.05	Operation	☐ Individual ☐ Parallel ☐ Redundant ☐ Hot stand- by
1.06	Degree of enclosure protection & temp. class	
1.07	System type	☐ Transistorised ☐ Thyristorised
1.08	Mounting type	
1.09	Access	☐ Front ☐ Rear ☐ Double front
2.00	ENVIRONMENTAL CONDITIONS	
2.01	Place of Installation	
2.02	Site / environmental condition	
2.03	Area classification	
3.0	SUPPLY NETWORK CHARACTERISTICS	
3.01	Voltage	
3.02	Phase Number	
3.03	Frequency	
3.04	Neutral System	
3.05	Upstream protections (Supply by others)	
4.00	USE NETWORK DATA	
4.01	Output Power	
4.02	Output Voltage	
4.03	No. of phases	
4.04	Frequency	
4.05	Neutral System	
4.06	Online battery monitoring & Diagnostic facility	
4.07	Communication facility	
5.00	RECTIFIER	
5.01	Type (3,6,12 Pulses)	
5.02	Rectifier Quantity / Sizing (50%, 100%)	
5.03	Input transformer	
5.04	a. Rating	

**DATA SHEET
FOR
UNINTERRUPTED POWER SUPPLY**

5.05	b. Rated primary voltage		
5.06	c. Inrush current		
5.07	Operating Condition		
5.04	a. Stand alone	☐ Yes	☐ No
5.05	b. Stand By	☐ Parallel	☐ Hot
5.06	Sharing of Loads	☐ Yes	☐ No
5.07	Rated power (Floating Mode)	☐ With Fan	☐ Without Fan
5.08	Maximum observed load		
5.09	Recommended breaker rating		
5.10	Battery quantity / Sizing (50%, 100 %,)		
5.11	Input peak current		
5.12	Rectifier rated output current		
5.13	Limitation of rectifier current (After 10mn, 3mn, 1mn, 10s)		
5.14	Rectifier output voltage / Voltage variation		
5.15	a. Floating Mode		
5.16	b. Commissioning Mode		
5.17	c. High rate mode		
5.18	Ripple voltage with battery		
5.19	Residual ripple battery current		
5.20	Current Harmonic rejection		
5.21	Automatic changeover floating / commissioning	☐ Yes	☐ No
5.22	Automatic High rate operation	☐ Yes	☐ No
5.23	Efficiency	*	
5.24	Power factor	*	
5.25	Execution	☐ Thyristor	☐ IGBT Transistor
6.00	RECTIFIER CONTROL		
6.01	Rectifier ON / OFF	☐ Local	☐ Remote
6.02	Rectifier input MCCB	☐ Local	☐ Remote
6.03	Change over floating / commissioning	☐ Local	☐ Remote
6.04	High rate operation	☐ Local	☐ Remote
6.05	High rate operation duration timer	☐ Yes	☐ No
6.06	Battery MCCB	☐ Local	☐ Remote
6.07	DC output voltage adjustment	☐ Local	☐ Remote
6.09	DC current limit adjustment	☐ Yes	☐ No
7.00	RECTIFIER MEASURE DISPLAY		
7.01	DC circuit voltage	☐ Yes	☐ No
7.02	Battery charge and discharge current	☐ Yes	☐ No
7.03	Rectifier output current	☐ Yes	☐ No
7.04	AC ammeter & voltmeter with selector switches for rectifier inputs	☐ Yes (Via Display)	☐ No
7.05	Battery Autonomy time remaining	☐ Yes	☐ No
8.00	RECTIFIER MONITORING		
8.01	AC Input supply available	☐ Local	☐ Remote
8.02	Rectifier ON / OFF	☐ Local	☐ Remote
8.03	Operating Mode	☐ Floating	☐ Commissioning ☐ High rate

**DATA SHEET
FOR
UNINTERRUPTED POWER SUPPLY**

8.04	Manual / Automatic Operation	☐ Local	☐ Remote
8.05	Operation on Battery	☐ Local	☐ Remote
8.06	Commissioning / High rate inhibition	☐ Local	☐ Remote
8.07	DC Voltage High	☐ Local	☐ Remote
8.8	DC Voltage low	☐ Local	☐ Remote
8.09	Imminent discharge battery	☐ Local	☐ Remote
9.00	RECTIFIER FAULT DISPLAY		
9.01	AC input phase under voltage / failure	☐ Local	☐ Remote
9.02	Rectifier failure	☐ Local	☐ Remote
9.03	DC over voltage	☐ Local	☐ Remote
9.04	Charging failure / Battery discharging	☐ Local	☐ Remote
9.05	Battery disconnected	☐ Local	☐ Remote
9.06	DC earth fault	☐ Local	☐ Remote
9.07	Cubical fan failure	☐ Local	☐ Remote
9.08	Rectifier over current	☐ Local	☐ Remote
9.09	Battery over current	☐ Local	☐ Remote
10.00	RECTIFIER CUBICLE		
10.01	Length / Depth / Height	*	
10.02	Weight	*	
10.03	Cooling mode	*	
10.04	Anti condenser heaters	☐ Yes	☐ No
10.05	Protection against external surges	☐ Yes	☐ No
10.06	Internal lights	☐ Yes	☐ No
11.00	INVERTER		
11.01	PVM technology	☐ Yes	☐ No
11.02	Inverter Quantity (50%, 100%, ...)	*	
11.03	Output voltage window	*	
11.04	Operating conditions		
11.05	a. Stand alone	☐ Yes	☐ No
11.06	b. Stand b	☐ Parallel	☐ Hot
11.07	c. Sharing of the load	☐ Yes	☐ No
11.08	Rated power	* ☐ With fan	☐ Without fan
11.09	Output voltage regulation		
11.10	a. Steady state (%)		
11.11	b. Transient 50, 100% load change (%)		
11.12	c. Voltage recovery time		
11.13	Output voltage adjustment (%)		
11.14	Semi conductor sizing		
11.15	a. Maximum temp. (125%,....)	*	
11.16	b. Maximum current (125%,...)	*	
11.17	Inverter efficiency 4/4, 3/4, 2/4, 1/4 load	*	
11.16	Overall UPS efficiency 4/4, 3/4, 2/4, 1/4 load	*	
12.00	INVERTER CONTROL		

**DATA SHEET
FOR
UNINTERRUPTED POWER SUPPLY**

12.01	Inverter ON / OFF	☐ Local	☐ Remote
12.02	AC output voltage adjustment	☐ Local	☐ Remote
12.03	Synchronizing range adjustment	☐ Local	☐ Remote
12.04	Load transfer initiating	☐ Local	☐ Remote
12.05	Inverter output MCCB	☐ Local	☐ Remote
13.00	INVERTER MEASURE DISPLAY		
13.01	Output inverter voltage	☐ Yes	☐ No
13.02	Output inverter current	☐ Yes	☐ No
13.03	Output inverter frequency	☐ Yes	☐ No
13.04	By pass input voltage	☐ Yes	☐ No
14.00	INVERTER MONITORING		
14.01	Supply available	☐ Local	☐ Remote
14.02	Inverter ON	☐ Local	☐ Remote
14.03	Load on inverter	☐ Local	☐ Remote
14.04	Load on by pass	☐ Local	☐ Remote
14.05	Alternative / by pass supply available	☐ Local	☐ Remote
14.06	Inverter / by pass synchronization	☐ Local	☐ Remote
14.07	Static switch by passed	☐ Local	☐ Remote
15.0	INVERTER FAULT DISPLAY		
15.01	Inverter failure	☐ Local	☐ Remote
15.02	Output voltage deviation	☐ Local	☐ Remote
15.03	Inverter over current / Output over load	☐ Local	☐ Remote
15.04	Synchronizing fault	☐ Local	☐ Remote
15.05	Operation by pass transformer	☐ Local	☐ Remote
15.06	Emergency supply fault	☐ Local	☐ Remote
15.07	AC earth fault	☐ Local	☐ Remote
15.08	Cooling fan failure	☐ Local	☐ Remote
15.09	Cubicle inverter stack over temperature	☐ Local	☐ Remote
16.00	INVERTER CUBICLE		
16.01	Length / Depth / Height	*	
16.02	Weight	*	
16.03	Cooling mode	*	
16.04	Anti condenser heaters	☐ Yes	☐ No
16.05	Internal lighting	☐ Yes	☐ No
17.00	RECTIFIER & INVERTER CUBICLE SIGNALIZATION		
17.01	Type (Lamps, LED, Display unit)		
17.02	Signalization of colors		
17.03	Lamp test	Yes	
17.04	Fault reset push buttons	Yes	
17.05	Auto diagnostic display	Yes	
17.06	Type of remote signaling		
17.07	Serial link communication	Yes	

**DATA SHEET
FOR
UNINTERRUPTED POWER SUPPLY**

17.08	Battery diagnostic facilities	
17.09	Connection to SCMS	
17.10	Communication facilities	
17.11	General mimic diagram	
17.12	Common fault signal	
18.00	RECTIFIER & INVERTER CUBICLE GENERAL CHARACTERISTICS	
18.01	Access	
18.02	Cable entry	Bottom
18.03	Overall length / Depth / Height	*
18.04	Overall weigh	*
18.05	Degree of protection (IP)	IP 42
18.06	Painting	
18.07	a. Treatment	
18.08	b. Color	
18.09	Global noise level at full load	
19.00	BY PASS	
19.01	Manual by pass switch	☐ Yes ☐ No
19.02	Max. allowable short ckt current	☐ Yes ☐ No
19.03	Protection against external surges	☐ Yes ☐ No
20.00	STATIC SWITCH	
20.01	Quantity	
20.02	Static, Electromechanical	
20.03	Change over inverter / transformer	
20.04	a. Manual, Automatic	
20.05	b. With, without breaking	
20.06	c. Operating time	
21.00	BY PASS TRANSFORMER	
21.01	Manufacture / Type	*
21.02	Quantity	*
21.03	Rated Power	*
21.04	Rated primary voltage	
21.05	Rated secondary voltage at no load	*
21.06	Rated frequency	
21.07	No. of phases	
21.08	Connection symbol and vector group	*
22.00	BATTERY	
22.01	Manufacturer	*
22.02	Quantity / Sizing (50%, 100 %,....)	
22.03	Type	
22.04	a. Vented, Gas recombination	
22.05	b. Lead acid, Cadmium-Nickel	
22.06	Rated voltage	*

**DATA SHEET
FOR
UNINTERRUPTED POWER SUPPLY**

22.07	Number of Cell	*
22.08	Voltage per cell	
22.09	a. Floating mode	*
22.10	b. Commissioning Mode	*
22.11	c. High rate mode	*
22.12	d. End of discharge at 20° C	*
22.13	Capacity	
22.14	a. Batter fully charged (Ah)	*
22.15	b. After hours of discharge (h/Ah)	*
22.16	Autonomy	
22.17	Load current	
22.18	a. Float mode	*
22.19	b. Commissioning mode	*
22.20	c. High rate mode	*
22.21	Short circuit current at	
22.22	a. Battery fully discharge	*
22.23	b. Battery end of discharge	*
22.24	Charging time in commissioning mode up to	
22.25	a. 80% capacity	*
22.26	b. 100% capacity	*
22.27	Charging in high rate mode	
22.28	a. 80% capacity	*
22.29	b. 100% capacity	*
22.30	Battery hydrogen emission	
22.31	a. High rate charge	*
22.32	b. Commissioning charge	*
22.33	c. Float charge	*
22.34	Delivery condition	
22.34	a. Cells delivery filled, dry	*
22.35	b. Electrolyte delivery dry	*
22.36	Max. storage time before first charging battery	*
22.37	Cable connecting battery to UPS unit	*
22.38	Battery cable route length	
23.00	INSTALLATION	
23.01	Location	
23.02	a. Battery room – well ventilated	☐ Yes ☐ No
23.03	b. Battery discharge room	☐ Yes ☐ No
23.04	Mounting	
23.05	a. Cable with fixing frame	☐ Yes ☐ No
23.06	b. On steel stands with proper foot installation	☐ Yes ☐ No
23.07	c. No. of tiers / steps (3 step maximum)	*
23.08	Dimensions / Weight per cell	
23.09	a. Length / Depth / Weight	*
23.10	b. Weight with electrolyte	*
23.11	c. Volume of electrolyte	*
23.12	Overall length / Depth / Height	

**DATA SHEET
FOR
UNINTERRUPTED POWER SUPPLY**

23.13	a. Cubicle	*	
23.14	b. Steel stand	*	
23.15	Overall weight	*	
23.16	Required ventilation		
23.17	a. Floating mode	*	
23.15	b. Commissioning / High rate mode	*	
23.16	Heat dissipation		
23.17	a. Floating mode	*	
23.18	b. Commissioning / High rate mode	*	
24.00	ACCESSORIES		
24.01	Densimeter	☐ Yes	☐ No
24.02	Portable voltmeter	☐ Yes	☐ No
24.03	Portable earth fault detector	☐ Yes	☐ No
24.04	Automatic filling device	☐ Yes	☐ No
24.05	Thermometer	☐ Yes	☐ No
24.06	Nameplates	☐ Yes	☐ No
24.07	Connections	☐ Yes	☐ No
24.08	Isolating breaker		
24.09	a. Type		
24.10	b. Tripping Coil	☐ Yes	☐ No
24.11	c. Enclosure		
24.12	Tool box	☐ Yes	☐ No
24.13	Fixing Accessories	☐ Yes	☐ No
24.14	Battery load discharge MCCB	☐ Yes	☐ No
24.15	Battery online monitoring system		
24.16	Communication to SCMS		
NOTES:			
	*	Data to be filled by supplier with its bid in the supplier data column, those data shall be in accordance with standard specification	
	#	Data to be defined during detailed engineering	
	# #	Data to be verified by supplier	

DATA SHEET
FOR
HV AND LV CABLES

**DATA SHEET
FOR
HV AND LV CABLES**

GENERAL INFORMATION		
Applicable To: ☐ Proposal ☐ Purchase ☐ As Built ☐ Vendor shall complete Data Sheet with information not otherwise provided by Buyer.		
Client: _____		
Facility: _____	Tag Number: _____	
Location: _____	Manufacturer/Model No.: _____	
Service: _____		
[TECHNICAL DATA SHEET]		
1.00	Service / Application	
2.00	Make / Country of Origin	*
3.00	Site / Environment Conditions	
4.00	Power system details	
4.01	System Voltage	
4.02	System frequency	
4.03	No. of phases & wires.	
4.04	Earthing	
4.05	Voltage Rating of Cables	☐ Earthed ☐ Unearthed
	a) With earthed neutral	
	b) With unearthed neutral	
4.06	Maximum system voltage	
5.00	Type of cables	
5.01		☐ High Voltage ☐ low voltage
5.02		☐ XLPE Insulated ☐ PVC Insulated
5.03		☐ Fire Safe (FS) ☐ Heat Resistance (HR)
5.04		☐ Flame Retardant , Low Smoke (FRLS)
5.05		☐ Non flame retardant , Low smoke (NONFRLS)
6.00	Cable quantity – furnish details for each type	
6.01	Quantity of H.V Cable with type & other details	
6.02	Quantity of L.V. power cable with type & other details	
6.03	Quantity of L.V. power cable with type & other details	
6.04	Quantity of L.V. power cable with type & other details	
7.00	Minimum bending radius	
8.00	De rating factors	
9.00	Single phase to ground fault current	☐ Applicable AMP
	For 1 second	☐ Not applicable
10.00	Conductor	
10.01	Material	
10.02	No. of cores & cross section area	
10.03	Current carrying capacit A	*

**DATA SHEET
FOR
HV AND LV CABLES**

	Short circuit current carrying capacity KA	*
10.04	Whether colour coded	☐ Yes ☐ No
10.05	Whether numbered	☐ Yes ☐ No
10.06	Core identification details	*
10.07	Whether stranded conductor	☐ Yes ☐ No
	- Flexibility class	*
10.08	Whether shaped conductor	☐ Yes ☐ No
10.09	Whether plated conductor	☐ Yes ☐ No
10.10	Plating details	*
10.11	Conductor resistance at 20°C (DC) OHM/KM	*
	- Conductor resistance at 20°C (DC) OHM/KM	*
	- Conductor resistance at 50 Hz OHM/KM	*
10.12	Conductor screening requirement	☐ Yes ☐ No
	- Type, material & thickness of screening	*
10.13	Annealing test for copper	*
10.14	Tensile strength of aluminium N/mm ²	*
10.15	Wrapping test for aluminium	*
11.00	Conductor insulation	*
11.01	Insulation material & grade	*
11.02	Insulation thickness MM	*
11.03	Screening requirement	☐ Yes ☐ No
11.04	Type, material & thickness of screening	*
11.05	Tensile strength of aluminium	*
11.06	Wrapping test for aluminium	*
12.00	Inner sheath	☐ Required ☐ Not required
12.01	Material & colour	*
12.02	Type of inner sheath	☐ extruded ☐ wrapped/tapped
		☐ FRLS ☐ NON FRLS
12.03	Inner sheath thickness - MM	*
12.04	Whether filler/dummy cores provided	☐ Yes ☐ No
12.05	Materials of dummy cores	*
13.00	Armouring	☐ Required ☐ Not Required
13.01	Type of armouring	☐ Wire ☐ Flat
13.02	Material & coating	☐ Steel ☐ Aluminium
		☐ other (specify)
		☐ Galvanised ☐ Non Galvanised
13.03	Thickness / diameter / gauge of armour	*
13.04	Whether PVC tape provided below armour	☐ Yes ☐ No
14.00	Outer sheath	*

DATA SHEET FOR HV AND LV CABLES

14.01	Material	*
14.02	Type	☐ Heat resistance (HR) ☐ Fire safe (FS)
		☐ Flame retardant, low smoke (FRLS)
		☐ Non flame retardant low smoke (NONFRLS)
14.03	Thickness -MM	*
14.04	Colour	*
14.05	Temperature grade	*
14.06	Oxygen index	*
14.07	Anti-termite & Anti-Rodent characters required	☐ Yes ☐ No
14.08	Tensile strength -MM	*
14.09	Elongation %	*
15.00	Outer diameter of complete cable	*
16.00	Diameter of cable with cores & inner sheath only	*
17.00	Diameter with cores, inner sheath & armouring	*
18.00	Voltage drop of cable per KM length	*
18.01	When laid in air.V	*
18.02	When laid in ground V	*
18.03	When laid in tray/ductV	*
19.00	Whether length marking on the cable is required	☐ Yes ☐ No
20.00	Whether drum length as per consumer	☐ Yes ☐ No
	Requirement can be supplied	
21.00	Cable lengths supplied in each drum.	*
22.00	Per meter weight of complete cable	*
23.00	Total weight of cable with drum KG	*
24.00	Quantity variation	*
25.00	Tests	
25.01	a) Wheather special test to be carried out on samples	☐ Yes ☐ No
	b) Cables to undergo special test	
25.02	a) Wheather type test to be carried out on samples	☐ Yes ☐ No
	b) Cables to be type tested.	
26.00	Additional information / requirements	
27.00	Reference codes	
NOTES:		
	* Data to be filled by supplier with its bid in the supplier data column, those data shall be in accordance with standard specification	
	☐ Indicates applicable choice / requirement.	
	Vendor shall follow reference codes as specified and / or otherwise shall list out codes followed by them	

**DATA SHEET
FOR
SOLAR ELECTRIC POWER SYSTEM**

**DATA SHEET
FOR
SOLAR ELECTRIC POWER SYSTEM**

DOCNO: VCS-DS-EL-006
Rev No : 01

1.	Solar System	
1.1.	Type	Photovoltaic
1.2.	Application	Telecom; scada; lighting and other electrical loads
1.3.	Load Voltage	230 V AC 3Φ/1Φ
1.4.	Ripple Output	20 mV
1.5.	Daily Load Demand	As per Load List/SOR
1.6.	System Earthing	Floating
1.7.	Battery Backup Required	Yes
1.8.	Type Of Alternative Energy Source Available	Grid Power
1.9.	Location (Solar Panels)	Unclassified Area
1.10.	Wind Velocity (Max.)	
1.11.	Latitude	< 100 M above MSL
1.12.	Longitude	As per Site
1.13.	Design Ambient Temp	45°C
1.14.	Insolation Data	As per Site
1.15.	Expected Life Span	25 years for all components
2.	Solar Panel	
2.1.	Module Output Watts Peak	
2.2.	No. Of "NO SUN DAYS" Battery Backup Required	03 Days
2.3.	Load To Be Disconnected If Battery State Of Charge Is Low (Indicate SoC %)	Yes (30%)
2.4.	PV Array Mounting Considerations	Suitable to withstand summer Storms
2.5.	Solar Module Framing Material	Aluminium
2.6.	Module Dimensions /Weight	
2.7.	Junction Box Material Of Solar Panel	
2.8.	Material Of Bird Spikes	
2.9.	No. Of Bird Spikes Per Module	
2.10.	No. Of By-Pass Diodes Per Module	
2.11.	Make And Type Of By-Pass Diodes	
2.12.	No. Of Solar Cells Per Module	
2.13.	Solar Cell Manufacturer's Type Ref. No.	

**DATA SHEET
FOR
SOLAR ELECTRIC POWER SYSTEM**

DOCNO: VCS-DS-EL-006
Rev No : 01

2.14.	Make Of Solar Modules	
2.15.	Country Of Origin	
2.16.	Max. Temperature Rise Of Solar Cells Under Severe Working Condition Over Max. Ambient Temperature	
2.17.	Nominal Voltage Of Solar Array	
2.18.	Annual Deficit Of Capacity (kWh) From Solar Array	
2.19.	Material Of Solar Array Junction Box	
2.20.	Degree Of Protection Of Solar Array JB	
2.21.	No. Of Solar Panels	
3.	Solar Charge Controller	
3.1.	Type	
3.2.	Enclosure Degree Of Protection	IP-51
3.3.	Dimensions	_____ mm(L) x _____ mm (W) x _____ mm (H)
3.4.	Weight	
3.5.	Mounting	Floor/Wall mounted
3.6.	Cable Entry	From bottom
3.7.	Access	From front only
3.8.	Internal Wiring Minimum Size Control	Vendor Standard
3.9.	Make	
3.10.	Country Of Origin	
3.11.	Voltage Regulator	

Battery Bank

For Battery Banks refer datasheet for battery bank

NOTES:

1. The design load shall be finalized by the contractor based on actual load of selected equipment. However, the daily load demand given under Item 1.5 are minimum required.
2. Vendor shall furnish duly filled-in datasheet along with the Bids.
3. Ah capacity of battery shall be selected considering design ambient of 40°C.
4. The interconnecting cables between solar panel and Main junction boxes shall be Flame retardant Low Smoke (FRLS) type. All cables shall be in continuous lengths without intermediate joints.
5. The loads shall be considered as a minimum. The loads as indicated are tentative. The contractor shall decide the final load based on the final selected equipment.

**DATA SHEET
FOR
LV DISTRIBUTION BOARD**

**DATA SHEET
FOR
LV DISTRIBUTION BOARD**

**DATA SHEET FOR AC/DC SWITCHBOARD
PART-I (TO BE FURNISHED BY PURCHASER)**

1. SITE CONDITIONS:	
1.1 Design Temp	40°C
1.2 Relative humidity	Highly humid
1.3 Altitude above MSL	Less than 1000 m
1.4 Location	Various
1.5 Atmosphere	Highly corrosive and dusty as applicable for oil and gas installation
2. OPERATING CONDITIONS	
2.1 Voltage	AC 415 V 3Φ 4 Wire/ AC 240 V 1Φ 2 Wire / Other Please specify
2.2 Frequency	50 Hz ± 3% (applicable for AC switchboards)
2.3 No of phases	3Φ / 1Φ (applicable for AC switchboards)
2.4 System fault level	Min.25kA for 415 V AC & Min. 10 kA for DC switchboards (However DC Switchboards shall be suitable for withstanding fault level/current as applicable for short circuit contribution of Ni-Cd batteries at a particular location)
2.5 System earthing	Solidly earthed for AC & Floating for DC
2.6 Auxiliary supply	By Vendor
2.7 Power supply for spring charging motor	By Vendor
3. ELECTRICAL DATA	
3.1 Short circuit withstand capacity for 1 sec	Min.25kA for 415 V AC (See SLD for exact capacity) & Min. 10 kA for DC switchboards (However DC Switchboards shall be suitable for withstanding fault level/current as applicable for short circuit contribution of Ni-Cd batteries at a particular location)
3.2 Busbar current rating inside panel at specified ambient	As per Single line diagrams
3.3 Busbars Insulation	Heat shrink PVC Sleeves
3.4 System breaking capacity	Min.25kA for 415 V AC & Min. 10 kA for DC switchboards (See SLD for exact capacity) (However DC Switchboards shall be suitable for withstanding fault level/current as applicable for short circuit contribution of Ni-Cd batteries at a particular location)
3.5 System making capacity	As per approved Test certificates
3.6 Type of Circuit breaker	As per Single Line Diagram
3.7 Duty cycle of breaker	Not applicable
3.8 Incoming power entry	During Detailed Engineering
3.9 Cable entry (I/C & O/G)	During Detailed Engineering

**DATA SHEET
FOR
LV DISTRIBUTION BOARD**

3.10 Bus duct entry	Not applicable
3.11 Colour shade Exterior	As per IS-5
3.12 Feeder arrangement	Single front, fixed type suitable for flush mounting against wall with front access, front maintenance only and without rear access. Contractor shall ensure that equipment supplied can be located in available space. For incoming and outgoing feeder details, refer SLDs
3.13 Minimum motor starter module size	Vendor standard
3.14 Minimum switch-fuse module size	Vendor standard
3.15 Floor fixing	Integral base frame and tack welding to the floor channel
3.16 MAKE OF EQUIPMENTS / COMPONENTS	Refer Approved Vendor List

**DATA SHEET
FOR
LV DISTRIBUTION BOARD**

**PART-II
(TO BE FILLED UP BY VENDOR ALONG WITH QUOTATION)
415 V AC / 24V DC Switchboard**

- 1.0 Make: _____
- 2.0 Type / designation: _____
- 3.0 Degree of protection: _____
- 4.0 Overall weight of CB panel
- Incomer _____ kg
- Outgoing _____ kg
- 5.1 Overall dimensions of CB panel
- Length: _____ mm
- Depth: _____ mm
- Height: _____ mm
- NOTE: Vendor shall furnish the dimensions of various types/ratings of CB panels separately.
- 5.2 Overall dimensions of MCC/contactor controlled feeder panel:
- Length: _____ mm
- Depth: _____ mm
- Height: _____ mm
- 6.1 Overall dimensions of each switchboard:
- PCC (Length*Depth*Height): _____ mm
- PMCC (Length*Depth*Height): _____ mm
- MCC (Length*Depth*Height): _____ mm
- ASB (Length*Depth*Height): _____ mm
- LDB (Length*Depth*Height): _____ mm
- 6.2 Overall weight and dimensions of largest shipping section:
- Weight: _____ kg
- Length: _____ mm
- Depth: _____ mm
- Height: _____ mm

**DATA SHEET
FOR
LV DISTRIBUTION BOARD**

7.0 Recommended clearances for SWBD

Front: _____mm

Rear: _____mm

Above: _____mm

8.0 Shock loading on foundation :

9.0 Max size/no of PVC-insulated Al cond (AYFY) _____

cables that can be terminated inside the panel

with rear extension/ without rear extension

10.0 Clearance in air

Phase to phase : _____mm

Phase to earth : _____mm

11.0 Main horizontal bus bar

11.1 Busbar current rating at design ambient (40 °C) : _____A

11.2 Main bus bar size :

11.3 Main bus bar material : _____Al/Cu

11.4 Main bus bar location : _____Top/Bottom

12.0 Vertical bus bars

12.1 Busbar current rating at design ambient (40 °C) : _____A

12.2 Bus bar size : _____

12.3 Bus bar material : _____Al/Cu

13.0 Insulating material : _____

14.0 Earth bus size/material : _____mm²/ Al / Cu

15.0 1 min power frequency voltage : _____kV

16.0 1 sec short circuit withstand capacity : _____kA

17.0 Peak dynamic withstand capacity : _____kA

18.0 Safety shutter provided for test and drawout positions : _____Yes/No

19.0 Whether adaptor panel required between PCC/MCC panel : Yes/No

19.1 If Yes, furnish dimensions :

**DATA SHEET
FOR
LV DISTRIBUTION BOARD**

20.0 CIRCUIT BREAKER (Following data for each rating of breaker)

20.1	Make :	_____
20.2	Type designation :	_____
20.3	No of poles/phase :	_____
20.4	Nominal current rating (in free air) :	_____ A at °C
20.5	In panel current rating at site conditions :	_____ A
20.6	Breaking capacity :	_____ kA
20.7	Short time rating (1 sec) :	_____ kA
20.8	Peak making current :	_____ kA (peak)
20.9	1 min dry withstand volt (power frequency) :	_____
20.10	Duty cycle :	
20.11	Total opening time :	m sec
20.12	Total closing time :	m sec
20.13	Power required for opening :	W/VA
20.14	Power required for closing :	W/VA
20.15	Power required for spring charging motor :	W/VA
20.16	Breaker is trip free :	Yes
20.17	Closing mechanism :	
20.18	Provision of manual spring charging :	Yes/No
20.19	Tripping mechanism :	
20.20	Mechanical trip PB provided :	Yes/No
20.21	Mechanical ON/OFF indicator provided :	Yes/No
20.22	Operation counter provided :	Yes/No
20.23	Time taken for spring charging :	sec
20.24	No. of auxiliary contacts :	NO + NC
20.25	Derating required for capacitor switching :	%

22.0 CONTACTOR (Following data for each rating of contactor)

22.1 Make :

**DATA SHEET
FOR
LV DISTRIBUTION BOARD**

22.2	Type designation :	_____
22.3	Rated voltage :	_____
22.4	Rated current	_____
	AC-3 Duty :	_____
	AC-4 Duty :	_____
22.5	Thermal rating :	_____
22.6	Making capacity :	_____
22.7	Breaking capacity :	_____
22.8	Switching frequency : ops/hr	_____
22.9	Life Electrical :	_____ ops (at rated voltage)
	Mechanical :	_____ ops
22.10	Coil consumption - Pick up :	_____ VA
22.11	Coil consumption - Hold on :	_____ VA
22.12	Closing time :	_____ secs
22.13	Opening time :	_____ secs
22.14	No of aux. contacts :	_____ NO + NC
22.15	Maximum permitted back up fuse rating :	_____ Amps

23.0 SWITCH (Following data for each rating of switch)

23.1	Rated voltage :	_____
23.2	Rated current :	_____
23.3	AC 23 rating :	_____
23.4	Rated making capacity :	_____
23.5	Rated breaking capacity :	_____
23.6	Rated short circuit withstand current with max. permissible rated fuses :	_____
23.7	Mechanical life :	_____
23.8	Maximum permitted back up fuse rating :	_____

**DATA SHEET
FOR
LV DISTRIBUTION BOARD**

24.0 THERMAL OVERLOAD RELAY (Following data for each type of relay)

- 24.1 Make : _____
- 24.2 Type : _____
- 24.3 Setting range : _____
- 24.4 Single phasing preventor : Intergral / Separate
- 24.5 Type of operation : Direct / CT operated
- 24.6 Maximum permitted back up fuse rating : _____

25.0 FUSES (Following data for each rating of fuse)

- 25.1 Make : _____
- 25.2 Type : _____
- 25.3 Current rating _____

**DATA SHEET
FOR
POWER AND CONTROL CABLES**

**DATA SHEET
FOR
POWER AND CONTROL CABLES**

GENERAL INFORMATION		
Applicable To: ☐ Proposal ☐ Purchase ☐ As Built ☐ Vendor shall complete Data Sheet with information not otherwise provided by Buyer.		
Client: _____		
Facility: _____	Tag Number: _____	
Location: _____	Manufacturer/Model No.: _____	
Service: _____		
[TECHNICAL DATA SHEET]		
1.	Name of manufacturer	
2.	Voltage Grade	
3.	Type of cable	
4.	Standard Referred	
5.	Conductor	
	➤ Normal cross sectional area	
	➤ Shape of the conductor	
	➤ Maximum DC resistance at 20 Deg.C	
	➤ Number of stands	
6.	Insulation	
	➤ Type and material of insulation	
	➤ Thickness of insulation	
	➤ Colour Scheme/core identification	
	➤ Extruded	
7	Inner Sheath	
	➤ Material	
	➤ Minimum Thickness	
	➤ Extruded	
	➤ Approximate dia over inner sheath	
8	Armour	
	➤ Type	
	➤ Material	
	➤ Nominal Thickness	
9	Outer Sheath	
	➤ Material	
	➤ Minimum Thickness	
	➤ Extruded	
10.	Approximate overall diameter	
11.	Normal drum length	
12.	AC resistance of the conductor at maximum operating temperature.	
13.	Approximate reactance per phases at 50Hz	

**DATA SHEET
FOR
POWER AND CONTROL CABLES**

14.	Current Rating	
➤	In ground	
➤	In air	
➤	Maximum conductor temperature during continuous operation.	
➤	Maximum conductor temperature during short circuit.	
➤	Maximum permissible bending radius.	

**DATA SHEET
FOR
LIGHTING DISTRIBUTION BOARD AND LIGHTING PANEL**

**DATA SHEET
FOR
LIGHTING DISTRIBUTION BOARD AND LIGHTING
PANEL**

GENERAL INFORMATION		
Applicable To: ☐ Proposal ☐ Purchase ☐ As Built ☐ Vendor shall complete Data Sheet with Information not otherwise provided by Buyer.		
Client: _____	Tag Number: _____	
Facility: _____	Manufacturer/Model No.: _____	
Location: _____		
Service: _____		

[TECHNICAL DATA SHEET]		
1.00	GENERAL	
1.01	Service / application	
1.02	Panel name	
1.03	Make/type/model no. & country of origin	
1.04	Degree of protection of enclosure & temp. Class	
1.05	Installation	☐ Indoor ☐ Outdoor
1.06	Mounting type	☐ Floor ☐ Wall ☐ Frame / Structure
2.00 SITE CONDITION		
2.01	Location	
2.02	Site / environment conditions	
2.03	Area classification	
3.00 DISTRIBUTION BOARD DETAILS		
3.01	Enclosure construction material and type	☐ Metallic ☐ Non - Metallic ☐ Sheet steel ☐ Casting ☐ Cold rolled ☐ Hot rolled
3.02	Thickness of enclosure	*
3.03	Access	☐ Front ☐ Rear
4.00 INCOMER DETAILS		
4.01	Voltage and frequency	
4.02	No. Of phases and wires	
4.03	Cable size and type	
4.04	Cable entry	☐ Top ☐ Bottom ☐ Side
4.05	a. Incomer switch type	☐ MCCB ☐ MCB ☐ RCCB / ELCB ☐ Switch - Fuse unit
4.06	b. Rating and no. Of poles	*
4.07	c. Sensitivity of RCCB / ELCB	*
5.00 OUTGOING CIRCUIT DETAILS		
5.01	Voltage and frequency	
5.02	No. Of outgoing circuits with ratings	
5.03	Cable entry	☐ Top ☐ Bottom ☐ Side
5.04	a. With switch fuse units	
5.05	b. With MCB/ MCCB	
5.06	c. With ELCB / RCCB	
5.07	d. With contactor - timer interlocks	

**DATA SHEET
FOR
LIGHTING DISTRIBUTION BOARD AND LIGHTING
PANEL**

5.08	e. With contactor - photocell interlocks	
5.09	f. With other interlocks	
5.10	Sensitivity of ELCB / RCCB	*
5.11	No. of poles in switching component	*
5.12	No. of outgoing cables with cable size & type	
5.13	Cable entry	☐ Top ☐ Bottom ☐ Side
6.00	BUSBAR	
6.01	Whether Bus bars required	☐ Yes ☐ No
6.02	Bus bar material & size	*
6.03	Nominal rating	*
6.04	Short circuit rating	
6.05	Bus bar clearances	
6.06	a. Phase to phase	
6.07	b. Phase to earth	
6.08	c. Phase to neutral	
6.09	Minimum area of conductors used for internal wiring	*
6.10	Cable glands	
6.11	Whether bus bars required	☐ Yes ☐ No
6.12	a. Cable gland supply	
6.13	b. Cable gland type / details	
6.14	Overall dimensions of panel (LxBxH)	
6.15	Weight kg	
6.16	Color shade of finish coat	
6.17	Additional information / requirements	
6.18	Reference codes	

**DATA SHEET
FOR
LIGHTING FIXTURES & ACCESSORIES**

**DATA SHEET
FOR
LIGHTING FIXTURE AND ACCESSORIES**

GENERAL INFORMATION		
Applicable To: ☐ Proposal ☐ Purchase ☐ As Built ☐ Vendor shall complete Data Sheet with information not otherwise provided by Buyer.		
Client: _____		
Facility: _____	Tag Number: _____	
Location: _____	Manufacturer/Model No.: _____	
Service: _____		
[TECHNICAL DATA SHEET]		
1.00	GENERAL	
1.01	Service / application	
1.03	Make & country of origin	*
1.04	Degree of protection of enclosure & temp. Class	
1.05	Temperature class	
2.00	SITE CONDITION	
2.01	Location / installation	
2.02	Site / environment conditions	
2.03	Area classification	
3.00	POWER SYSTEM DETAILS	
3.01	Power system	☐ A.C. ☐ D.C.
3.02	Voltage & frequency	
3.03	System in case of A.C. Power	
3.04	a. No. of phases & wire	
3.05	b. Neutral system	☐ With Neutral ☐ Without Neutral
3.06	c. Phase to Phase voltage	
3.07	d. Phase to earth voltage	
3.08	e. Whether neutral is earthed	☐ Yes ☐ No
3.09	System in case of D.C. Power	☐ Earthed ☐ Unearthed
4.00	LUMINAIRES TERMINAL DETAILS	
4.01	Indoor & unclassified area	
4.02	a. Type & Size of terminal	
4.03	b. Conductor size & material	
4.04	c. Termination method	
4.05	Outdoor & hazardous area	
4.06	a. Type & size of terminal	
4.07	b. Conductor size & material	
4.08	c. Termination method	
4.09	Earthing terminals	
4.10	a. Type & size of terminal	

**DATA SHEET
FOR
LIGHTING FIXTURE AND ACCESSORIES**

4.11	b. Conductor size & material	
3.00	FIXTURES / LUMINAIRES	
4.12	Type of fixtures/luminaires	
4.13		☐ Fluorescent
4.14		☐ Sodium Vapour
4.15		☐ Mercury Vapour
4.16		☐ Incandescent
4.17		☐ Halogen
4.18	FLUORESCENT LAMP FIXTURES	
4.19	Type of fixtures	☐ Fluorescent ☐ Compact fluorescent
4.20	Location / installation	☐ Indoor ☐ Outdoor
4.21	Mounting in case of indoor type	☐ Ceiling ☐ Recess ☐ Bracket
4.22	a. Other details about fixture	
4.23	b. Details	
4.24	Mounting in case of outdoor type	☐ Ceiling Pole ☐ Recess ☐ Bracket
4.25	Other details about fixture type	
4.26	Power supply details	
4.27	Ballast & starter details	*
4.28	No. Of indoor type fixtures (with type & rating details)	
4.29	No. Of outdoor type fixtures (with type & rating details)	
4.30	Lamp details	*
4.31	a. Rating, type & average life	
4.32	b. Luminous output after 100 hrs burning	
4.33	c. Luminous output after 1000 hrs burning	
4.34	d. Lamp cap type	
4.35	SODIUM VAPOUR LAMP FIXTURES	
4.36	Type of fixtures	☐ Low pressure ☐ High pressure
4.37	Location & application	
4.38		☐ Indoor ☐ Outdoor
4.39		☐ Street Lighting ☐ Flood Lighting
4.40		☐ Bay Lighting ☐ Area Lighting
4.41	Mounting in case of indoor type	☐ Ceiling ☐ Bracket
4.42	a. Whether control gear required separately	☐ Yes ☐ No
4.43	b. Other details about fixture	
4.44	Mounting in case of outdoor type	☐ Ceiling Pole ☐ Mast/Tower ☐ Bracket

**DATA SHEET
FOR
LIGHTING FIXTURE AND ACCESSORIES**

4.45	a. whether control gear required separately	☐ Yes	☐ No
4.46	b. Other details about fixture		
4.47	Power supply details		
4.48	Control gear details		
4.49	No. Of indoor type fixtures (with type & rating details)		
4.50	No. Of outdoor type fixtures (with type & rating details)		
4.51	Lamp details		
4.52	a. Rating, type & average life		
4.53	b. Luminous output after 100 hrs burning		
4.54	c. Luminous output after 1000 hrs burning		
4.55	d. Lamp cap type	☐ Pin	☐ Edison Screw
4.56	MERCURY VAPOUR LAMP FIXTURES		
4.57	Type of fixtures	☐ Low Pressure	☐ High Pressure
4.58	Location & application		
4.59		☐ Indoor	☐ Outdoor
4.60		☐ Street Lighting	☐ Flood Lighting
4.61		☐ Bay Lighting	☐ Area Lighting
4.62			
4.63	Mounting in case of indoor type	☐ Ceiling	☐ Bracket
4.64	c. Whether control gear required separately	☐ Yes	☐ No
4.65	d. Other details about fixture		
4.66	Mounting in case of outdoor type	☐ Ceiling Pole	☐ Mast/Tower ☐ Bracket
4.67	c. whether control gear required separately	☐ Yes	☐ No
4.68	d. Other details about fixture		
4.69	Power supply details		
4.70	Control gear details		
4.71	No. Of indoor type fixtures (with type & rating details)		
4.72	No. Of outdoor type fixtures (with type & rating details)		
4.73	Lamp details		
4.74	a. Rating, type & average life		
4.75	b. Luminous output after 100 hrs burning		
4.76	c. Luminous output after 1000 hrs burning		
4.77	d. Lamp cap type	☐ Pin	☐ Edison screw

**DATA SHEET
FOR
LIGHTING FIXTURE AND ACCESSORIES**

4.78	INCANDESCENT LAMP FIXTURES	
4.79	Location / installation	☐ Indoor ☐ Outdoor
4.80	Application	
4.81	Mounting in case of indoor type	☐ Ceiling ☐ Bracket ☐ Recess
4.82	Mounting in case of outdoor type	☐ Ceiling ☐ Mast/Tower ☐ Bracket ☐ Pole
4.83	Power supply details	
4.84	No. Of indoor type fixtures (with type & rating details)	
4.85	No. Of outdoor type fixtures (with type & rating details)	
4.86	Lamp details	
4.87	a. Rating, type & average life	
4.88	b. Luminous output after 100 hrs burning	
4.89	c. Luminous output after 1000 hrs burning	
4.90	d. Lamp cap type	
4.91	HALOGEN LAMP FIXTURES	
4.92	Mounting type	☐ Ceiling ☐ Mast/Tower ☐ Pole / Post ☐ Recess
4.93	Mounting type	
4.94	Power supply details	
4.95	No. Of fixtures with type & rating details	
4.96	Lamp details	
4.97	a. Rating, type & average life	
4.98	b. Luminous output after 100 hrs burning	
4.99	c. Luminous output after 1000 hrs burning	
4.100	d. Lamp cap type	
4.101	Manufacturer's catalogues for fixture & Lamps enclosed	☐ Yes ☐ No
4.102	Power factor of capacitors	*
4.103	Conductor material of ballasts	*
4.104	Insulation class of ballast	*
4.105	Luminaires & accessories for each type	
4.106	Internal wiring size	*
4.107	Wire guard size & material	*

**DATA SHEET
FOR
LIGHTING FIXTURE AND ACCESSORIES**

4.108	Material & thickness of housing & Reflectors	*
4.109	Protective coatings	☐ Painted ☐ Coated
4.110	Material of coating	*
4.111	- coating film thickness	
4.112	Colour shade of finish coat	
4.113	a. Fixture	
4.114	b. Control gear box	
4.115	Weight of luminaires	*
4.116	Packing details	*
4.117	Additional information / requirements	
4.118	Reference codes	
NOTES:		
	* Data to be filled by supplier with its bid in the supplier data column, those data shall be in accordance with standard specification	
	# Data to be defined during detailed engineering	
	# # Data to be verified by supplier	

**DATA SHEET
FOR
BATTERY CHARGER**

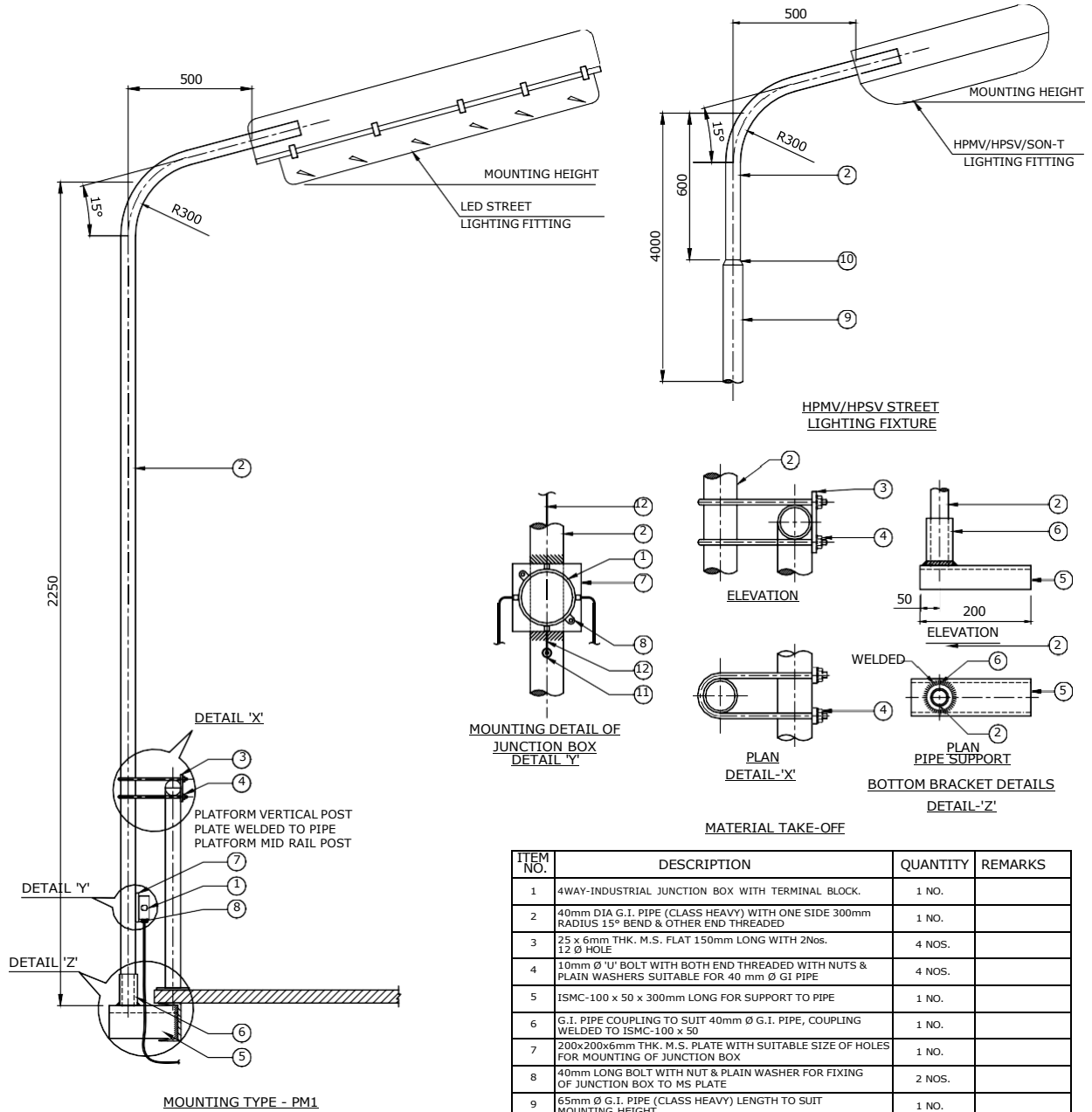
**DATA SHEET
FOR
BATTERY CHARGER**

GENERAL INFORMATION			
Applicable To: ☐ Proposal ☐ Purchase ☐ As Built Client: _____ Facility: _____ Location: _____ Service: _____		☐ Vendor shall complete Data Sheet with information not otherwise provided by Buyer. Tag Number: _____ Manufacturer/Model No.: _____	
[TECHNICAL DATA SHEET]			
1.0	Service		
2.0	Application		
3.0	Tag no.		
4.0	Make / model no. & country of origin	*	
5.0	Location / installation	☐ Indoor ☐ Outdoor	
6.0	Site / environment conditions		
7.0	Area classification		
8.0	Type		
9.0	a). Charger rating		
	b). Connected load		
	c). Charging time		
10.0	Battery details	*	
	a). Float/trickle charging current	*	
	b). Boost charging current A	*	
	c). Boost charging voltage V	*	
	d). Boost charging time (hr)	*	
	e). Type of battery		
	f). Battery capacity & number of cell		
11.0	Input details		
	a). Voltage V		
	b). Frequency Hz		
	c). Fault level KA		
	d). Supply variation		
	e). Ac input current during boost charging		
12.0	Output details		
12.1	Rated voltage V	*	
12.2	Float charger	*	
	a). Voltage range V	*	
	b). Current range A		
	c). Method of voltage control	*	
12.3	Boost charger	*	
	a). Voltage range V	*	
	b). Current range A	*	
	c). Method of voltage control	*	
13.0	Voltage regulation from full load to no load		
14.0	Harmonic content at rated load		
15.0	Efficiency	20% load	100% load
	a). Float charger %	*	*
	b). Boost charger %	*	*
16.0	Power factor	20% load	100% load

**DATA SHEET
FOR
BATTERY CHARGER**

	a). Float charger %	*	*
	b). Boost charger %	*	*
17.0	Type and make of components	*	
	a). Rectifier	*	
	b). MCCB / MCB	*	
	c). Indicating instruments	*	
	d). Annunciators	*	
	e). Push buttons	*	
	f). Indicating lamps	☐ Required	☐ Not required
18.0	Annunciators requirement	*	
19.0	No. Of annunciator points		
20.0	Construction details		
	a). Mounting type	☐ Floor	☐ Wall ☐ frame
	b). Type of cooling	☐ Top	☐ Bottom ☐ Side
	c). Cable entry	☐ Front	☐ Rear
	d). Access		
	e). Enclosure degree of protection and temperature class		
	f). Bus – bar material	*	
	g). Continuous current rating of bus bar A	*	
	h). Short circuit withstand capacity KA	☐ Yes	☐ No
21.0	Provision provided for remote annunciator		
22.0	Glands	*	
	a). Type	*	
	b). Number		
	c). Cable size sq.mm	*	
	d). Supply required	☐ Yes	☐ No
23.0	OVERALL DIMENSION (LxWxH) MM	*	
24.0	Weight kg	*	
25.0	Earth bus terminal and size	*	
26.0	Heat output from panel W	*	
27.0	Space heater	☐ Required	☐ Not required
	a). Voltage, rating & qty. Details of space heater	*	
28.0	Panel illumination	☐ Required	☐ Not required
	a). Voltage, rating & qty. Details of lamp	*	
29.0	Painting	*	
30.0	Colour shade of finish coat	*	
31.0	Whether erection, testing and commissioning in vendor's scope	☐ Yes	☐ No
32.0	Additional information / requirements		
33.0	Reference codes		
NOTES:			
	*	Data to be filled by supplier with its bid in the supplier data column, those data shall be in accordance with standard specification	
	#	Data to be defined during detailed engineering	
	#	Data to be verified by supplier	

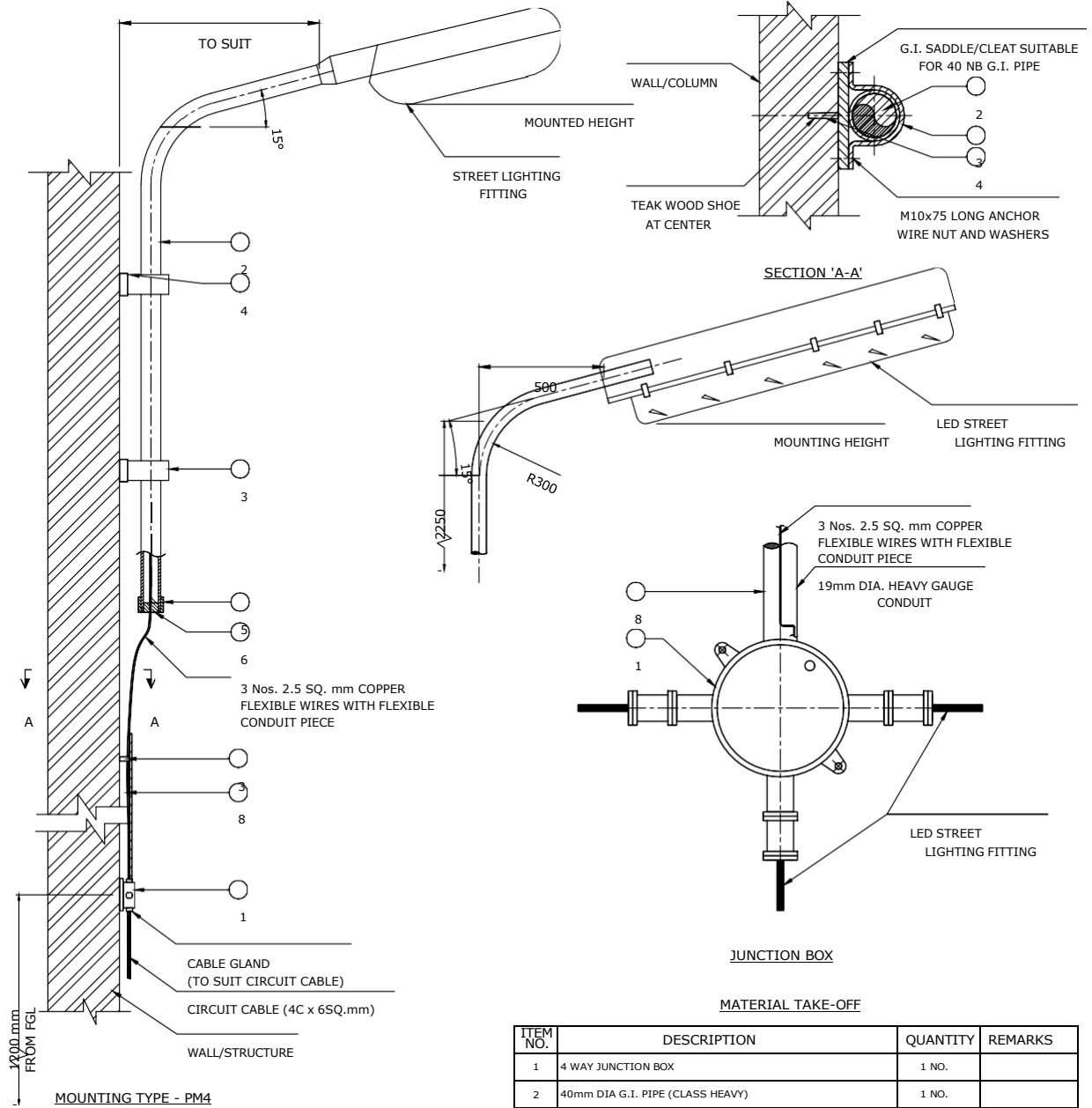
**TYPICAL HANDRAIL PIPE MOUNTING DETAILS
OF LED HPMV/HPSV LIGHTING
FITTING ON PLATFORM**



NOTES:

1. MOUNTING HEIGHT SHALL NOT EXCEED 4 MTRS. FROM THE TOP OF PLATFORM.
2. LIGHT FITTING SHALL BE WITH ONE EXTERNAL EARTH CONNECTION AND USE THIRD CORE OR PVC FLEXIBLE CABLE FOR INTERNAL EARTHING. EARTH JUNCTION BOX WITH TWO EXTERNAL EARTH CONDUCTORS.
3. CABLE GLANDS USED FOR TERMINATION OF FLEXIBLE CABLE SHALL BE DOUBLE SEAL WITH CONE GRIP TYPE.
4. PLUG ALL UNUSED ENTRIES OF LIGHTING FITTING AND JUNCTION BOX WITH THREADED STOPPING PLUGS.
5. WHEN MOUNTING HEIGHT IS MORE THEN 2.25M THEN 65 Ø G.I. PIPE WITH REDUCER SHALL BE USED.

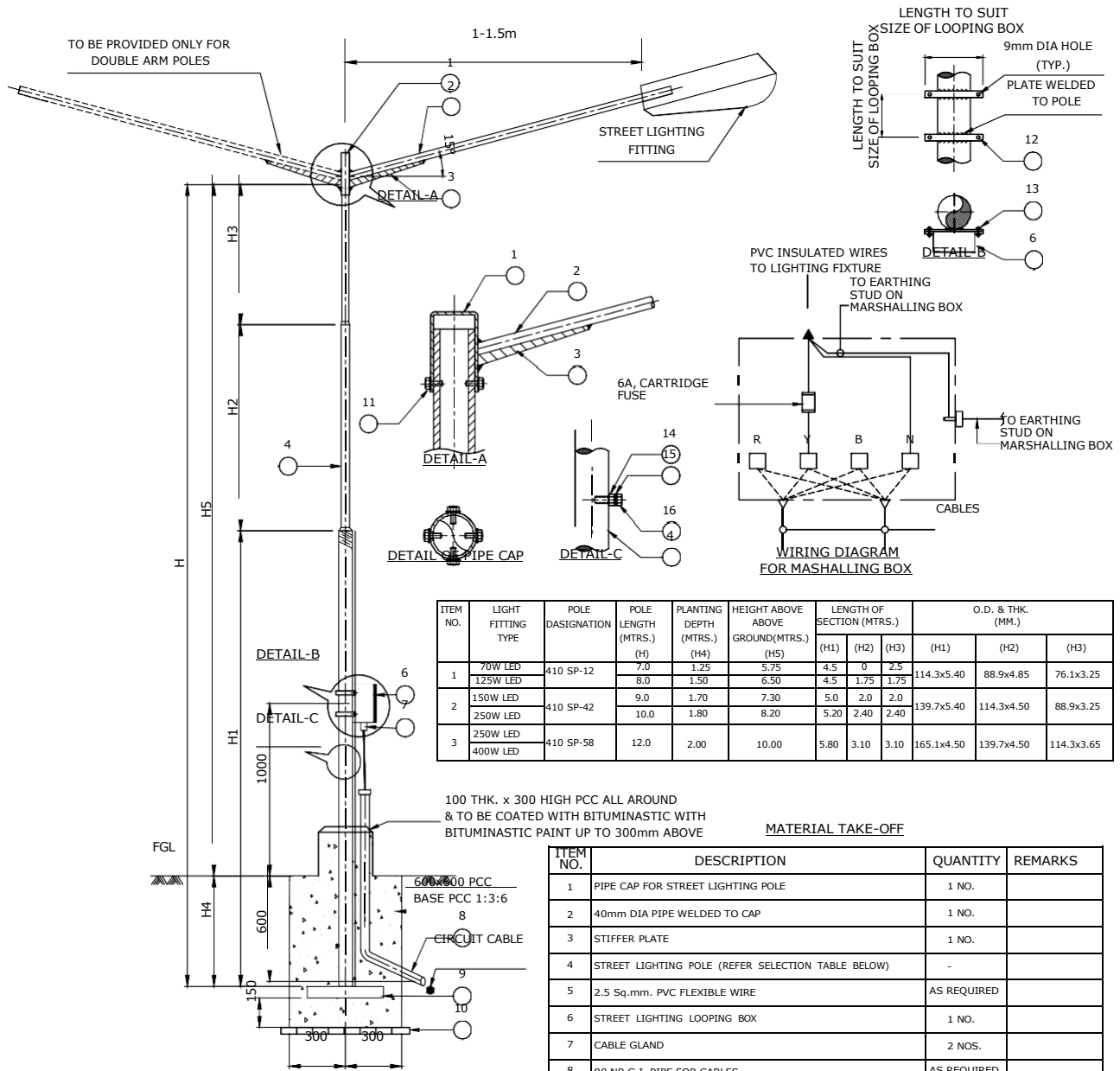
**TYPICAL MOUNTING DETAILS
OF STREET LIGHTING FITTING
(WALL/COLUMN MOUNTED)**



ITEM NO.	DESCRIPTION	QUANTITY	REMARKS
1	4 WAY JUNCTION BOX	1 NO.	
2	40mm DIA G.I. PIPE (CLASS HEAVY)	1 NO.	
3	G.I. SADDLE/CLEAT TO SUITABLE FOR 40mm Ø & G.I. PIPE WITH SCREWS, PLAIN WASHERS AND SPRING WASHERS	2 NOS.	
4	15mm THK. TEAK WOOD SHOE WITH BITUMINOUS PAINT	1 BLOCK	
5	G.I. PIPE COUPLING (TO SUIT 40mm Ø G.I. PIPE)	1 NO.	
6	RURDER GROMMET (TO SUIT 40mm Ø G.I. PIPE)	1 NO.	
7	50mm DIA G.I. PIPE SLEAVE	1 NO.	
8	19mm DIA G.I. HEAVY GAUGE CONDUIT	AS REQUIRED	
9	10A, 250V D.P WEATHER PROOF LIGHTING SWITCH WITH BOTTOM ENTRY	1 NO.	
10	SCREW WITH PLAIN WASHER AND RAWAL PLUG FOR FIXING JB & LIGHTING SWITCH	8 NOS.	

NOTES:

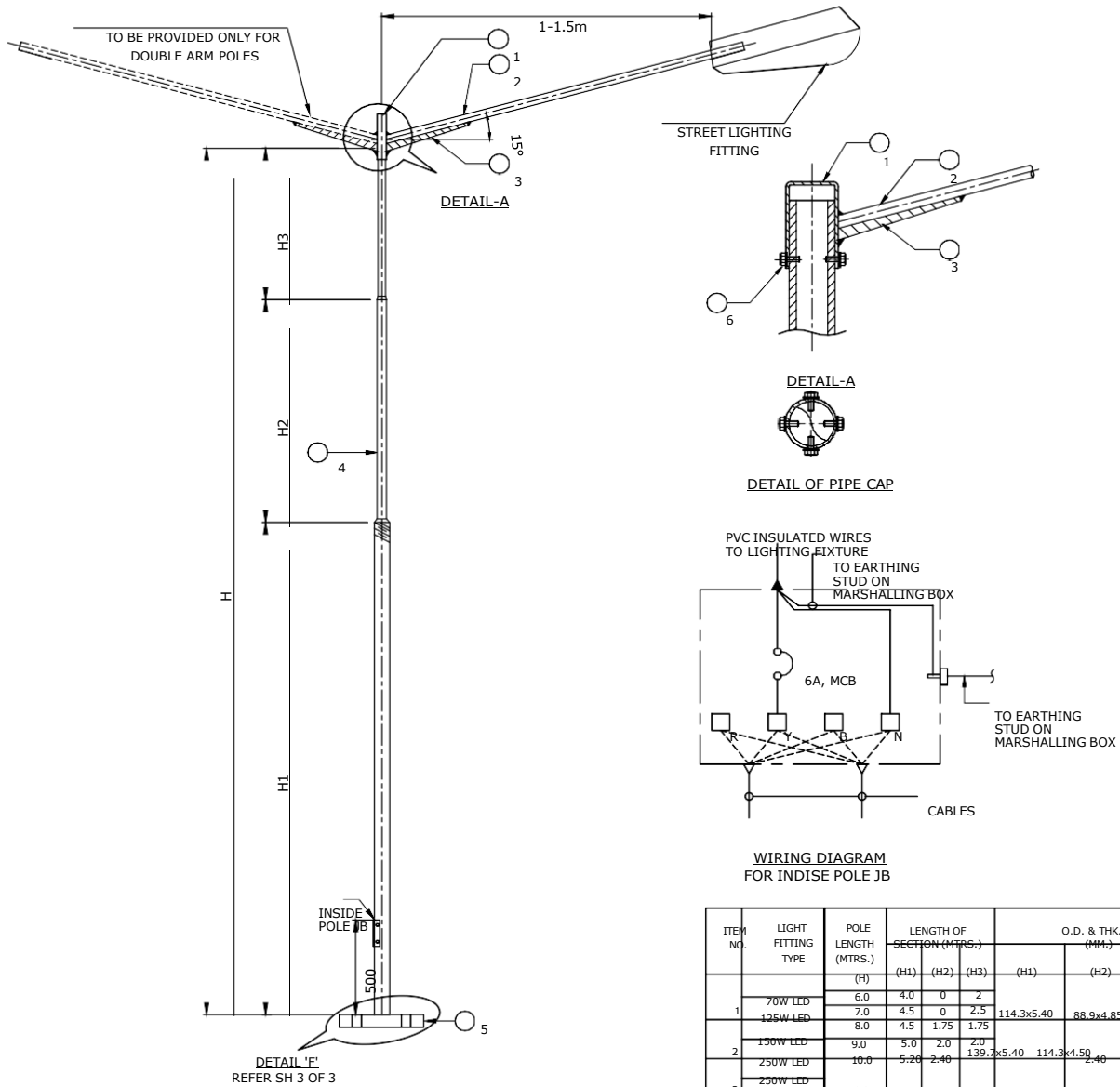
TYPICAL MOUNTING DETAILS OF STREET LIGHTING FITTING



NOTES:

- ALL DIMENSIONS ARE IN MILLIMETERS.
- POLE MATERIAL SHALL BE G.I. OR M.S AS PER PROJECT CONTRACT REQUIREMENTS .
- AFTER INSTALLATION THE ASSEMBLY IS TO BE PREPARED, PRIMED AND PAINTED IN ACCORDANCE WITH THE PROJECT PAINTING SPECIFICATION IF MATERIAL IS M.S.
- LIGHT FITTING FIXING DETAILS TO BE FURNISHED BY SITE.
- EARTHING TERMINAL ARE LOCATED DIAMETRICALLY OPPOSITE.
- ALL NUTS, BOLTS AND WASHERS SHALL BE GALVANISED AND ZINC PASSIVATED.
- MOUNTING DETAILS OF CONTROL GEAR BOX AND LOOPING BOX REFER INSTALLATION DETAILS.
- ALL SHARP EDGES AND BURRS SHALL BE REMOVED.
- POLE SHALL BE MADE FROM TUBULAR STEEL PIPES SWAGED AND WELDED CONFORMING TO DESIGNATION AS MENTIONED IN ABOVE TABLE- AS IS-2713 (PART III) - 1980.
- DOUBLE ARM SHALL BE EITHER AT 180° OR 30° AS PER THE LOCATION OF THE LIGHTING FITTING & SITE REQUIREMENT.

**TYPICAL MOUNTING DETAILS
OF STREET LIGHTING FITTING**



ITEM NO.	LIGHT FITTING TYPE	POLE LENGTH (MTRS.)	LENGTH OF SECTION (MTRS.)				O.D. & THK. (MM.)		
			(H)	(H1)	(H2)	(H3)	(H1)	(H2)	(H3)
1	70W LED	6.0	4.0	0	2		114.3x5.40	88.9x4.85	76.1x3.25
	125W LED	7.0	4.5	0	2.5				
		8.0	4.5	1.75	1.75				
2	150W LED	9.0	5.0	2.0	2.0		139.7x5.40	114.3x4.50	88.9x3.25
	250W LED	10.0	5.25	2.40				2.40	
3	250W LED	12.0	5.80	3.10	3.10		165.1x4.50	139.7x4.50	114.3x3.65

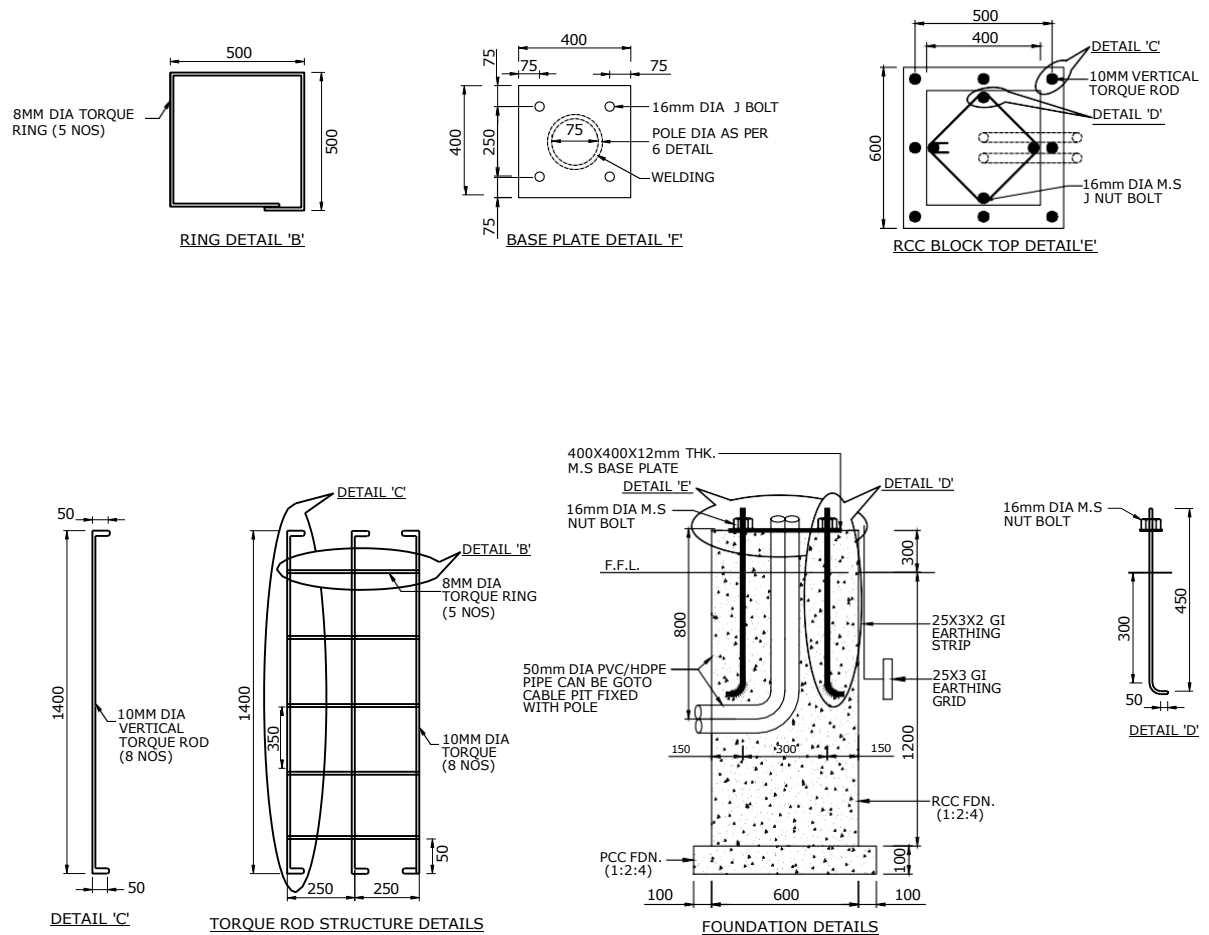
MATERIAL TAKE-OFF

ITEM NO.	DESCRIPTION	QUANTITY	REMARKS
1	PIPE CAP FOR STREET LIGHTING POLE	1 NO.	
2	40mm DIA PIPE WELDED TO CAP	1 NO.	
3	STIFFER PLATE	1 NO.	
4	STREET LIGHTING POLE (REFER SELECTION TABLE BELOW)	-	
5	400x400x12mm THK. M.S. PLATE WITH 1 Nos. 20mm Ø HOLES	1 NO.	
6	M10 x 30mm LONG FULL THREADED BOLT	4 NOS.	

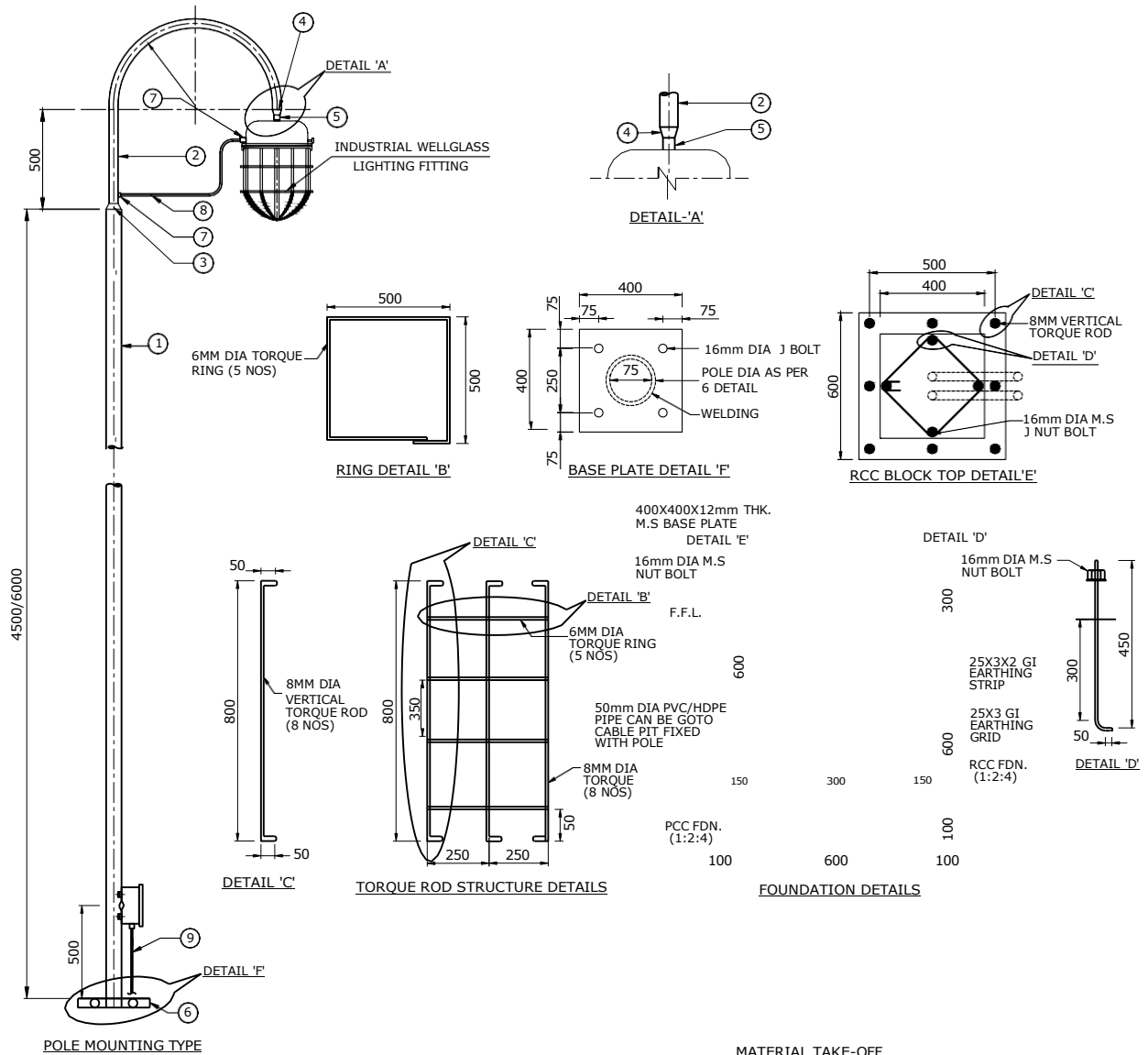
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. AFTER INSTALLATION THE ASSEMBLY IS TO BE PREPARED, PRIMED AND PAINTED IN ACCORDANCE WITH THE PROJECT PAINTING SPECIFICATION.
3. LIGHT FITTING FIXING DETAILS TO BE FURNISHED BY SITE.
4. EARTHING TERMINAL ARE LOCATED DIAMETRICALLY OPPOSITE.
5. ALL NUTS, BOLTS AND WASHERS SHALL BE GALVANISED AND ZINC PASSIVATED.
6. MOUNTING DETAILS OF CONTROL GEAR BOX AND LOOPING BOX REFER INSTALLATION DETAILS.
7. ALL SHARP EDGES AND BURRS SHALL BE REMOVED.
8. POLE SHALL BE MADE FROM TUBULAR STEEL PIPES SWAGED AND WELDED CONFORMING TO DESIGNATION AS MENTIONED IN ABOVE TABLE- AS IS-2713 (PART III) - 1980.
9. DOUBLE ARM SHALL BE EITHER AT 180° OR 30° AS PER THE LOCATION OF THE LIGHTING FITTING & SITE REQUIREMENT.

TYPICAL MOUNTING DETAILS OF STREET LIGHTING FITTING



TYPICAL FOUNDATION MOUNTED LIGHTING POLE DETAILS INDUSTRIAL
TYPE/WITH BUILT-IN CONTROL GEAR TYPE LIGHTING FIXTURE



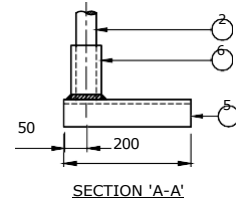
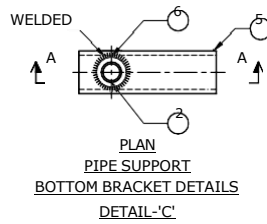
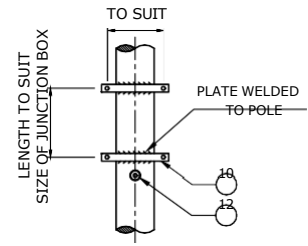
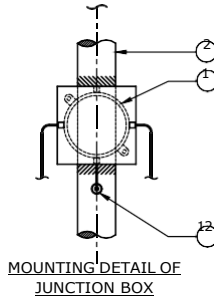
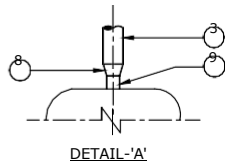
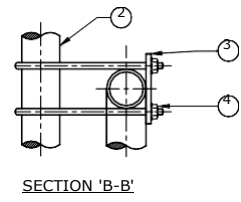
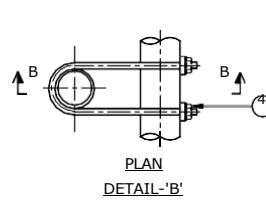
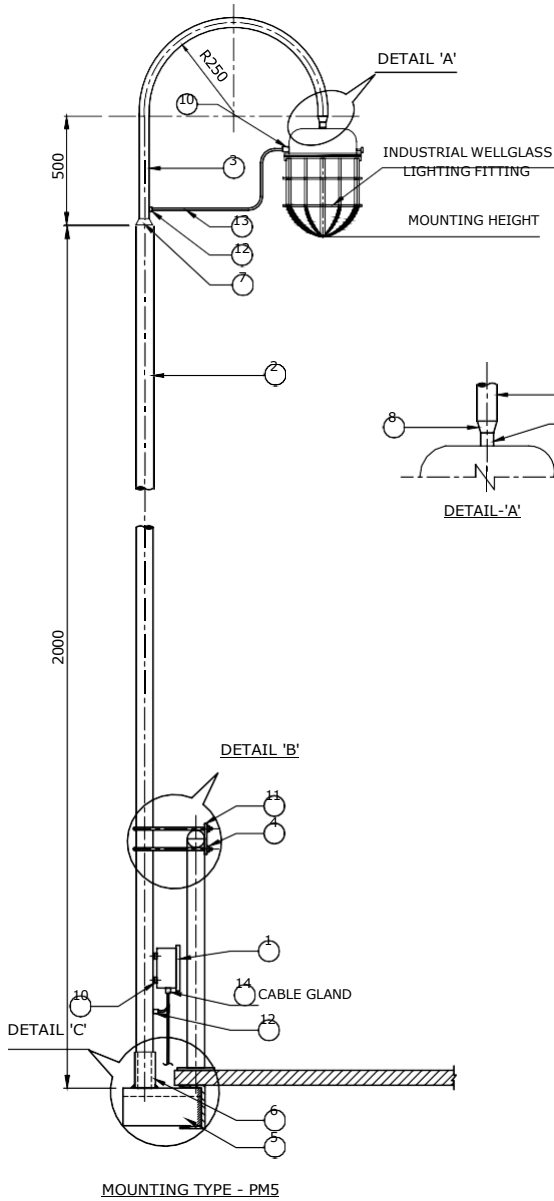
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. CABLE GLAND USED FOR TERMINATION OF FLEXIBLE CABLE SHALL BE DOUBLE SEAL WITH CONE GRIP FOR BRADING.
3. PLUG ALL UNUSED ENTRIES OF LIGHTING FITTING AND JUNCTION BOX WITH THREADED STOPPING PLUGS.
4. ALL NUTS, BOLTS AND WASHERS SHALL BE GALVANISED.
5. ALL SHARP EDGES AND BURRS SHALL BE REMOVED. SITE FABRICATED STEEL SHALL BE PAINTED WITH TWO COATS OF ANTI-CORROSIVE PAINT AND TWO COATS OF EPOXY PAINTS.
6. ALL DAMAGE TO GALVANISED FINISHED SHALL BE MADE GOOD WITH ZINC RICH PAINT.

MATERIAL TAKE-OFF

ITEM NO.	DESCRIPTION	QUANTITY	REMARKS
1	75/100mm Ø G.I. PIPE (CLASS HEAVY) FOR 4.5/6Mtr.	1 NOS.	
2	40mm Ø G.I. PIPE (CLASS HEAVY) WITH ONE END SWAN NECK 250mm RADIUS 180° BEND & BOTH END THREADED. MAX. 1Mtr.	1 NOS.	
3	G.I. REDUCER - 75 x 40	1 NOS.	
4	G.I. REDUCER - 40 x 19	1 NOS.	
5	G.I. NIPPLE THREADED AT BOTH END	1 NOS.	
6	400x400x10mm THK. M.S. PLATE WITH 1 Nos. 20mm Ø HOLES	1 NOS.	
7	RURDER GROMMET TO SUIT FLEXIBLE WIRE	2 NOS.	
8	2.5 Sq. mm SQ. FRLS FLEXIBLE CABLE	1 NOS.	
9	25 x 3 G.I. FLAT CONNECTION	1 NOS.	

**TYPICAL PLATFORM MOUNTED PIPE DETAILS
INDUSTRIAL TYPE/WITH BUILT-IN CONTROL
GEAR OR WITHOUT CONTROL GEAR TYPE
LIGHTING FIXTURE**



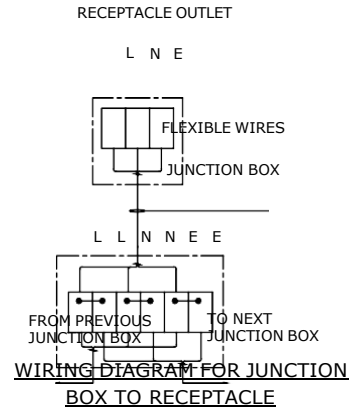
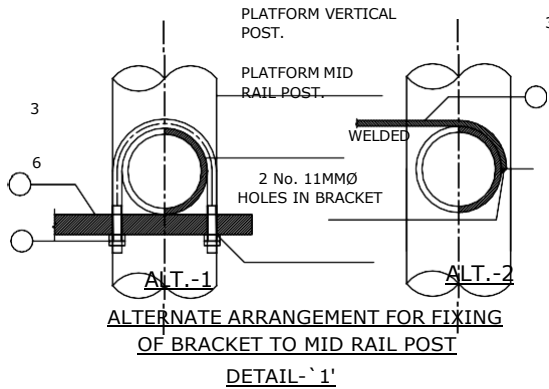
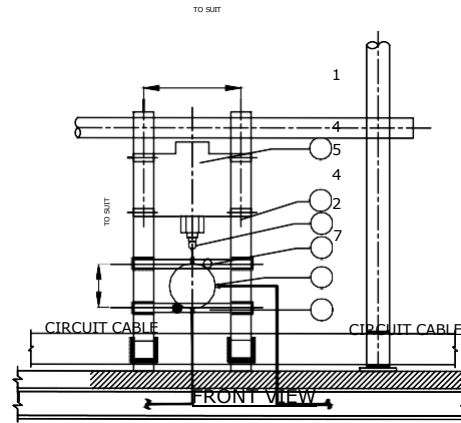
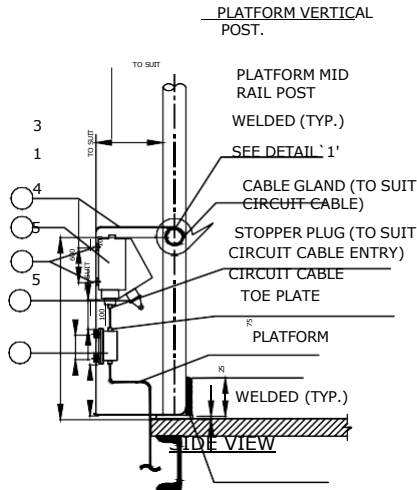
MATERIAL TAKE-OFF

ITEM NO.	DESCRIPTION	QUANTITY	REMARKS
1	JUNCTION BOX OR CONTROL GEAR BOX	1 NO.	
2	65mm Ø G.I. PIPE (CLASS HEAVY) WITH BOTH SIDE THREADING MAX. LENGTH 3.0 Mtrs.	1 NO.	
3	40mm Ø G.I. PIPE (CLASS HEAVY) WITH ONE END SWAN NECK 250mm RADIUS 180° BEND & BOTH END THREADED. MAX. 1Mtr.	1 NO.	
4	10mm Ø 'U' BOLT SUITABLE FOR 65mm Ø PIPE WITH BOTH END THREADED WITH NUTS 2Nos. PLAIN & 1NO. SPRING WASHER SUITABLE	4 NOS.	
5	ISMC-100 x 50 x 350mm LONG	1 NO.	
6	G.I. COUPLING SUITABLE FOR 65mm Ø G.I. PIPE	1 NO.	
7	G.I. REDUCER - 60 x 40	1 NO.	
8	G.I. REDUCER - 40 x 19	1 NO.	
9	G.I. NIPPLE THREADED AT BOTH END	1 NO.	
10	150x150x6mm THK. M.S. PLATE WITH 2 Nos. 12mm Ø HOLES OR 50x6x300 LONG G.I. FLATE WITH 2 Nos. 12mm Ø HOLES.	1 NO./2 Nos.	REFER VIEW -A'
11	50 x 6 x 150mm LONG G.I. FLAT WITH 2 Nos. 12mm Ø HOLES.	4 NOS.	
12	RURDER GROMMET TO SUIT FLEXIBLE WIRE	2 NOS.	
13	2.5 Sq. mm SQ. FLEXIBLE CABLE	3.5Mtrs. MAX.	
14	CABLE GLAND SUITABLE FOR ITEM NO. 13	2 NOS.	

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. MOUNTING HEIGHT SHALL NOT EXCEED 2.5M FROM THE PLATFORM.
3. CABLE GLAND USED FOR TERMINATION OF FLEXIBLE CABLE SHALL BE DOUBLE SEAL WITH CONE GRIP FOR BRADING.
4. PLUG ALL UNUSED ENTRIES OF LIGHTING FITTING AND JUNCTION BOX WITH THREADED STOPPING PLUGS.
5. ALL NUTS, BOLTS AND WASHERS SHALL BE GALVANISED.
6. ALL SHARP EDGES AND BURRS SHALL BE REMOVED. SITE FABRICATED STEEL SHALL BE PAINTED WITH TWO COATS OF ANTI-CORROSIVE PAINT AND TWO COATS OF EPOXY PAINTS.
7. ALL DAMAGE TO GALVANISED FINISHED SHALL BE MADE GOOD WITH ZINC RICH PAINT.
8. WHERE POSSIBLE LOCATE LAMP POST ADJACENT TO HANDRAIL POST.

**TYPICAL MOUNTING DETAILS OF SINGLE
PHASE SOCKET OUTLET ON HANDRAIL**



MATERIAL TAKE-OFF

ITEM NO.	DESCRIPTION	QUANTITY	REMARKS
1.	SMALL POWER SOCKET OUTLET	AS REQUIRED	
2.	JUNCTION BOX WITH TERMINAL BLOCK	AS REQUIRED	
3.	50 x 6mm THK. (LENGTH AS REQUIRED) MS FLAT FOR FIXING FOR POWER SOCKET OUTLET	3 MTRS.	
4.	M6 x 40mm LONG MS BOLT WITH NUT & WASHER FOR FIXING OF JUNCTION BOX ON BRACKET	8 NOS.	
5.	PLUG TO SUIT SMALL POWER SOCKET OUTLET	AS REQUIRED	
6.	M10 'U' BOLT OF SUITABLE TO MD HANDRAIL POST WITH THREADED BOTH THE SIDE WITH NUT, LOCK NUT & WASHER	2 NOS.	
7.	50 x 6mm THK. (LENGTH AS REQUIRED) MS FLAT FOR FIXING JUNCTION BOX	2 NOS.	

NOTES:

1. ALL DIMENSION ARE IN MM.
2. DRILLING OF ITEM 3 AND 7 TO BE DETERMINED BY FABRICATOR TO THE SOCKET OUTLET AND JUNCTION BOX.
3. JUNCTION BOX, RECEPTACLES AND ACCESSORIES SHALL BE CALLED UP ON THE RELEVANT LAYOUT DRAWING MATERIAL LIST AS REQUIRED.
4. ALL CABLE AND GLANDS SHALL CALLED UP ON DISTRIBUTION BOARD SCHEDULE.
5. AFTER FABRICATION THE ASSEMBLY IS TO BE PAINTED WITH TWO COATS OF ANTI-CORROSIVE PAINT AND TWO COATS OF EPOXY PAINT.
6. ALL NUTS, BOLTS, WASHERS SHALL BE GALVANISED OR ZINC PASSIVATED.
7. RECEPTACLES AND JUNCTION BOX SHALL BE CERTIFIED FOR THE HAZARDOUS AREA IN WHICH THEY ARE TO BE LOCATED.

FLEXIBLE CIRCUIT CABLE

FLOOD LIGHT FITTING
FLOOD LIGHT FIXING BRACKET
DETAIL 'X'
BRACKET ANGLE WELDED
BRACKET FIXED WITH ANCHOR M10-BOLT WHEN FIXTURE IS MOUNTED ON CONCRETE COLUMN
DETAIL 'Y'
CONTROL GEAR BOX (FOR FLOOD LIGHT)
INCOMING CIRCUIT CABLE
STEEL COLUMN OR CONCRETE COLUMN

TO SUIT

25 300 25

6Nos.-12Ø HOLES SUITABLE FOR M10 ANCHOR BOLT (TYP.)
BRACING ANGLE WELDED TO BRACKET

ELEVATION

650 300 50

SIDE VIEW

WELDED

500 150

FLEXIBLE CIRCUIT CABLE
CONTROL GEAR BOX (FOR FLOOD LIGHT)
CABLE GLAND (TO SUIT CIRCUIT CABLE)
STEEL COLUMN OR CONCRETE COLUMN
INCOMING CIRCUIT CABLE

MATERIAL TAKE-OFF

ITEM NO.	DESCRIPTION	QUANTITY	REMARKS
1	50 x 50 x 6mm THK. M.S. ANGLE (AS PER DETAIL-'X')	AS REQUIRED	
2	300 x 300 x 6mm THK. MILD STEEL PLATE FOR FIXING FLOOD LIGHT FITTING	1 NO.	
3	50 x 6mm THK. MILD STEEL FLAT (AS PER DETAIL-'Y')	2 NOS.	
4	M10-50mm LONG BOLT WITH LOCK NUT & WASHER FOR ANCHOR	4 NOS.	

Holes for mtg. control gear box (hole Ø to suit)

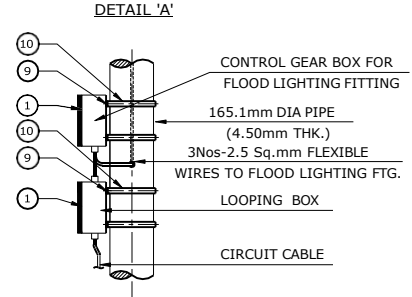
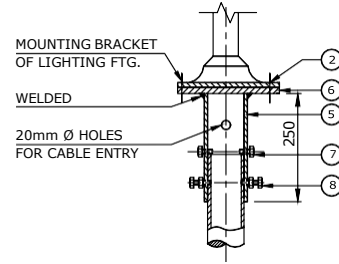
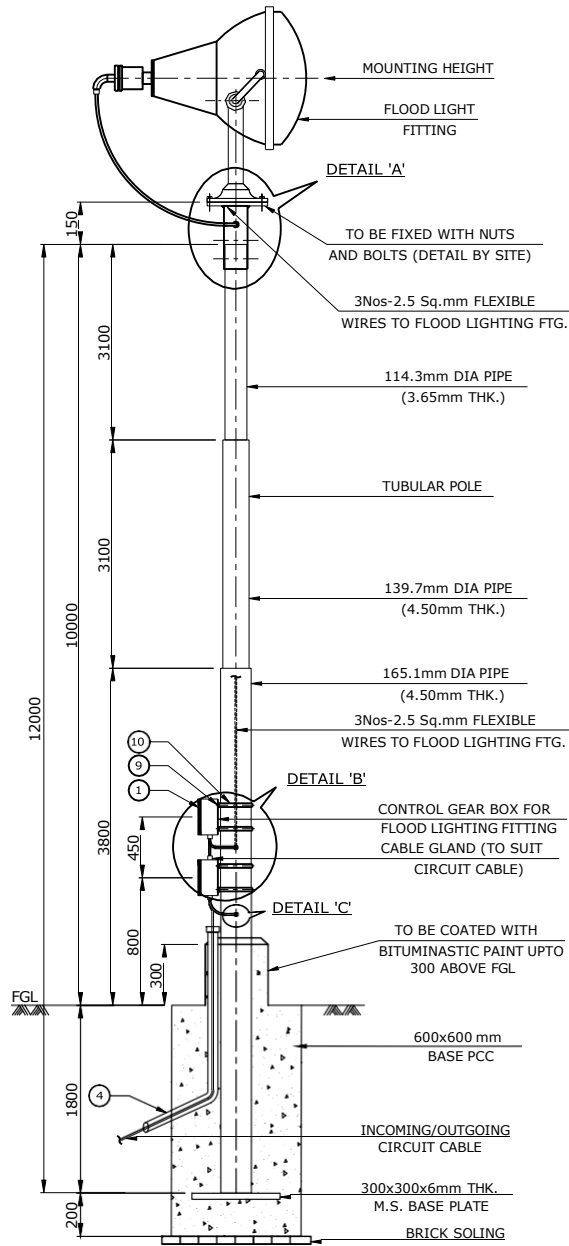
DETAIL 'Y'

12mm Ø HOLES FOR MTG. BRACKET TO WALL/COLUMN

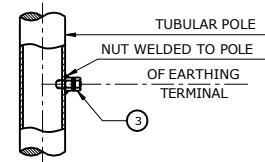
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. AFTER INSTALLATION THE ASSEMBLY IS TO BE PAINTED WITH TWO COATS OF ANTI-CORROSIVE PAINT AND TWO COATS OF EPOXY PAINT

ITEM NO.	DESCRIPTION	QUANTITY	REMARKS
1	50 x 50 x 6mm THK. M.S. ANGLE (AS PER DETAIL-'X')	AS REQUIRED	
2	300 x 300 x 6mm THK. MILD STEEL PLATE FOR FIXING FLOOD LIGHT FITTING	1 NO.	
3	50 x 6mm THK. MILD STEEL FLAT (AS PER DETAIL-'Y')	2 NOS.	
4	M10-50mm LONG BOLT WITH LOCK NUT & WASHER FOR FIXING FLOOD LIGHT FITTING	4 NOS.	
5	M10-68mm LONG STUD WITH NUT & LOCK WASHER FOR FIXING BRACKET	10 NOS.	
6	SADDLE/CLEAT (TO SUIT CABLE SIZE) WITH SUITABLE SIZE FIXING ANCHOR BOLTS LOCK WASHER 7 NUTS.	AS REQUIRED	

**TYPICAL MOUNTING DETAIL OF 1
FLOOD LIGHT FITTING**



DETAIL 'B'



DETAIL 'C'

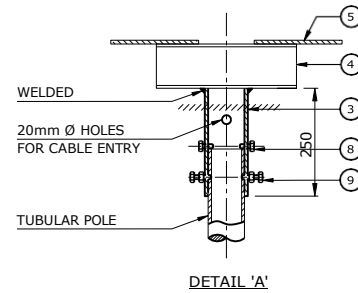
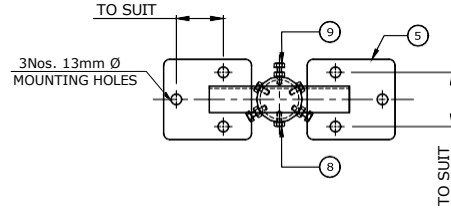
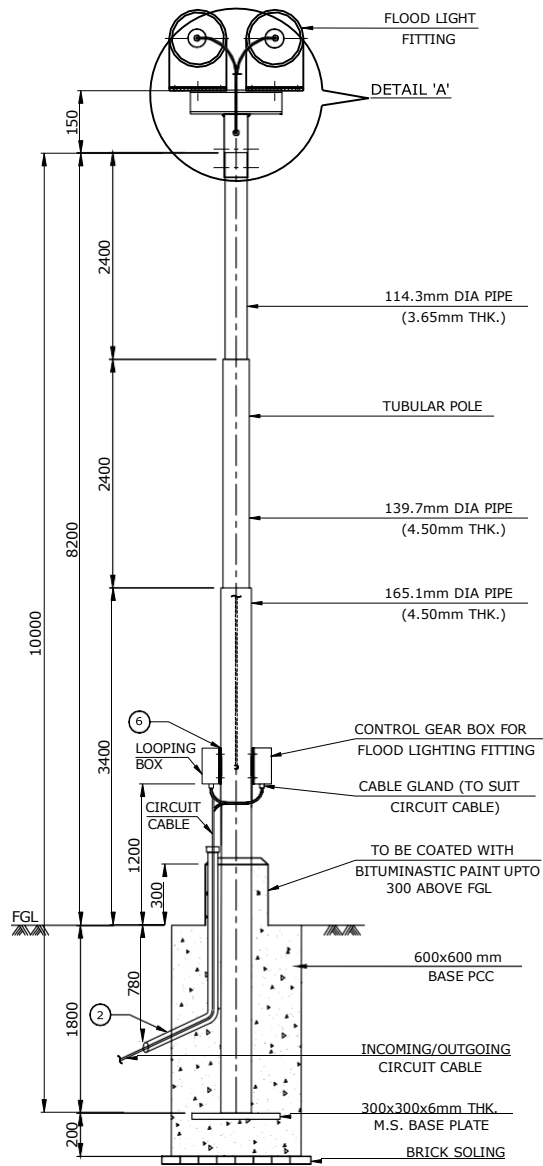
MATERIAL TAKE-OFF

ITEM NO.	DESCRIPTION	QUANTITY	REMARKS
1	STREET LIGHTING LOOPING BOX	1 NO.	
2	M8 x 40mm LONG BOLT WITH NUTS & PLAIN WASHER FOR FIXING FLOOD LIGHT	AS REQUIRED	
3	EARTHING TERMINAL M10-40mm LONG BOLT WITH NUTS, 2Nos. SPRING WASHERS & 2Nos. PLAIN WASHERS	1 NO.	
4	75mm NB G.I. PIPE SLEEVE	2 NOS.	
5	M.S PIPE CAP TO SUIT 1114.30mm DIA PIPE	1 NO.	
6	300 x 300 x 10mm THICK M.S. PLATE	1 NO.	
7	M10-40mm LONG BOLT TO BE USED AS STOPPER	3 NOS.	
8	M10 x 40mm LONG BOLT WITH LOCK NUT TO BE USED AS HOLDER	3 NOS.	
9	M8-40mm LONG BOLT WITH NUTS & PLAIN WASHER FOR FIXING OF CONTROL GEAR BOX & LOOPING BOX	8 NOS.	
10	BRACKET/CLAMP MADE OUT FROM 25x6mm THK. M.S. FLAT FOR FIXING OF CONTROL GEAR BOX & LOOPING BOX	4 NOS.	

NOTES:

- LIGHTING FITTING FIXING DETAILS TO BE FURNISHED BY SITE.
- EARTHING TERMINALS ARE LOCATED DIAMETRICALLY OPPOSITE.
- ALL NUTS, BOLTS AND WASHER SHALL BE GALVANISED OR ZINC PASSIVATED.
- MOUNTING DETAILS OF CONTROL GEAR BOX & LOOPING BOX REFER INSTALLATION DETAILS.
- ALL SHARP EDGES AND BURRS SHALL BE REMOVED.
- POLE SHALL BE MADE FROM TUBULAR STEEL PIPES SWAGED AND WELDED CONFORMING TO DESIGNATION 410TP-60 AS PER IS-2713 (PART II) - 1980.

**TYPICAL MOUNTING DETAIL OF 2 NOS.
INDUSTRIAL TYPE FLOOD LIGHTING FITTING**



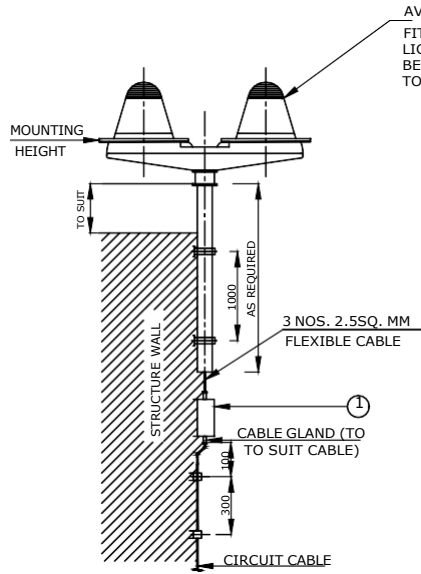
MATERIAL TAKE-OFF

ITEM NO.	DESCRIPTION	QUANTITY	REMARKS
1	STREET LIGHTING LOOPING BOX	-	
2	75mm NB G.I. PIPE SLEEVE	2 NOS.	
3	M.S PIPE CAP (TO SUIT 1114.30mm DIA PIPE)	1 NO.	
4	100 x 50 x 6mm THK. M.S. CHANNEL (LENGTH TO SUIT)	AS REQUIRED	
5	300 x 300 x 6mm THICK M.S. PLATE	2 NOS.	
6	50 x 6mm THICK M.S. FLAT (LENGTH TO SUIT)	AS REQUIRED	
7	M10-30mm LONG BOLT WITH NUT; WASHER FOR FIXING FLOOD LIGHT	AS REQUIRED	
8	M10 BOLT (TO BE USED AS STOPPER)	3 NOS.	
9	M10 BOLT WITH LOCK NUT (TO BE USED AS HOLDER)	3 NOS.	

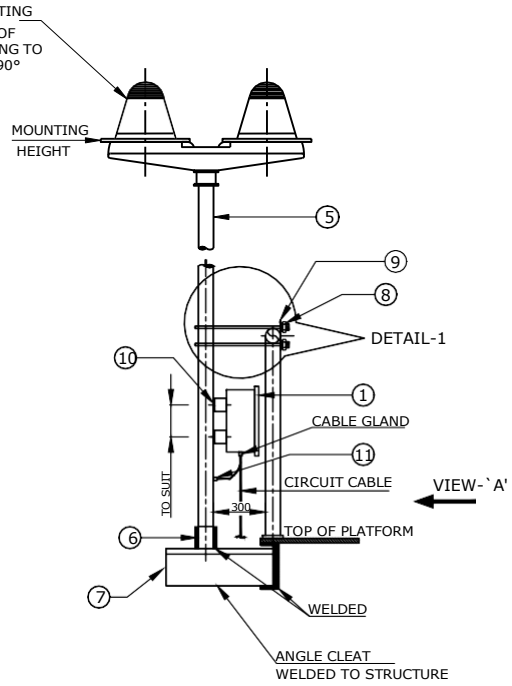
NOTES:

1. FIXING DETAILS TO BE FURNISHED BY SITE.
2. EARTHING TERMINALS ARE LOCATED DIAMETRICALLY OPPOSITE.
3. 2 Nos. 20mm Ø HOLES LOCATED DIAMETRICALLY OPPOSITE.
4. MOUNTING DETAILS OF CONTROL GEAR BOX & LOOPING BOX TO BE FIXED BY SITE.
5. FOR INCANDESCENT LAMP, FLEXIBLE CABLE TO GO DIRECTLY TO FITTING.
6. ALL SHARP EDGES AND BURRS SHALL BE REMOVED.
7. ALL NUTS, BOLTS AND WASHER SHALL BE GALVANISED OR ZINC PASSIVATED.
8. POLE SHALL BE MADE FROM TUBULAR STEEL PIPES SWAGED AND WELDED CONFORMING TO DESIGNATION 410TP-60 AS PER IS-2713 (PART II) - 1980.

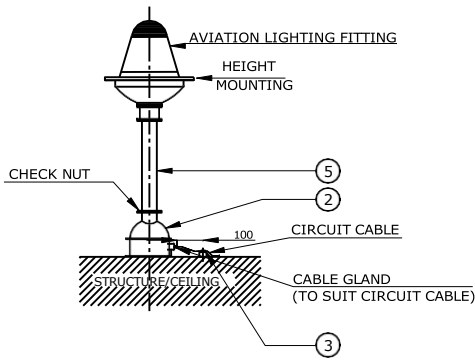
**TYPICAL MOUNTING DETAILS OF DOUBLE
OBSTRUCTION LIGHT FOR AVIATION
LIGHTING FITTING**



**FITTING MOUNTED ON SIDE
SUPPORT TO STRUCTURE/ WALL
MOUNTING TYPE-PM11**



**FITTING MOUNTED ON PLATFORM
MOUNTING TYPE-PM11**



**FITTING DIRECTLY MOUNTED
ON STRUCTURE/ CEILING MOUNTING TYPE PM-11**

MATERIAL TAKE-OFF

ITEM NO.	DESCRIPTION	QUANTITY	REMARKS
1.	JUNCTION BOX WEATHER PROOF TYPE	1 No.	
2.	JUNCTION BOX WEATHER PROOF WITH DOME COVER TO SUIT 40 MM DIA G.I. PIPE.	1 No.	
3.	SADDLE/CLEAT WITH FIXING M.S. 66MM LONG SCREWS/ STUCS, NUTS & LOCK WASHER FOR CIRCUIT CABLE.	AS REQUIRED	
4.	SADDLE/CLEAT WITH FIXING M.S. 66MM LONG SCREWS/ STUCS, NUTS & LOCK WASHER FOR 40 MM DIA PIPE.	AS REQUIRED	
5.	40 MM DIA G.I. PIPE (LENGTH AS REQUIRED) WITH BOTH ENDS THREADED & CHECK NUTS.	1 No.	
6.	G.I. COUPLING SUITABLE FOR 40 MM DIA G.I. PIPE.	1 No.	
7.	ISMC-100x50x350 MM LONG.	1 No.	
8.	10 MM DIA 'U' BOLT SUITABLE FOR 40 MM DIA PIPE WITH BOTH ENDS THREADED WITH NUTS 2NO. PLAIN AND 1NO. SPRING WASHERS WITH SUITABLE LENGTH.	4 No.	
9.	50x6x150MM LONG G.I. FLAT WITH 2NO. 12 MM DIA HOLES.	4 No.	
10.	150X150x6 THICK M.S. PLATE WITH 2NO. 12MM DIA HOLES OR 50x6X300 LONG G.I. FLAT WITH 2NO. 12MM DIA HOLES	1 No.	
11.	RURDER GROUMENT TO SUIT FLEXIBLE WIRE.	2 No.	

NOTES:

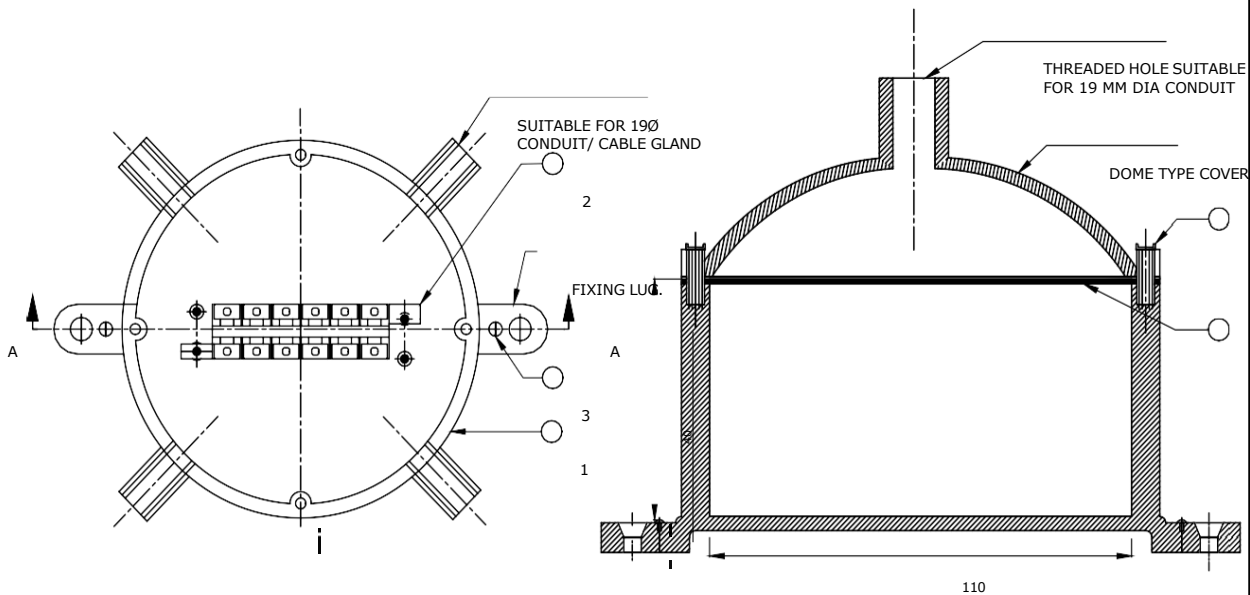
1. WEIGHT OF FITTING 5.5 KG.
2. USE FLEXIBLE WIRE FOR CONNECTION TO LIGHTING FROM JUNCTION BOX.
3. MOUNTING HEIGHT OF THE AVIATION LIGHTING FITTING SHALL BE AT HIGHER ELEVATION THAN THE STRUCTURE ON WHICH FITTING IS TO BE MOUNTED.

TYPICAL DETAILS OF DUST/WEATHERPROOF

ENERGISING QUALITY

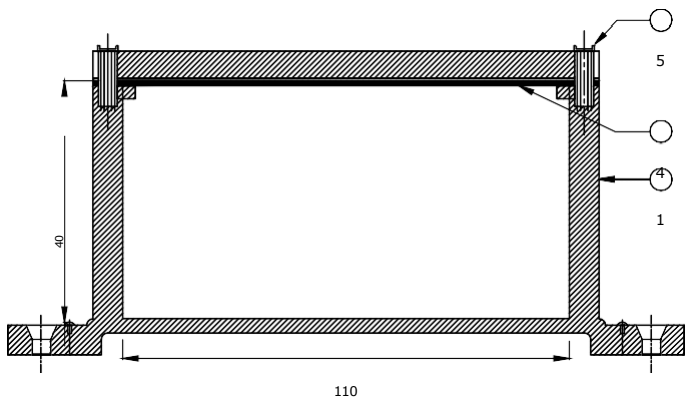
ROUND JUNCTION BOX

SHEET NO. 1 OF 1



VIEW WITH COVER REMOVED

JUNCTION WITH DOME COVER
SECTION 'A-A'



JUNCTION WITH PLANE COVER
SECTION 'A-A'

MATERIAL TAKE-OFF

ITEM NO	DESCRIPTION	QUANTITY	REMARKS
1.	JUNCTION BOX (CAST ALUMINIUM)	AS REQUIRED	
2.	30A, 4 WAY, TERMINAL BLOCK	1 No.	
3.	8 MM LONG BRASS SCREW WITH 2 No. PLAIN AND SPRING WASHER FOR INTERNAL AND EXTERNAL EARTHING TERMINAL.	2 No.	
4.	DISC TYPE NEOPRENE GASKET.	1 No.	
5.	COVER FIXING G.I. SCREWS WITH WASHER	4 No.	

NOTES:

GENERAL NOTES-EARTHING

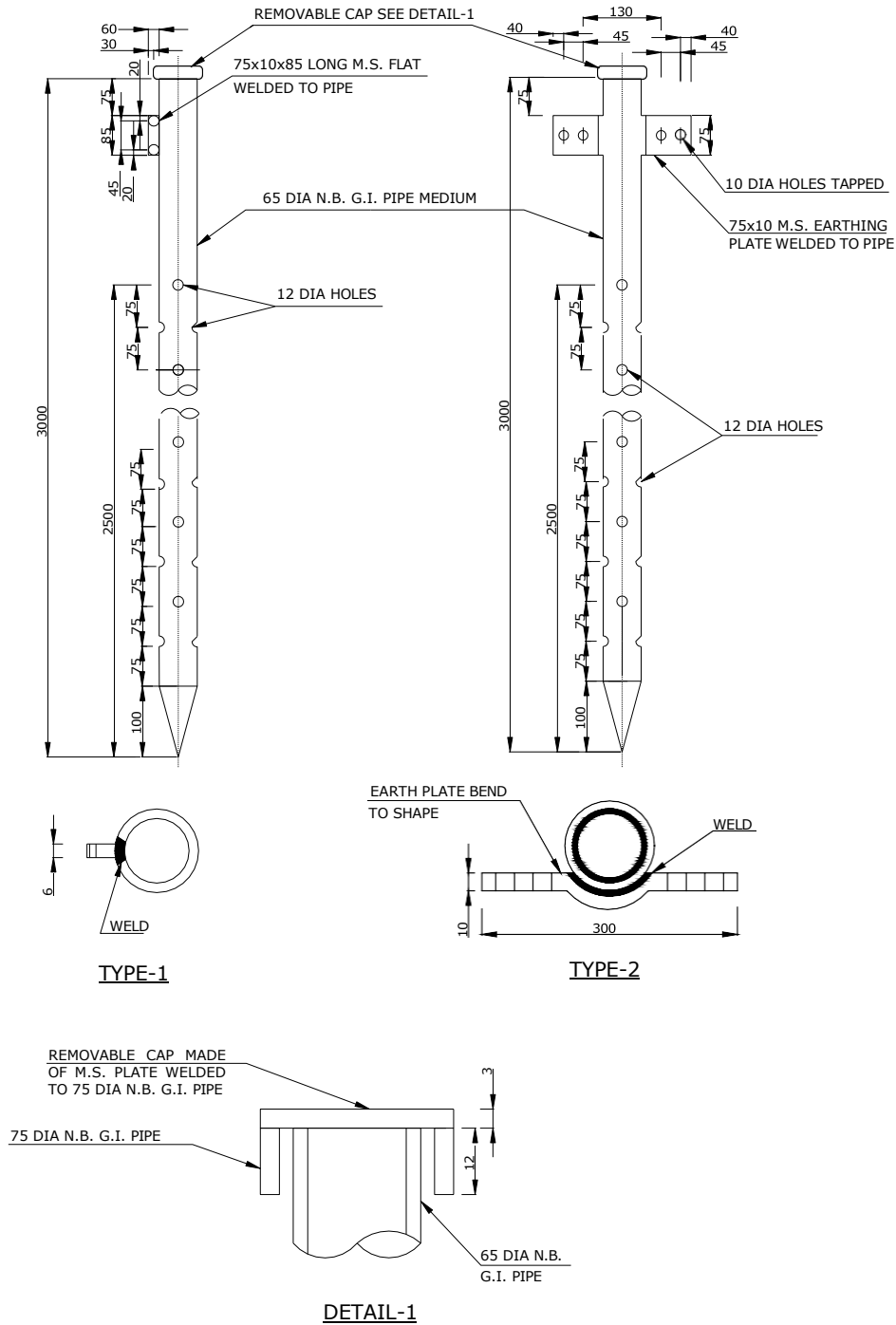
1. ENTIRE EARTHING INSTALLATION SHALL COMPLY WITH THE REQUIREMENT OF IS-3043:1987 INDIAN ELECTRICITY RULES OISD REGULATION AND OTHER APPLICABLE STATUTORY REGULATIONS AND SAFETY CODES IN THE LOCALITY OF THE INSTALLATION.
2. MAIN EARTH LOOPS SHALL BE OF 75x10mm G.I. STRIP ALUMINUM CONDUCTOR CABLES SHALL BE USED FOR EARTHING OF MOTORS, LOCAL CONTROL STATION ETC.
3. PIPE ELECTRODE SHALL BE USED FOR EARTH ELECTRODES, THE EARTH ELECTRODES SHALL BE KEPT SUFFICIENTLY AWAY FROM STRUCTURE TO CLEAR FOUNDATIONS, FOOTING ETC. SPACING OF MINIMUM 6 METERS SHALL BE KEPT BETWEEN ADJACENT EARTH ELECTRODES.
4. RESISTANCE OF EARTHING STATION SHALL BE MEASURED AT EACH EARTH ELECTRODE AFTER ITS INSTALLATION BY MEANS OF AN EARTH MEGGER. RESISTANCE OF EARTHING GRID SHALL BE MAINTAINED WITHIN 1 OHM (BY ADDITION OF EARTH ELECTRODE IN PARALLEL, IF NECESSARY).
5. THE MAIN EARTH LOOP (MEL) IN PLANT AREAS SHALL BE GENERALLY ROUTED UNDERGROUND EARTH CONDUCTORS TO INDIVIDUAL EQUIPMENT SHALL BE RUN ALONG WITH POWER AND CONTROL/ LIGHTING CABLES. WHEN EQUIPMENT ARE LOCATED AWAY FROM M.E.L. , SUITABLE SUB LOOPS MAY BE RUN UP TO THEM FOR DERIVING CONNECTIONS FOR INDIVIDUAL EQUIPMENT.
6. ALL ELECTRICAL EQUIPMENT SHALL BE EARTHED AT TWO DISTINCT POINTS WITH EARTH CONDUCTOR.
7. PROCESS/ UTILITY PIPE RACK COLUMN SHALL BE EARTHED AT EVERY 25 mtr. AT NEAREST AVAILABLE EARTHING NETWORK AS PER IS : 3043-1987.
8. ENTIRE EARTHING SHALL BE TESTED FOR CONTINUITY BY ELV TESTER AFTER INSTALLATION.
9. THE PLANT EARTHING SYSTEM SHALL ALSO BE USED FOR STATIC EARTHING OF PROCESS EQUIPMENT, PIPELINE EARTHING ETC. WHICH SHALL BE DONE BY USING 75X10mm THICK G.I. STRIP/ SIZE AS REQUIRED.
10. 75x10mm THICK G.I. STRIP SHALL BE USED FOR ENTIRE EARTHING NETWORK. ALL JOINTS SHALL BE WELDED EXCEPT AT EQUIPMENT ENDS, WHICH SHALL BE BOLTED.
11. ALL STRUCTURE STEEL WORK TO BE CONNECTED TO EARTHING SYSTEM.
12. FOR CONDUIT WIRING OF LIGHTING CIRCUITS, FOR EARTHING OF LIGHTING FITTINGS, JUNCTION BOXES 14 SWG
13. THE LIGHTNING PROTECTION SYSTEM SHALL BE DESIGNED IN ACCORDANCE WITH IS :2309-1989 ' CODE OF PRACTICE FOR PROTECTION OF BUILDING AND ALLIED STRUCTURES AGAINST LIGHTNING'.
14. EARTH SYSTEM AND LIGHTNING PROTECTION SHALL BE BONDED TO EACH OTHER TO PREVENT SIDE FLASH OVER, IF ADEQUATE CLEARANCE BETWEEN THE TWO SYSTEM CAN NOT BE MAINTAINED.
15. ALL HARDWARE SHALL BE OF STAINLESS STEEL.
16. WHEN EQUIPMENT DO NOT HAVE EXTERNAL EARTHING TERMINAL ELECTRICAL CONTRACTOR SHALL PROVIDE THE SAME ON EQUIPMENT. SIZES OF EARTH CONDUCTORS SHALL GENERALLY BE AS FOLLOWS:

GENERAL NOTES-EARTHING

EQUIPMENT EARTHING SCHEDULE

TYPE OF EQUIPMENT	EARTHING SIZE		
	G.I.	AL.	COPPER
MOTORS UPTO & INCLUDING 3.7 kW	8 SWG SOLID	1Cx6 SQ.mm	-
MOTORS 7.5 kW TO 9.3 kW & WELDING RECEPTACLES	10mmØ WIRE ROPE	1Cx10 SQ.mm	-
MOTORS 11 kW TO 22kW	10mmØ WIRE ROPE	1Cx16 SQ.mm	-
MOTORS 30kW	10mmØ WIRE ROPE	1Cx25 SQ.mm	-
MOTORS 37kW	16mmØ WIRE ROPE	1Cx35 SQ.mm	-
MOTORS 55kW	16mmØ WIRE ROPE	1Cx50 SQ.mm	-
MOTORS 75kW	16mmØ WIRE ROPE	1Cx120 SQ.mm	-
MOTORS 132kW	16mmØ WIRE ROPE	1Cx150 SQ.mm	-
MOTORS 160kW	16mmØ WIRE ROPE	1Cx185 SQ.mm	-
MOTORS ABOVE 160kW	16mmØ WIRE ROPE	-	-
BUILDING COLUMN	50x6 STRIP	-	-
STORAGE TANK & HEAT EXCHANGERS	50x6 STRIP	-	-
LOADING RACKS	50x6 STRIP	-	-
PIPE RACKS, VESSEL & INSTRUMENTS	10mmØ WIRE ROPE	-	-
LIGHTING, POWER & INSTRUMENT PANEL	10mmØ WIRE ROPE	-	-
MAIN EARTH GRID/ LT & HT SWITCH GEAR INTERCONNECTIONS/ POWER TRANSFORMER	75x10 STRIP	-	-
EHV & HV SUBSTATION	75x10 STRIP	-	-
PUSH BUTTON STATION	8 SWG SOLID	-	-
STREET LIGHTING POLES	10mmØ WIRE ROPE	-	-
LIGHTING TRANSFORMER	16mmØ WIRE ROPE	-	-
<u>LIGHTNING PROTECTION</u>			
ROOF CONDUCTOR	32x6 STRIP	N.A.	25x6 STRIP
ROOF CONDUCTOR (ABOVE GROUND)	32x6 STRIP	N.A.	25x6 STRIP
ROOF CONDUCTOR (BELOW GROUND)	50x6 STRIP	N.A.	50x6 STRIP
TEST LINK	50x10 STRIP	N.A.	50x6 STRIP
PIPE ELECTRODES	65Ø NB PIPE	N.A.	-

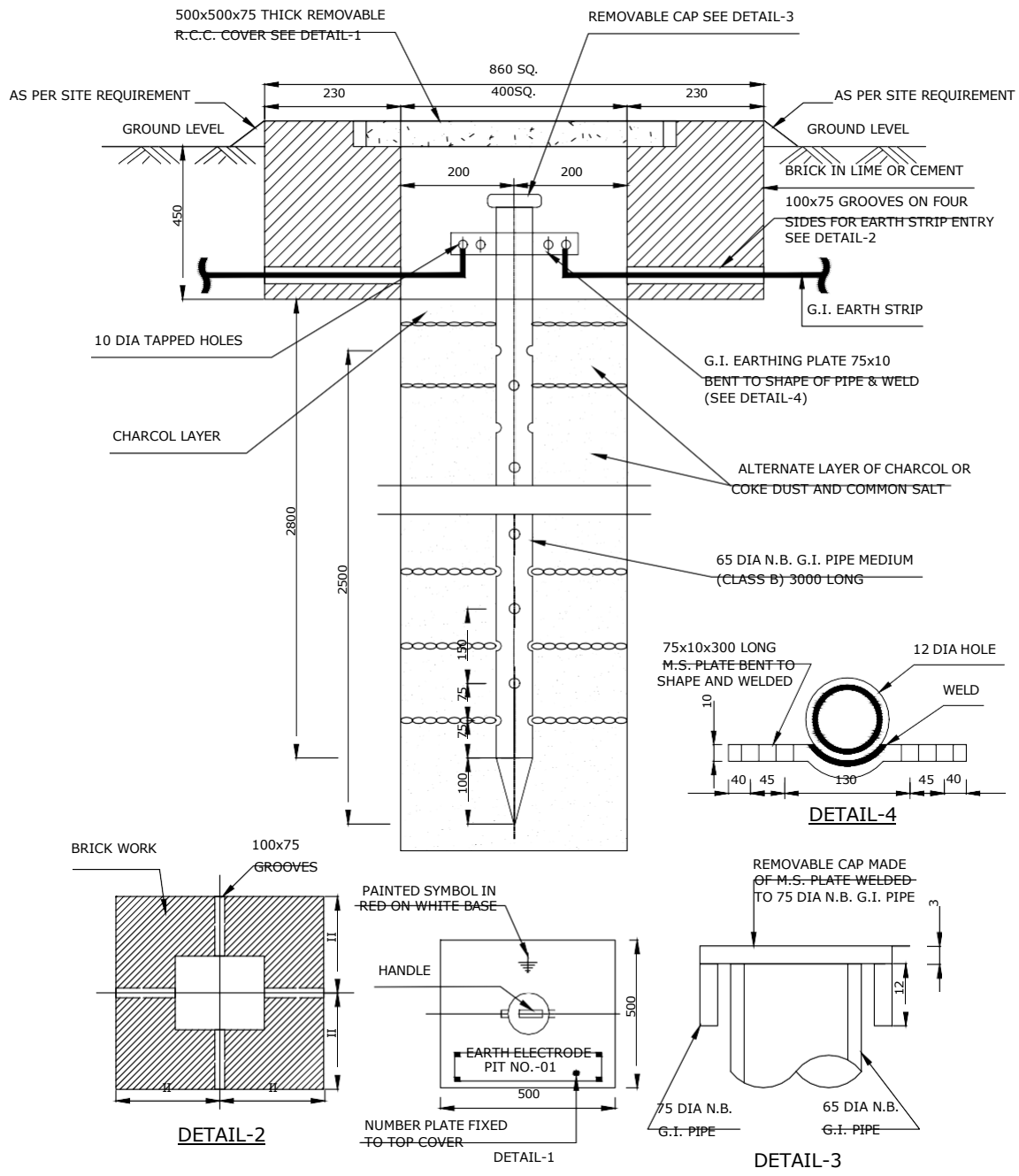
ELECTRODE FOR EARTHING SYSTEM



NOTES:

1. THE PIPE ASSEMBLY SHALL BE HOT DIP GALVANISED AFTER FABRICATION.
2. UNLESS STATED OTHERWISE ON PLAN DRAWINGS, ONLY TYPE-2 SHALL BE USED.

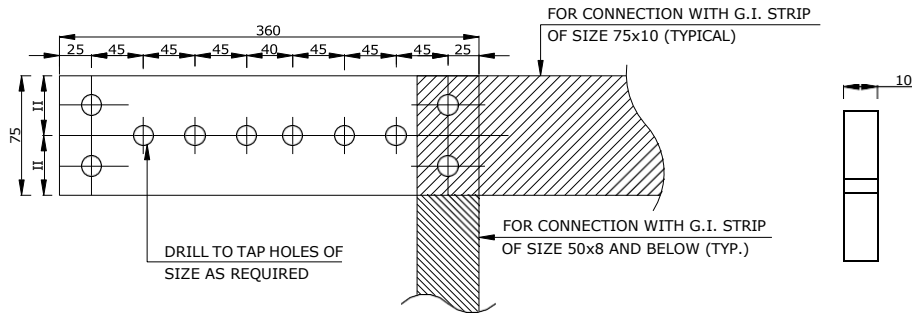
EARTH ELECTRODE IN TEST PIT



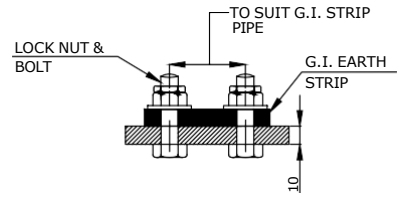
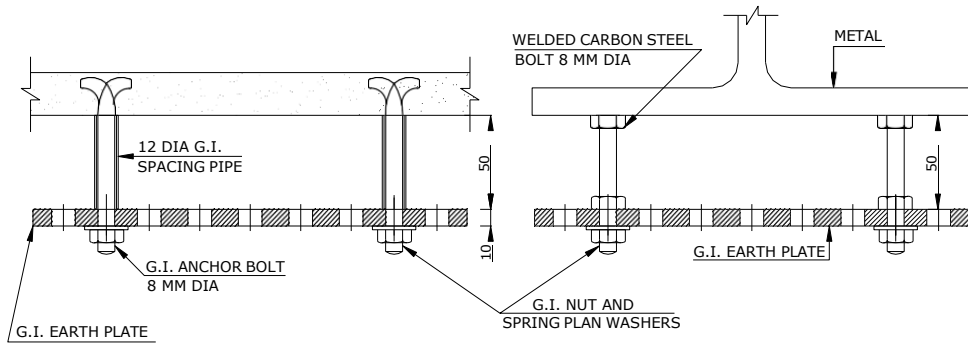
NOTES:

1. THE PIPE ASSEMBLY SHALL BE HOT DIP GALVANISED AFTER FABRICATION.
2. BRICK WORK SHALL BE DONE AFTER COMPACTING THE SOIL.

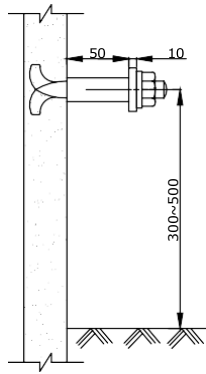
EARTH PLATES FIXING DETAILS



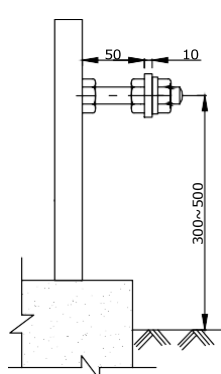
G.I. EARTH PLATE



TYPICAL FIXING DETAIL OF G.I.
EARTH STRIP TO EARTH PLATE



TYPICAL INSTALLATION OF EARTH PLATE ON R.C.C. STRUCTURES

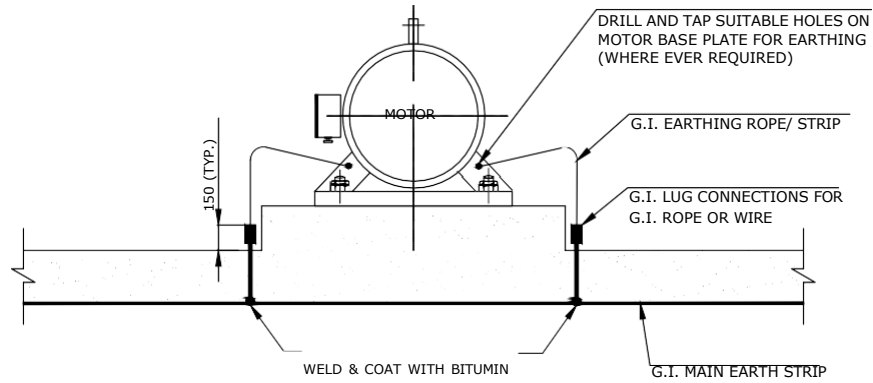


TYPICAL INSTALLATION OF EARTH PLATE ON STEEL STRUCTURES

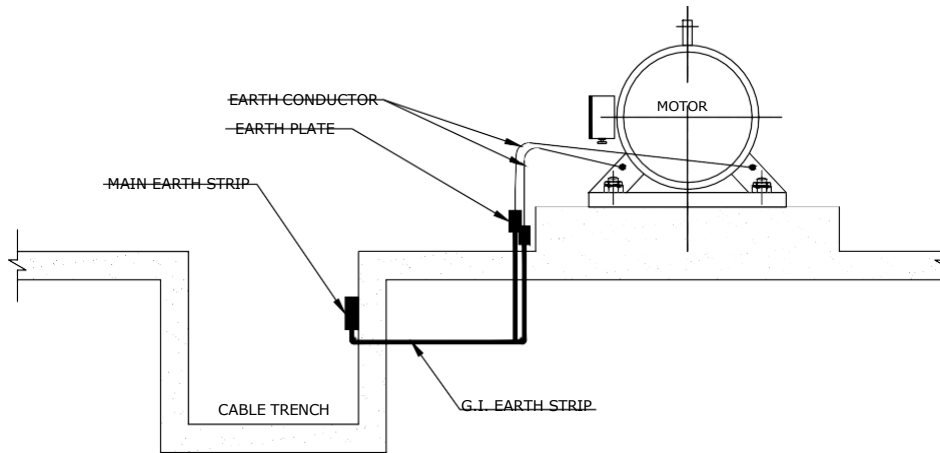
NOTES:

1. WHERE FIRE PROOFING OF STEEL STRUCTURES ARE ENCOUNTERED LENGTH OF CARBON STEEL BOLT SHALL BE INCREASED FOR FIXING OF EARTH PLATE.
2. ALL CONNECTIONS WITH EARTH PLATE SHALL BE MADE WITH G.I. BOLT, NUT, SPRING AND PLAIN WASHERS.

TYPICAL EARTHING FOR MOTOR



DETAIL-1 REMOTE EARTH PLATE

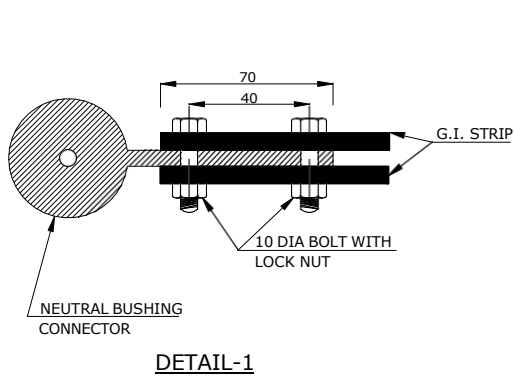
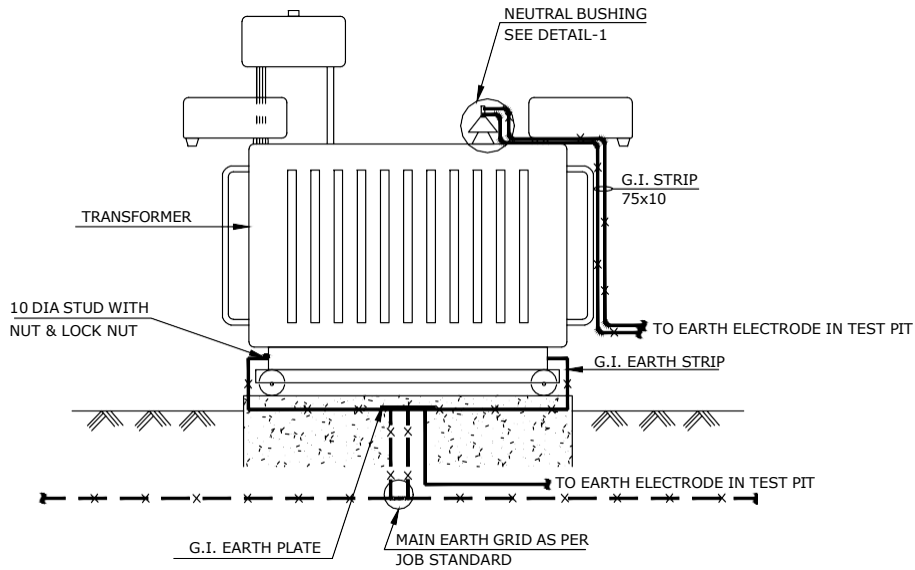


DETAIL-2 LOCAL EARTH PLATE

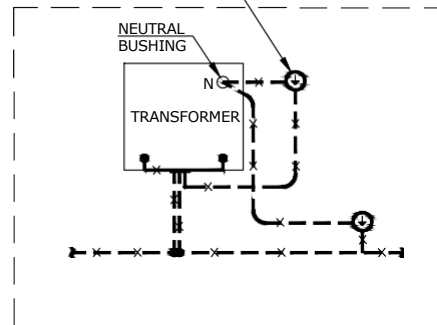
NOTES:

1. MOTOR FOUNDATION BOLT SHALL NOT BE USED FOR EARTHING.

TYPICAL ARRANGEMENT FOR
TRANSFORMER EARTHING
(NEUTRAL SOLIDLY EARTHED)



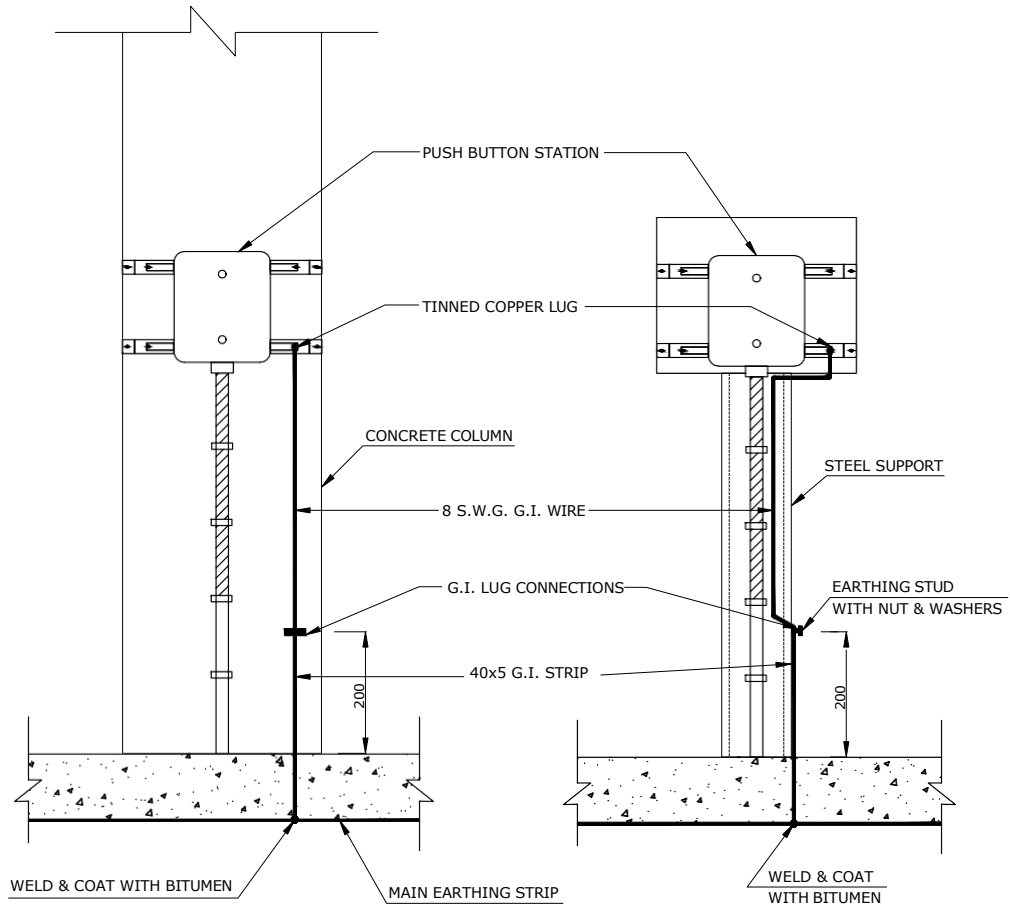
EARTH ELECTRODE IN TEST PIT
(SEE NOTE-3)



NOTES:

1. WHEREVER SEPERATE NEUTRAL BUSHING FOR EARTHING IS NOT PROVIDED THE NEUTRAL EARTHING SHALL BE DONE FROM BUS DUCT.
2. EARTH ELECTRODE IN TEST PITS SHALL BE SO LOCATED THAT DISTANCE BETWEEN TWO PITS SHALL BE MINIMUM 6 METER.
3. WHERE TRANSFORMERS NEUTRAL EARTHING IS DONE THROUGH N.G.R. THE CONNECTIONS BETWEEN NEUTRAL AND N.G.R. SHALL BE THROUGH CABLE. THE OTHER END END OF N.G.R. SHALL BE CONNECTED TO EARTH ELECTRODE.

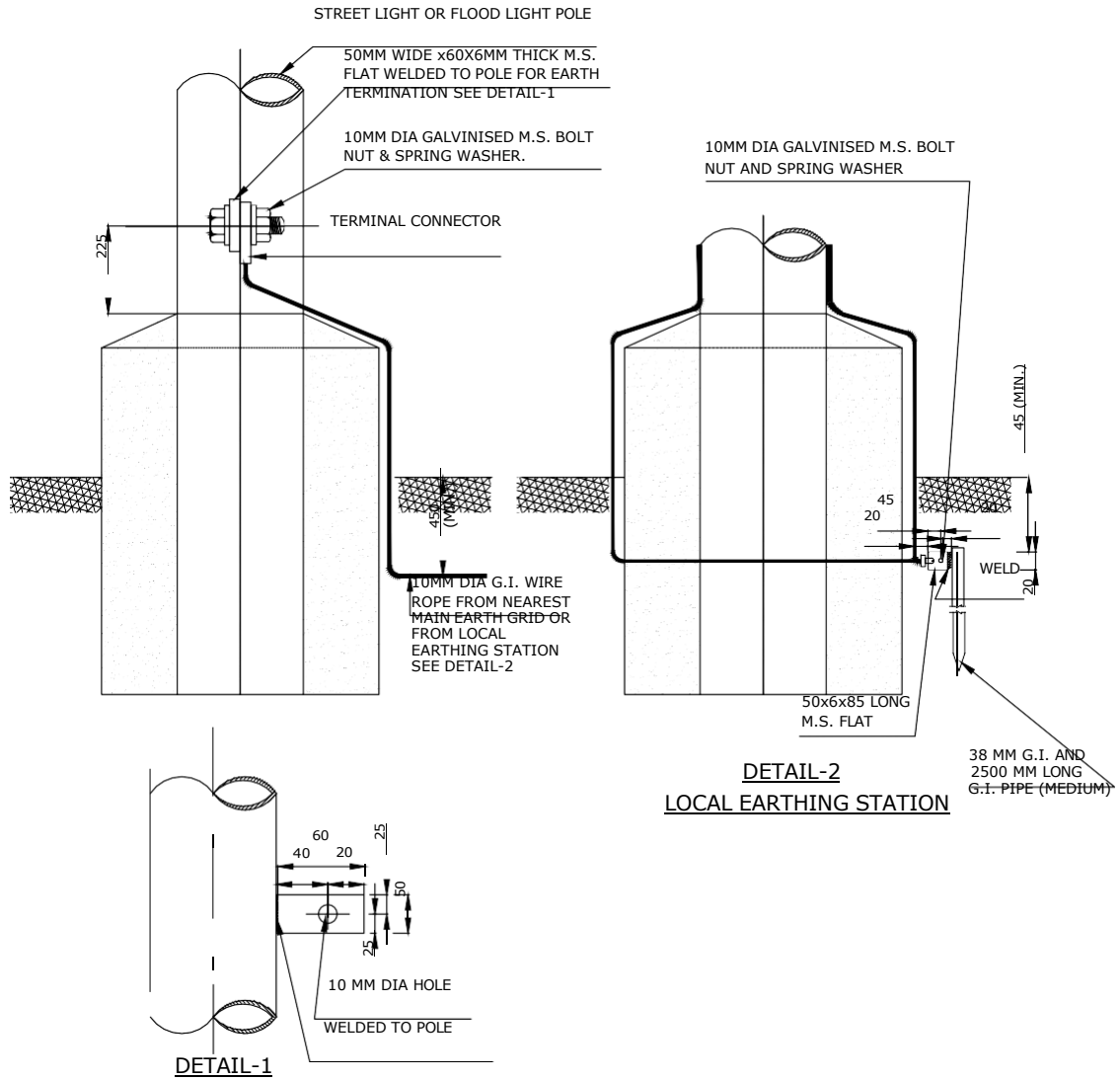
TYPICAL EARTH CONNECTION FOR
PUSH BUTTON STATION



NOTES:

1. ALTERNATIVELY CONNECTION SHALL BE TAKEN FROM THE NEAREST AVAILABLE EARTH PLATE.

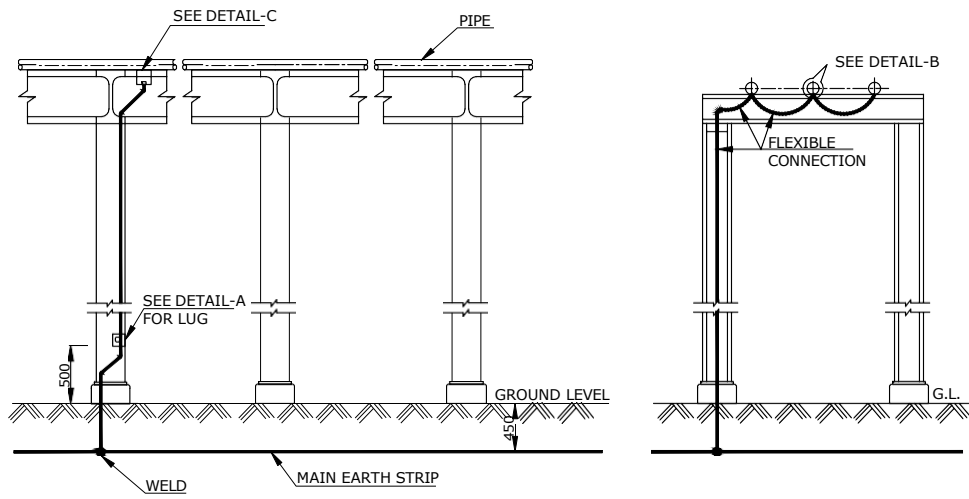
TYPICAL EARTH CONNECTION FOR STREET LIGHT POLE



NOTES:

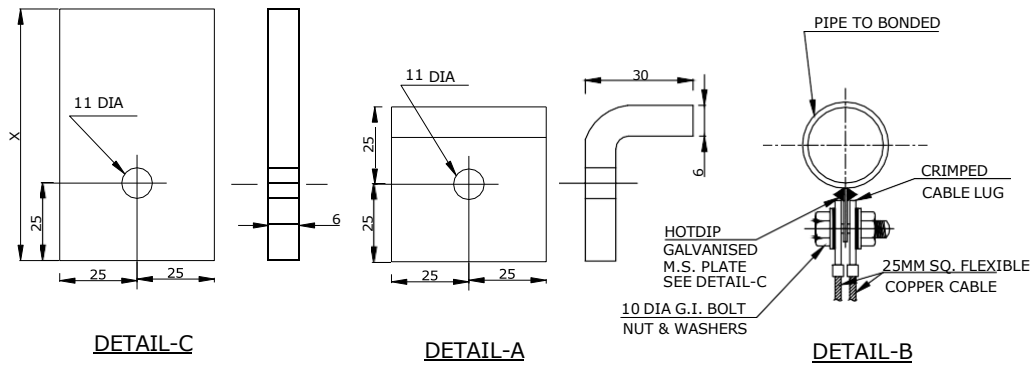
1. USE TWO EARTH WIRES IF VOLTAGE IN THE POLE JUNCTION BOX IS 415 VOLTS.

EARTHING/BONDING OF PIPES AND PIPE RACKS



FRONT VIEW

SIDE VIEW



DETAIL-C

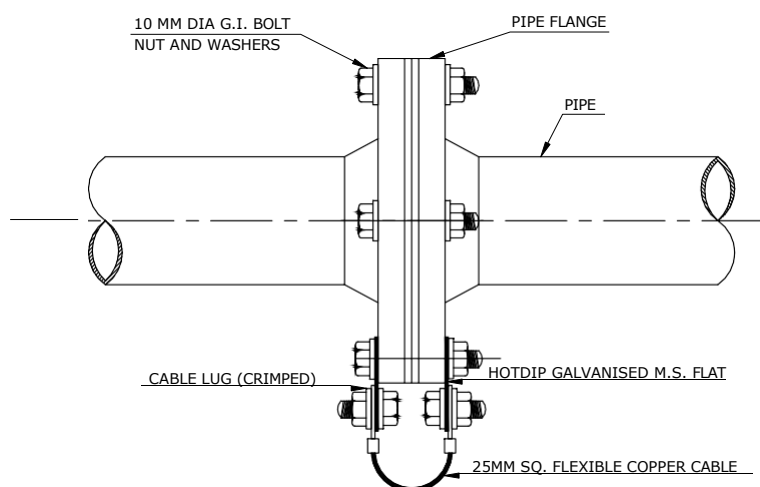
DETAIL-A

DETAIL-B

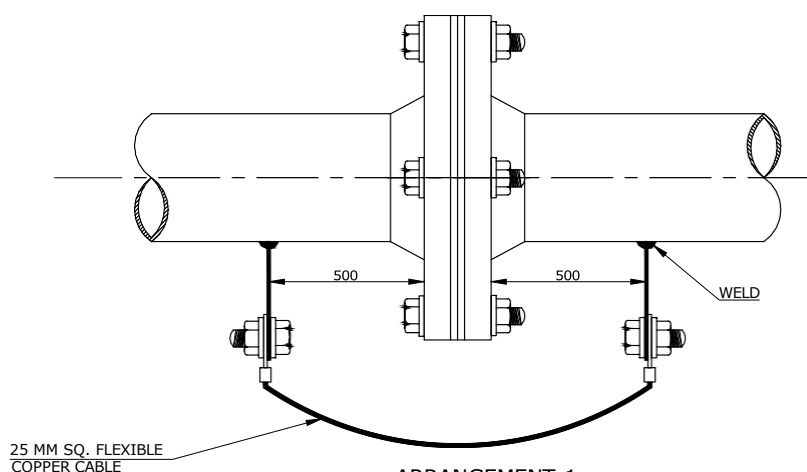
NOTES:

1. UNLESS MENTIONED OTHERWISE ON PLANS OR JOB SPECIFICATIONS. THE PIPELINES SHALL BE BONDED AND EARTHED AT THE ENTRY AND EXITS POINTS OF BATTERY LIMIT.
2. STEEL PIPE RACKS IN THE PROCESS UNIT AND OFFSITE AREA SHALL BE EARTHED AT EVERY 24 METRES.

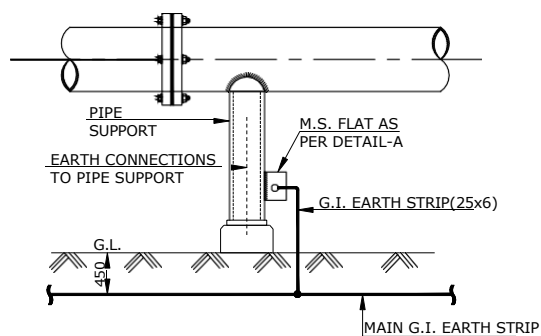
EARTHING/BONDING OF PIPES AND PIPE RACKS



ARRANGEMENT-2



ARRANGEMENT-1

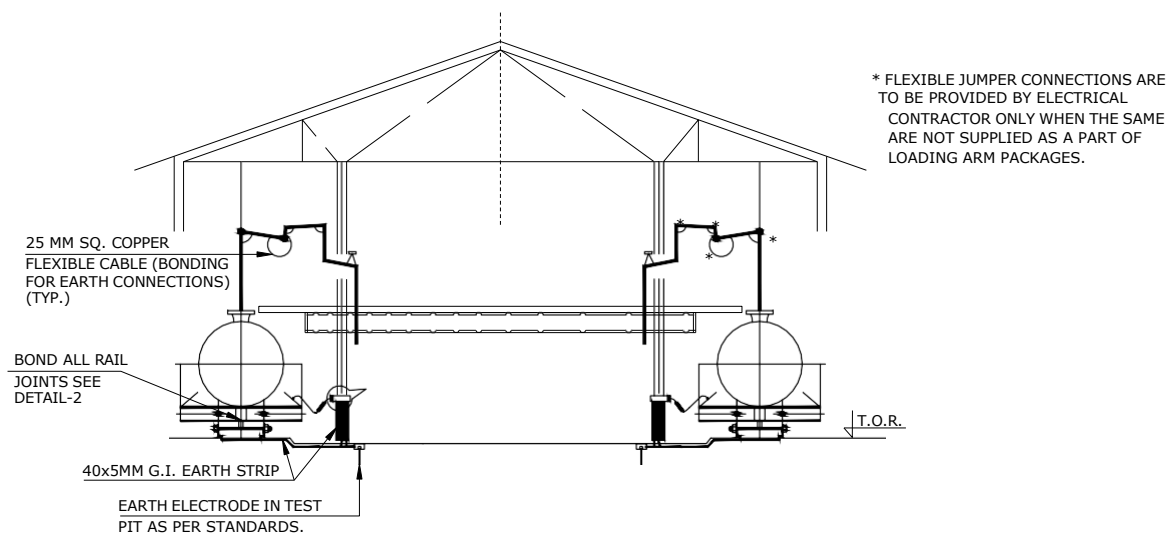


ARRANGEMENT-3

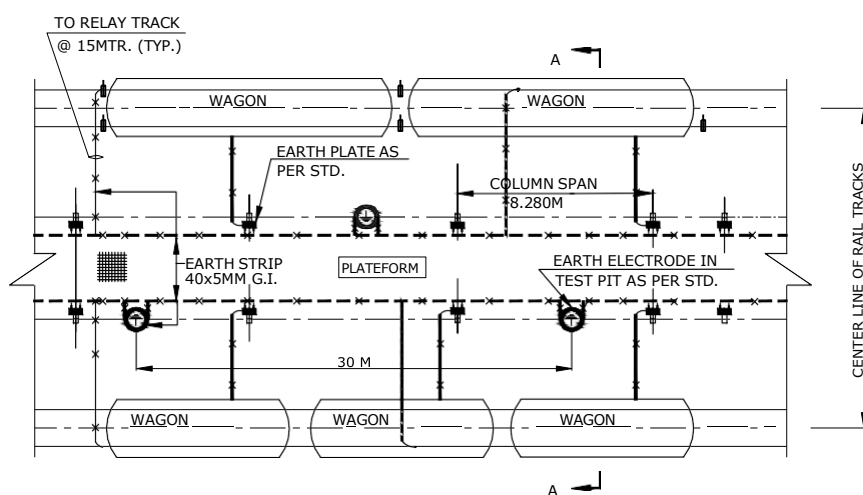
NOTES:

1. HOT DIP GALVANISED M.S. FLAT (50x 10x (x+50) WHERE x IS THE INSULATION THICKNESS) SHALL BE PROVIDED BY THE PIPING CONTACTOR.
2. SUPPLY OF FLEXIBLE COPPER CABLE, LUGS, BOLTS, NUTS, WASHERS HARDWARE AND MAKING CONNECTIONS, SHALL BE DONE BY ELECTRICAL CONTACTOR.

TYPICAL EARTHING ARRANGEMENT-WAGON



SECTION A-A

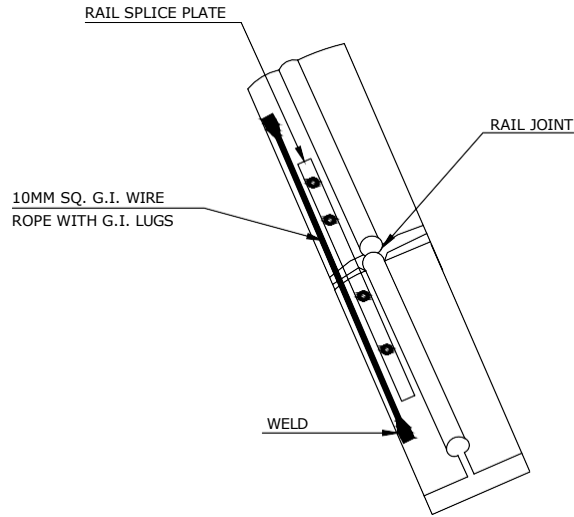


TYPICAL PART PLAN

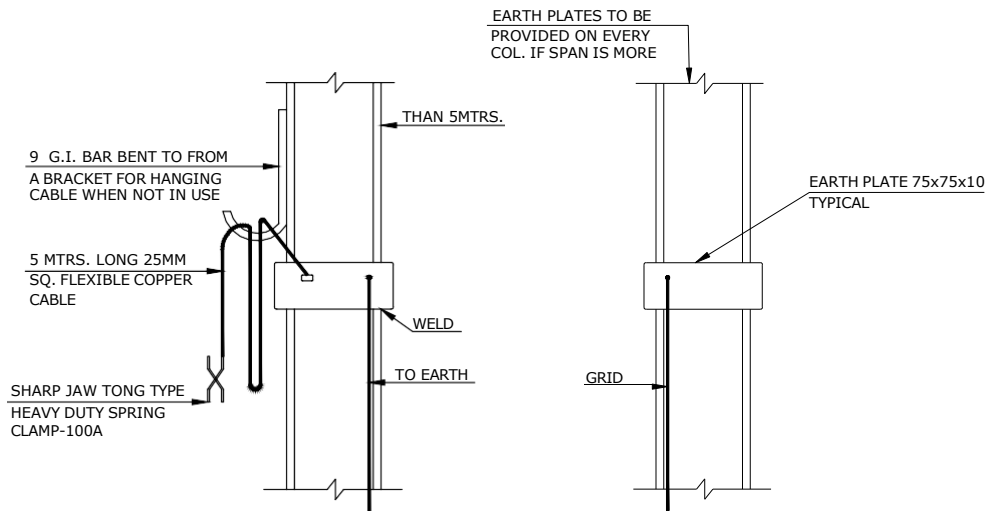
NOTES:

- SUPPLY OF FLEXIBLE CABLE AND SPRING CLAMPS BY ELECTRICAL CONTACTOR ARE NOT REQUIRED WHEN MONITORING OF EARTH SCHEME AND THE ABOVE MATERIAL ARE INCLUDED AS PART OF PLANT AUTOMATION PACKAGE.

TYPICAL EARTHING ARRANGEMENT-WAGON

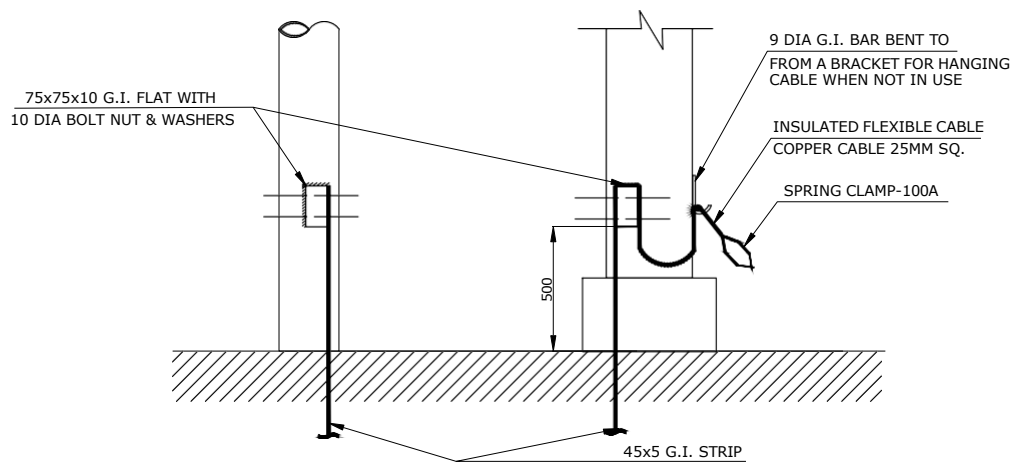
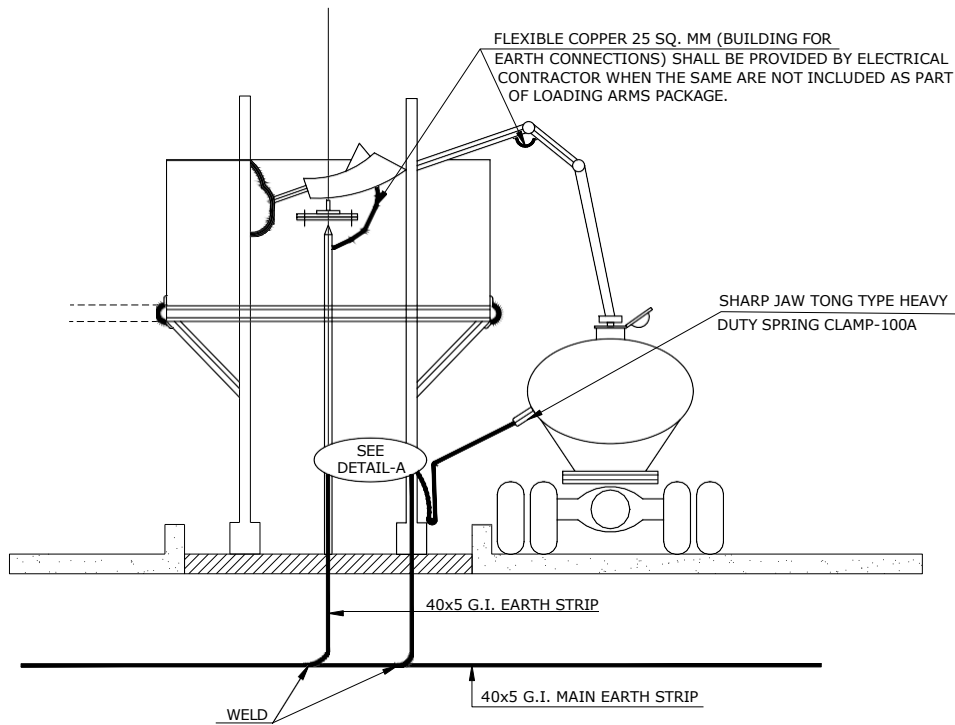


BONDING OF SINGLE RAIL DETAIL-2



DETAIL-1

EARTHING-TRUCK LOADING PLATFORM

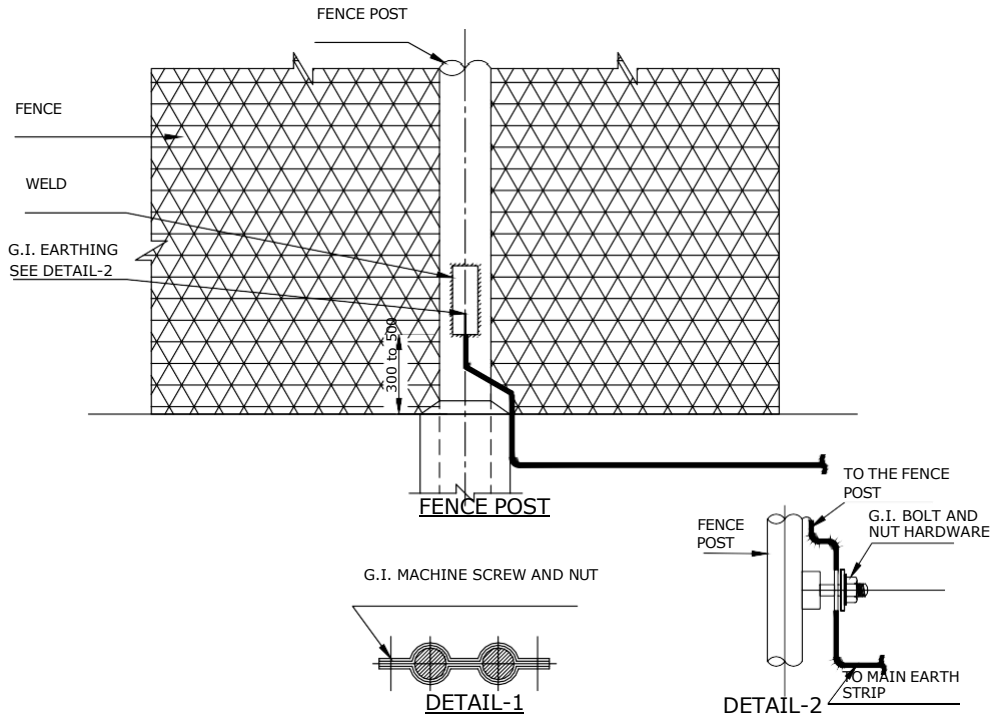
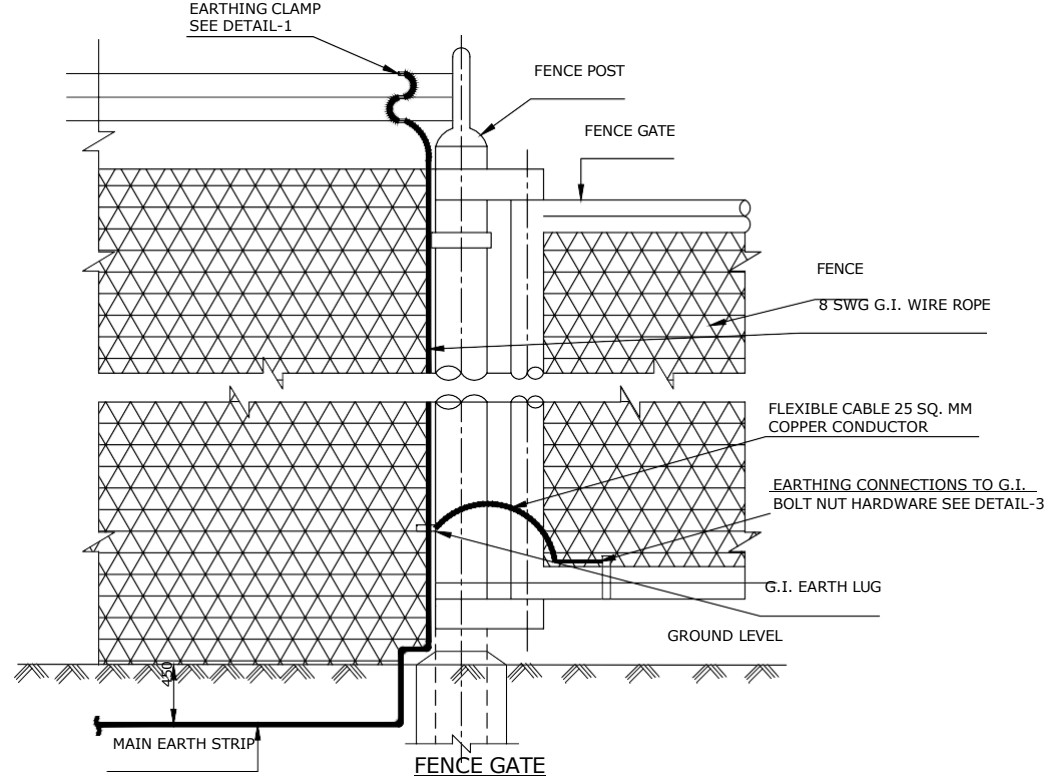


DETAIL-A

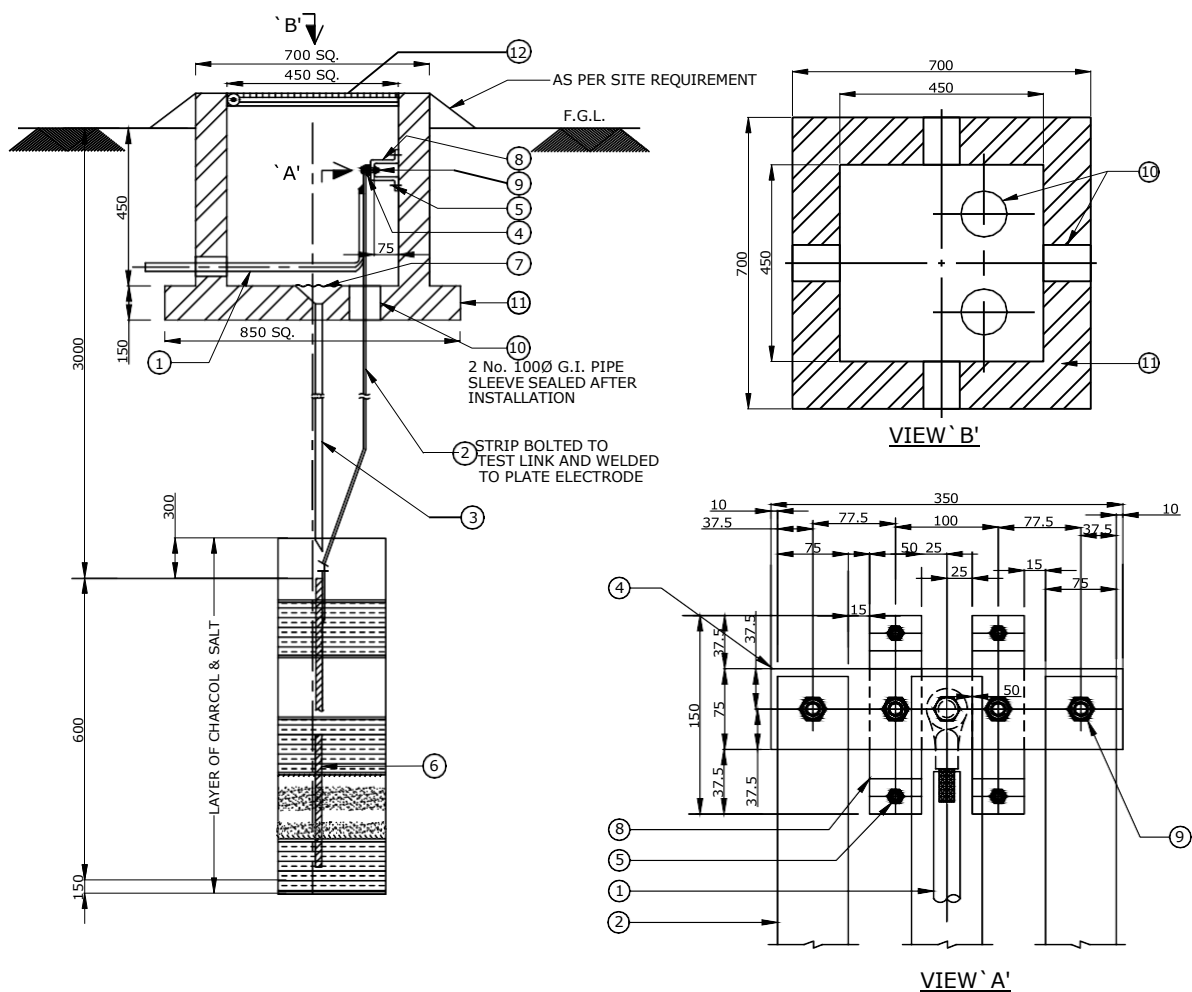
NOTES:

1. SUPPLY OF FLEXIBLE CABLE AND SPRING CLAMPS BY ELECTRICAL CONTACTOR ARE NOT REQUIRED WHEN MONITORING OF EARTH SCHEME AND THE ABOVE MATERIAL ARE INCLUDED AS PART OF PLANT AUTOMATION PACKAGE.

FENCE GATE EARTHING
(TRANSFORMER YARD)



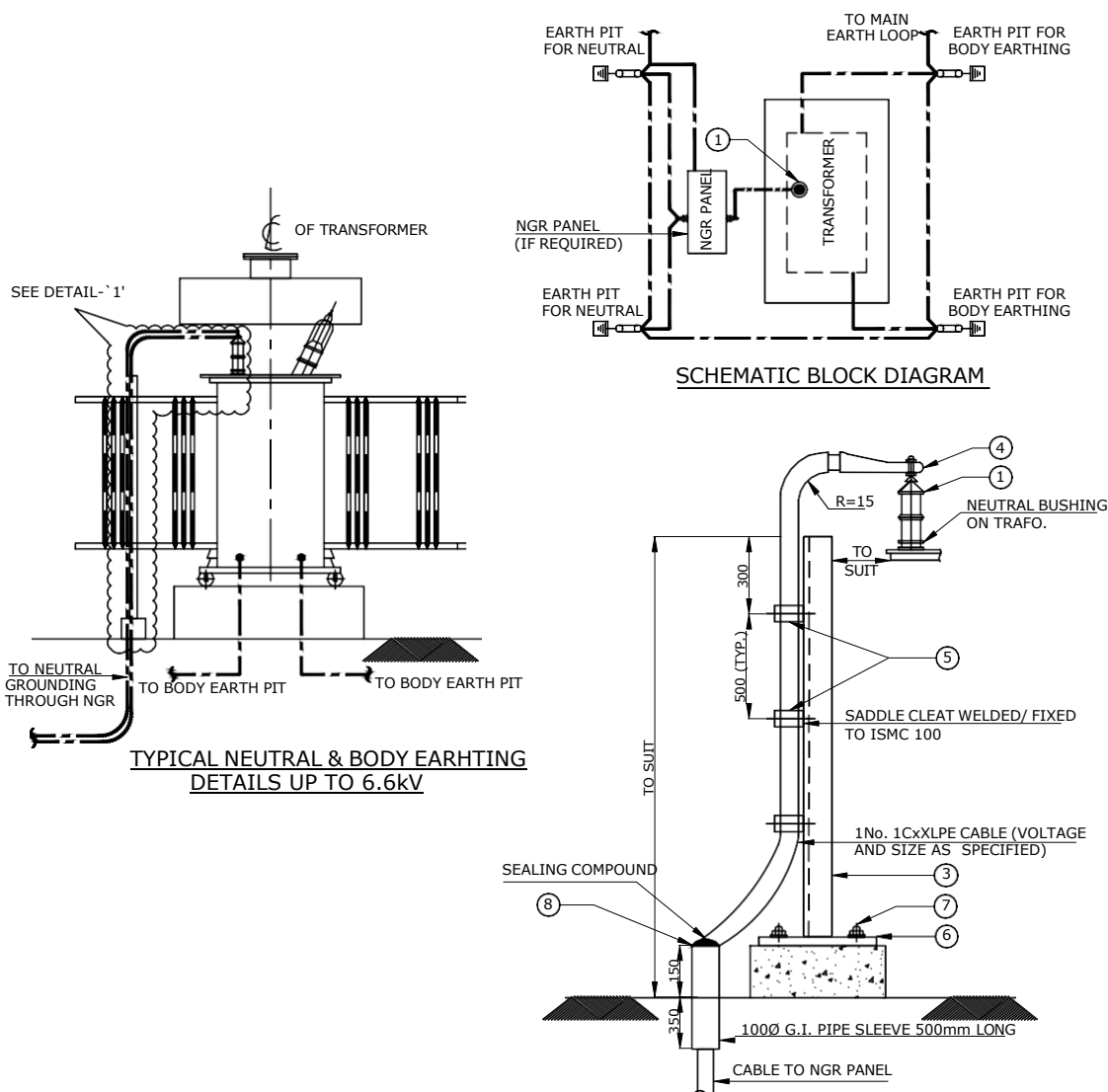
TYPICAL DETAILS OF PLATE EARTH ELECTRODE



MATERIAL TAKE-OFF

ITEM No	DESCRIPTION	QUANTITY	REMARKS
1.	75x10mm G.I. STRIP/ 25x3mm COPPER STRIP/ 1C PVC INSULATED CABLES AS SPECIFIED IN CONTRACT DOCUMENTS.	AS REQUIRED	
2.	75X8mm G.I. STRIP/ 25x3mm COPPER STRIPS	2 No.	
3.	25Ø G.I. PERFORATED PIPE FOR WATERING.	1 No.	
4.	350x75x10 mm THICK G.I. TEST LINK	1 No.	
5.	MB STAINLESS STEEL ANCHOR STUD WITH BOLT AND WASHER	4 No.	
6.	600x600x10 mm THICK G.I./3mm THICK COPPER EARTH ELECTRODE.	1 No.	
7.	WIRE MESH	1 No.	
8.	50x6 mm THICK 350 LONG G.I. SADDLE.	2 No.	
9.	M10 STAINLESS STEEL BOLT WITH 2 No. PLAIN & 1 No. SPRING WASHERS.	5 No.	
10.	100Ø G.I. PIPE SLEEVE SEALED AFTER INSTALLATION.	6 No.	
11.	BRICK WATERING CHAMBER WITH PLASTER FINISH INSIDE & OUTSIDE	1 No.	
12.	C.I. REMOVABLE COVER HINGED TO CAST IRON FRAME.	1 No.	

**TYPICAL TRANSFORMER NEUTRAL
& BODY EARTHING DETAILS FOR
RESISTANCE GROUNDED SYSTEM**



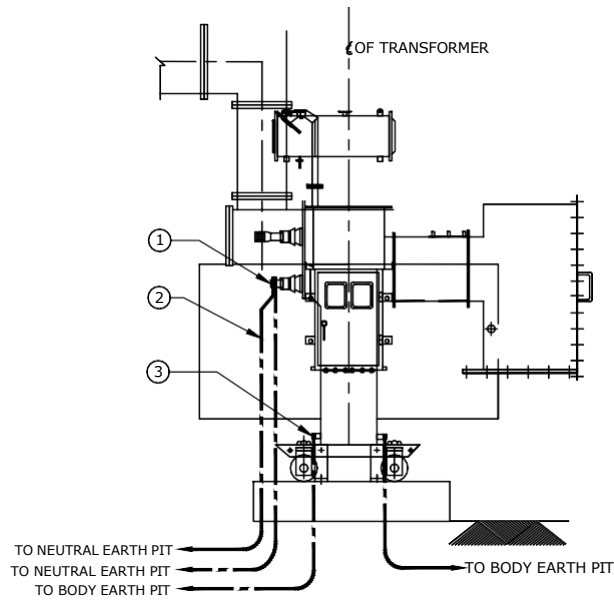
MATERIAL TAKE-OFF

ITEM No	DESCRIPTION	QUANTITY	REMARKS
1.	NEUTRAL BUSHING	1 No.	
2.	NUT & SPRING WASHERS TO SUIT TRANSFORMER BODY EARTHING	2 No.	
3.	ISMC 100-LENGTH TO SUIT	1 No.	
4.	CABLE LUG SUITABLE FOR CABLE SIZE	1 No.	
5.	MS SADDLE/ CLEAT TO SUIT CABLE DIA.	AS REQUIRED	
6.	150x150x6mm THICK PLATE WITH 4 No. 12Ø HOLES.	1 No.	
7.	M10 ANCHOR STUD WITH PLAIN AND SPRING WASHERS.	4 No.	
8.	SEALING COMPOUND	AS REQUIRED	

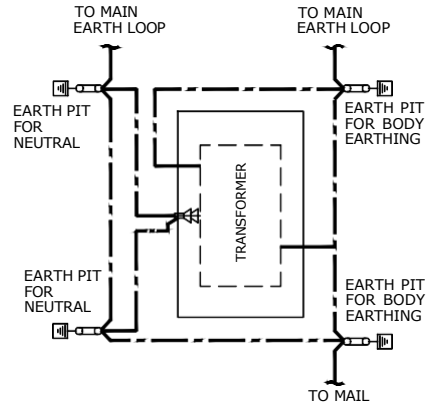
NOTES :-

1. ALL HARDWARE SHALL BE OF STAINLESS STEEL.
2. ALL STEEL STRUCTURE USED FOR ELECTRICAL INSTALLATION SHALL BE APPLIED TWO COATS OF ANTI CORROSIVE PRIMER AND EPOXY PAINT OF APPROVED SHADE.

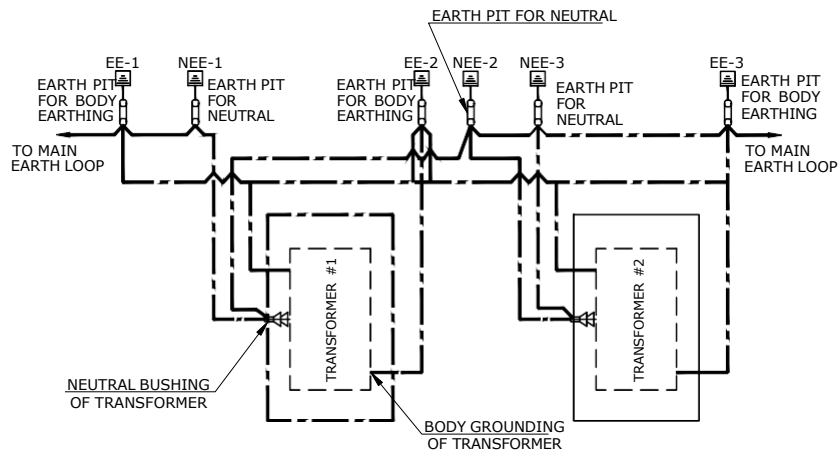
TYPICAL TRANSFORMER NEUTRAL
& BODY EARTHING SOLIDLY
GROUNDED SYSTEM



TYPICAL NEUTRAL & BODY EARTHING
DETAILS UP TO 0.433kV



SCHEMATIC DIAGRAM
FOR SINGLE TRANSFORMER



SCHEMATIC DIAGRAM
FOR TWO TRANSFORMER

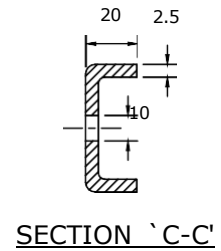
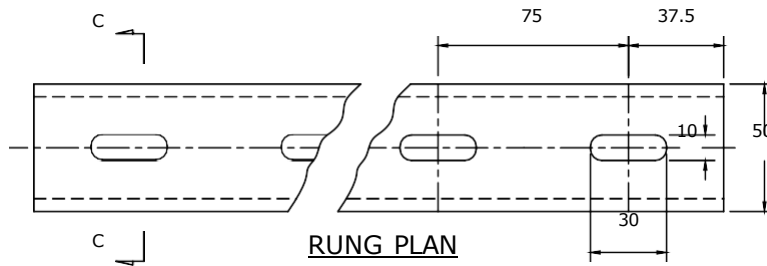
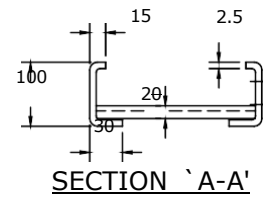
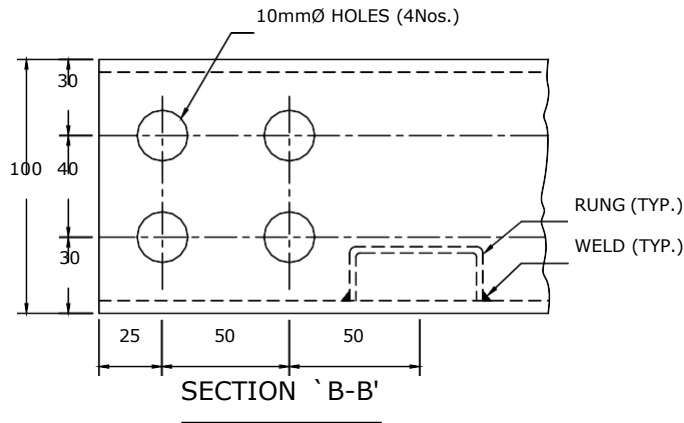
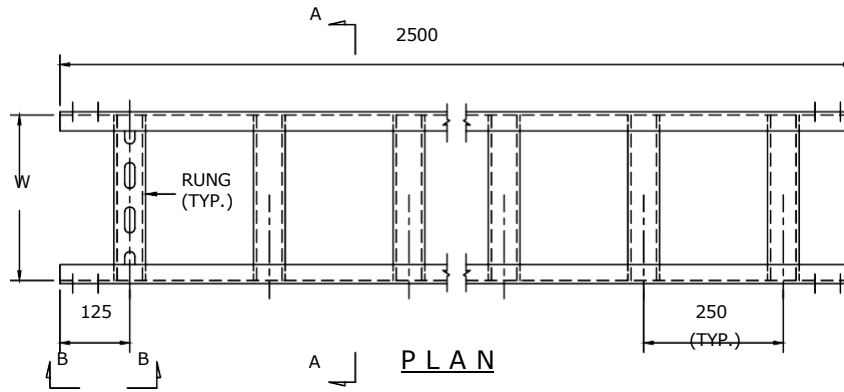
MATERIAL TAKE-OFF

ITEM No	DESCRIPTION	QUANTITY	REMARKS
1.	NEUTRAL BUSHING BY TRANSFORMER VENDOR	-	
2.	G.I. EARTH STRIP	AS PER DRG.	
3.	EARTHING PAD WITH BOLT NUT & SPRING WASHERS BY TRANSFORMER VENDOR	-	

NOTES :-

1. ALL HARDWARE SHALL BE OF STAINLESS STEEL.
2. ALL DAMAGE TO GALVANISED FINISHES SHALL BE PAINTED WITH ZINC RICH PAINT.
3. ALL STEEL STRUCTURE USED FOR ELECTRICAL INSTALLATION SHALL BE APPLIED TWO COATS OF ANTI CORROSIVE PRIMER AND EPOXY PAINT OF APPROVED SHADE.

STANDARD DRAWING
LADDER TYPE CABLE TRAY

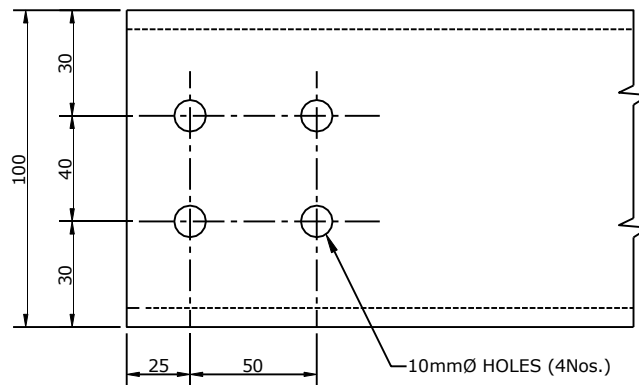
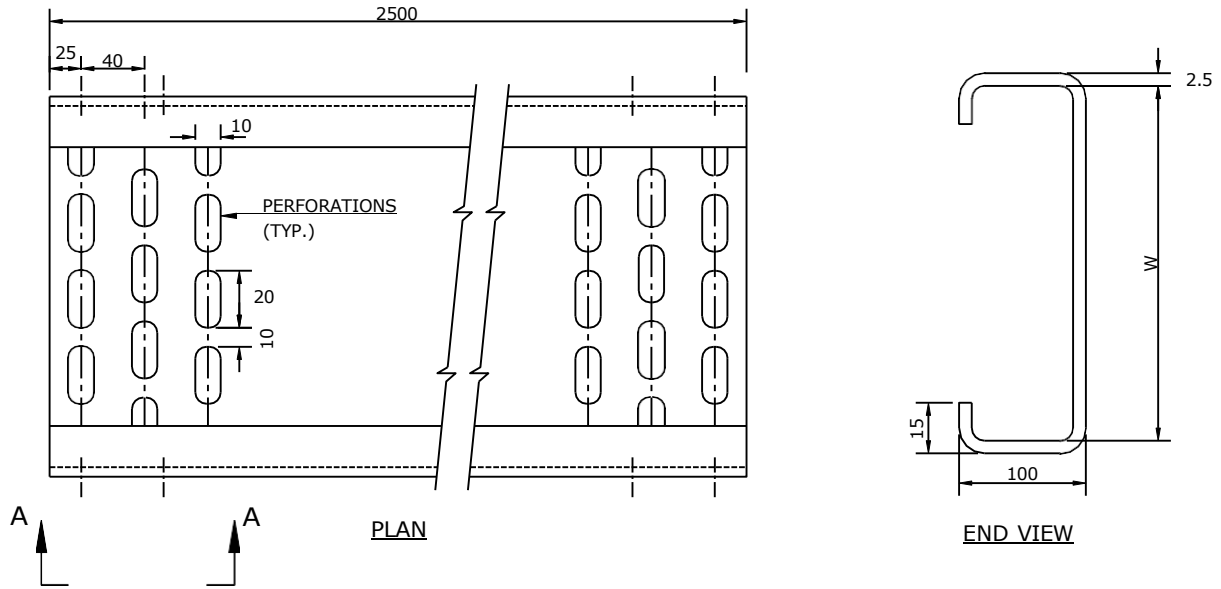


INSIDE TRAY WIDTH (W) - 150,300,450,600,800MM (AS PER MTO)
MATERIAL - 12 GAUGE (2.5MM) M.S.SHEET/G.S/AL/FRP (AS PER MTO)

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. M.S. SHEET SHALL CONFORM TO IS2062: 1992 OR EQUIVALENT INTERNATIONAL STANDARDS AND HOT DIP GALVANIZING SHALL BE DONE AS PER IS4759: 1996 OR EQUIVALENT INTERNATIONAL STANDARDS. CABLE TRAY SUPPLIED WITH OTHER MATERIALS SHALL CONFORMED TO RELEVANT IS/INTERNATIONAL STANDARDS.
3. THE MATERIAL DIMENSIONAL DETAILS SHOWN ARE TYPICAL FOR GS STRESS.
4. EACH CABLE TRAY SHALL BE SUPPLIED COMPLETE WITH MATCHING COUPLER PLATES WITH REQUIRE HARDWARE AS PER DRG. No. SD-75-6706.
5. CABLE TRAYS SHALL DESIGN FOR 3000mm SUPPORT SPAN UNLESS NOTED OTHERWISE FOR SPECIFIED TRAY LOADING.

STANDARD DRAWING
PERFORATED TYPE CABLE TRAY



SECTION 'A-A'

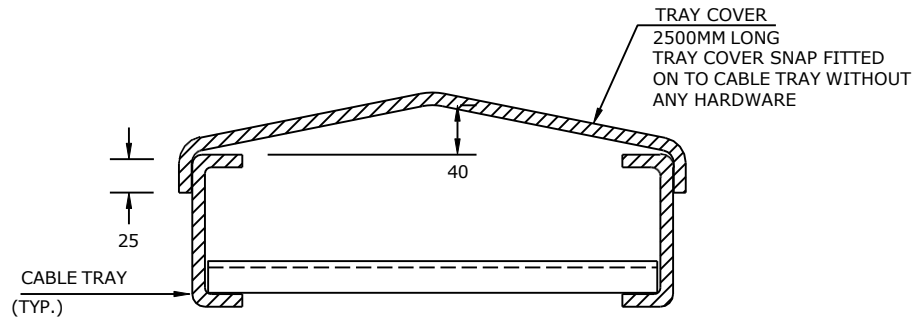
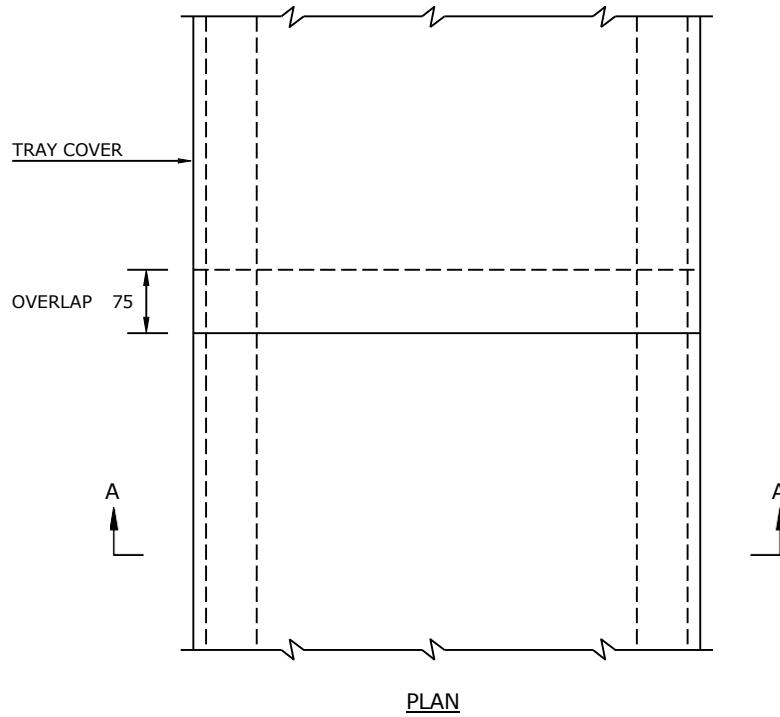
INSIDE WIDTH (W) - 100,150,300,450,600,800MM (AS PER MTO)
MATERIAL - 12 GAUGE (2.5MM) M.S.SHEET/G.S./AL/FRP (AS PER MTO)

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. M.S. SHEET SHALL CONFORM TO IS2062: 1992 OR EQUIVALENT INTERNATIONAL STANDARDS AND HOT DIP GALVANIZING SHALL BE DONE AS PER IS4759: 1996 OR EQUIVALENT INTERNATIONAL STANDARDS. CABLE TRAY SUPPLIED WITH OTHER MATERIALS SHALL CONFIRMED TO RELEVANT IS/INTERNATIONAL STANDARDS.
3. THE MATERIAL DIMENSIONAL DETAILS SHOWN ARE TYPICAL FOR GS STRESS.
4. EACH CABLE TRAYS SHALL BE SUPPLIED COMPLETE WITH MATCHING COUPLER PLATES WITH REQUIRED HARDWARE AS PER DRG. No. SD-75-6706.
5. CABLE TRAYS SHALL BE DESIGNED FOR 3000mm SUPPORT SPAN UNLESS NOTED OTHERWISE FOR SPECIFIED TRAY LOADING.

STANDARD DRAWING
CABLE TRAY COVER

TYPICAL ARRANGEMENT OF COVERING CABLE TRAY

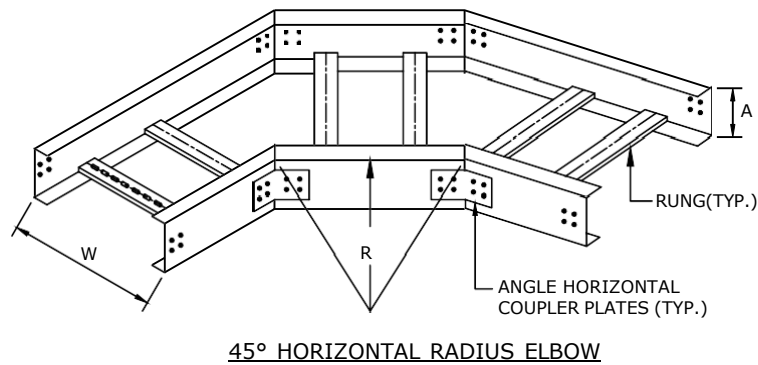
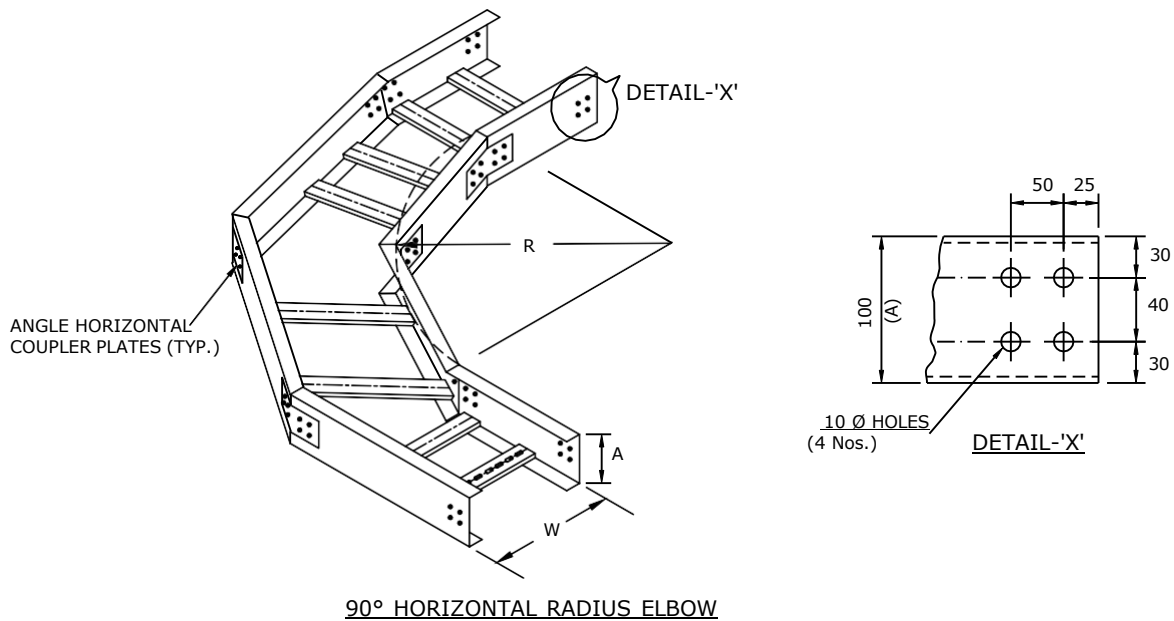


MATERIAL-16 GAUGE(1.7MM) M.S. SHEET/G.S./AL/FRP (AS PER MTO)
TRAY COVER MATERIAL SAME AS OF TRAY & TRAY WIDTH AS PER MTO

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. M.S. SHEET SHALL CONFORM TO IS2062: 1992 OR EQUIVALENT INTERNATIONAL STANDARDS AND HOT DIP GALVANIZING SHALL BE DONE AS PER IS4759: 1996 OR EQUIVALENT INTERNATIONAL STANDARDS. CABLE TRAY SUPPLIED WITH OTHER MATERIALS SHALL CONFORMED TO RELEVANT IS/INTERNATIONAL STANDARDS.

STANDARD DRAWING CABLE TRAY
ACCESSORIES



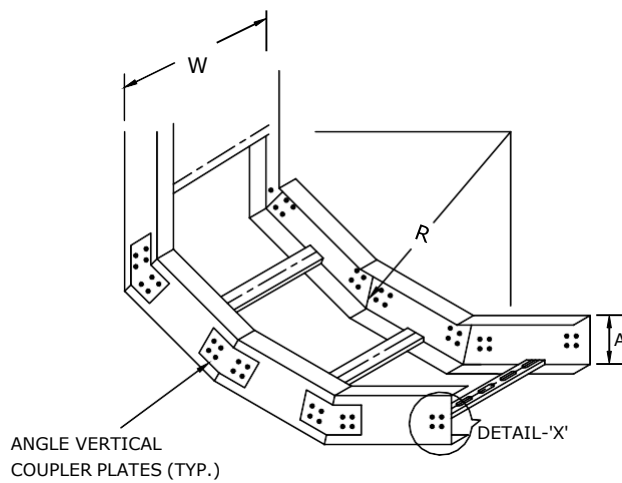
(W) INSIDE WIDTH OF TRAY - 150,300,450,600,800MM (AS PER MTO)
(A) DEPTH OF TRAY - 100MM UNLESS NOTED
(R) BENDING RADIUS (AS PER MTO)

NOTES:

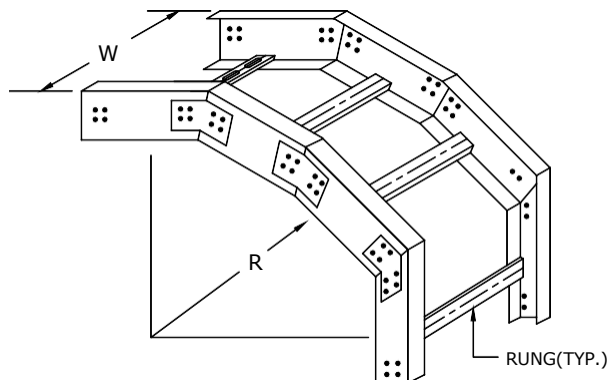
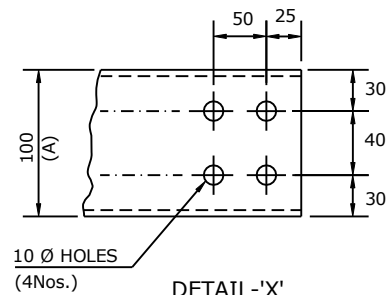
1. ALL DIMENSIONS ARE IN MM.
2. MATERIAL - 12 GAUGE(2.5MM) M.S. SHEET/G.S/AL/FRP (AS PER MTO).
3. M.S. SHEET SHALL CONFORM TO IS 2062: 1992 OR EQUIVALENT INTERNATIONAL STANDARDS AND HOT DIP GALVANIZING SHALL BE DONE AS PER IS 4759: 1996 OR EQUIVALENT INTERNATIONAL STANDARDS. TRAY FITTINGS SUPPLIED WITH OTHER MATERIAL SHALL CONFORM TO RELEVANT IS/INTERNATIONAL STANDARDS.
4. EACH CABLE TRAY SHALL BE SUPPLIED COMPLETE WITH MATCHING COUPLER PLATES WITH REQUIRE HARDWARE AS PER DRG. No. SD-75-6706.
5. ALL TRAY FITTINGS SHALL BE SUPPLIED COMPLETE WITH MATCHING ANGLE HORIZONTAL COUPLER PLATES & HARDWARE. ALTERNATIVELY WELDED ASSEMBLY MAY BE SUPPLIED FOR G.S. CABLE TRAY FITTINGS.

STANDARD DRAWING CABLE TRAY
ACCESSORIES

90° VERTICAL RADIUS ELBOW



INSIDE



OUTSIDE

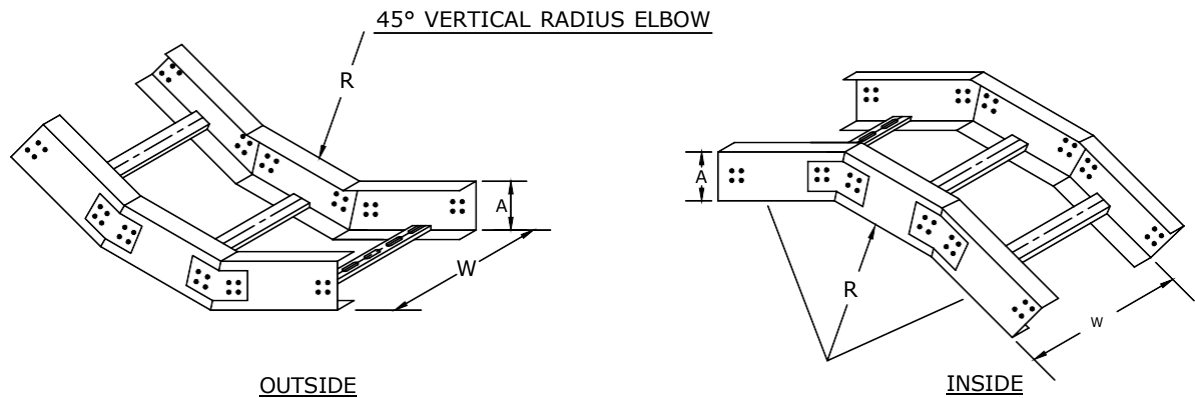
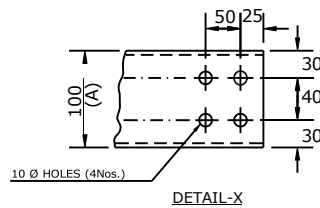
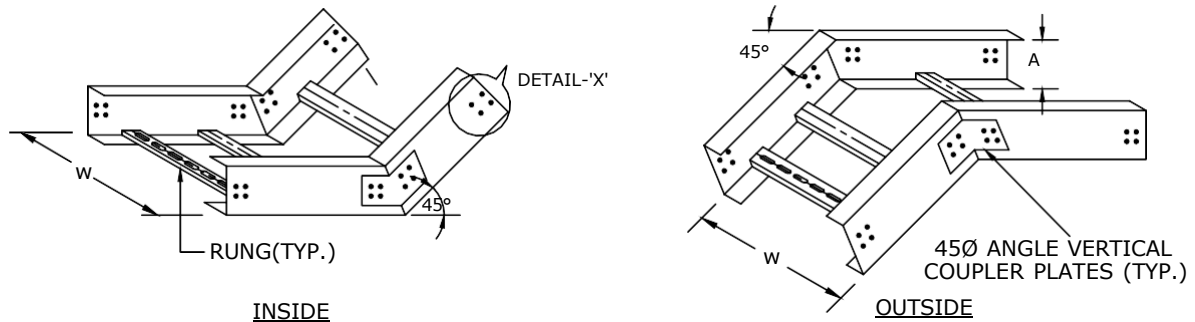
(W) INSIDE WIDTH OF TRAY - 150,300,450,600,800MM (AS PER MTO).
(A) DEPTH OF TRAY - 100MM UNLESS NOTED.
(R) BENDING RADIUS (AS PER MTO).

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. MATERIAL - 12 GAUGE(2.5MM) M.S. SHEET/G.S/AL/FRP (AS PER MTO).
3. M.S. SHEET SHALL CONFORM TO IS 2062: 1992 OR EQUIVALENT INTERNATIONAL STANDARDS AND HOT DIP GALVANIZING SHALL BE DONE AS PER IS 4759: 1996 OR EQUIVALENT INTERNATIONAL STANDARDS. TRAY FITTINGS SUPPLIED WITH OTHER MATERIAL SHALL CONFORM TO RELEVANT IS/INTERNATIONAL STANDARDS.
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5. ALL TRAY FITTINGS SHALL BE SUPPLIED COMPLETE WITH MATCHING ANGLE HORIZONTAL COUPLER PLATES AND HARDWARE. ALTERNATIVELY WELDED ASSEMBLY MAY BE SUPPLIED FOR G.S. CABLE TRAY FITTINGS.

STANDARD DRAWING CABLE TRAY

45° DIRECT VERTICAL ELBOW



(W) INSIDE WIDTH OF TRAY - 150,300,450,600,800MM (AS PER MTO)

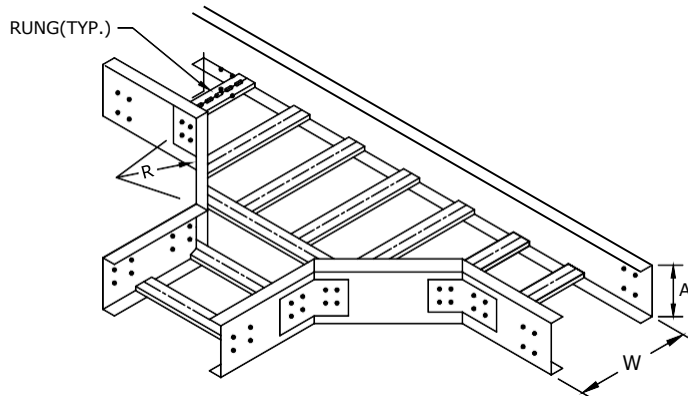
(A) DEPTH OF TRAY - 100MM UNLESS NOTED

(R) BENDING RADIUS (AS PER MTO)

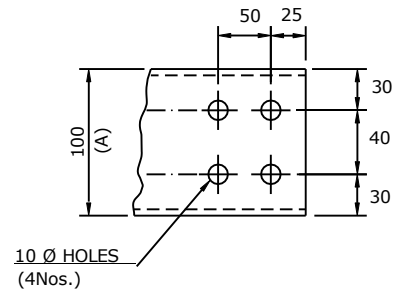
NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. MATERIAL - 12 GAUGE(2.5MM) M.S. SHEET/G.S/AL/FRP (AS PER MTO).
3. M.S. SHEET SHALL CONFORM TO IS 2062: 1992 OR EQUIVALENT INTERNATIONAL STANDARDS AND HOT DIP GALVANIZING SHALL BE DONE AS PER IS 4759: 1996 OR EQUIVALENT INTERNATIONAL STANDARDS. TRAY FITTINGS SUPPLIED WITH OTHER MATERIAL SHALL CONFORM TO RELEVANT IS/INTERNATIONAL STANDARDS.
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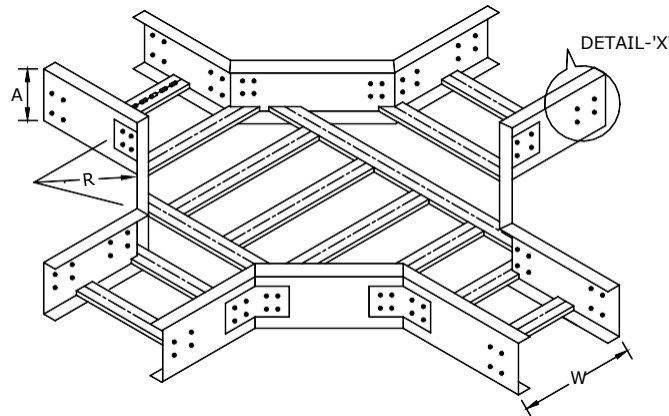
STANDARD DRAWING CABLE TRAY
ACCESSORIES



HORIZONTAL RADIUS TEE



DETAIL-'X'



HORIZONTAL RADIUS CROSS

(W) INSIDE WIDTH OF TRAY - 150,300,450,600,800MM (AS PER MTO)

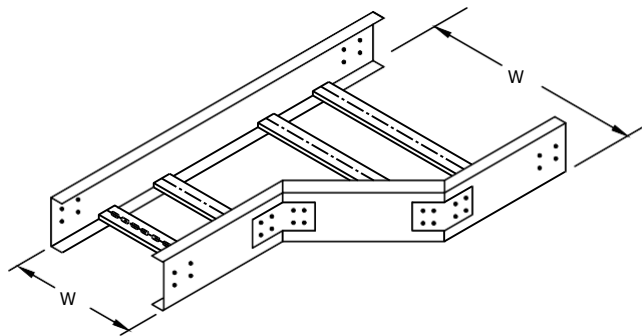
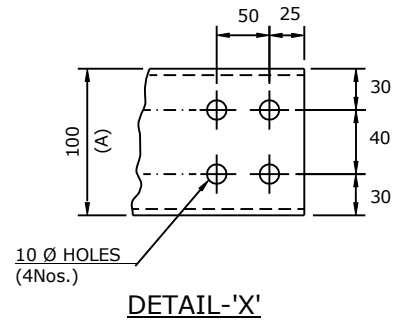
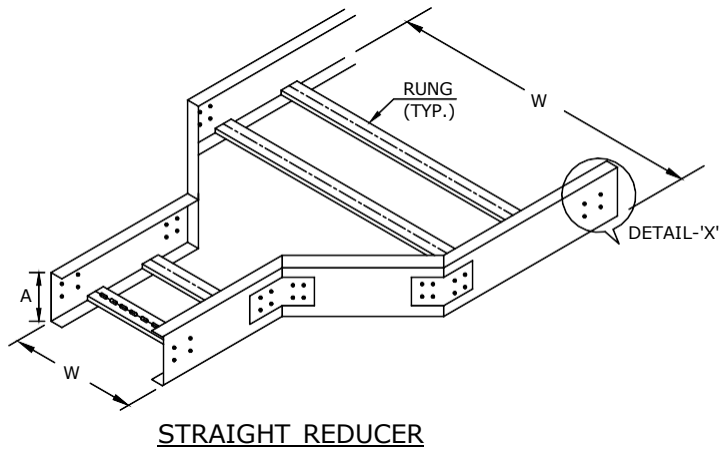
(A) DEPTH OF TRAY - 100MM UNLESS NOTED

(R) BENDING RADIUS (AS PER MTO)

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. MATERIAL - 12 GAUGE(2.5MM) M.S. SHEET/G.S/AL/FRP (AS PER MTO).
3. M.S. SHEET SHALL CONFORM TO IS 2062: 1992 OR EQUIVALENT INTERNATIONAL STANDARDS AND HOT DIP GALVANIZING SHALL BE DONE AS PER IS 4759: 1996 OR EQUIVALENT INTERNATIONAL STANDARDS. TRAY FITTINGS SUPPLIED WITH OTHER MATERIAL SHALL CONFORM TO RELEVANT IS/INTERNATIONAL STANDARDS.
4. EACH CABLE TRAY SHALL BE SUPPLIED COMPLETE WITH MATCHING COUPLER PLATES WITH REQUIRE HARDWARE AS PER DRG. No. SD-75-6706.
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STANDARD DRAWING CABLE TRAY
ACCESSORIES



(W) INSIDE WIDTH OF TRAY - 150,300,450,600,800MM (AS PER MTO)

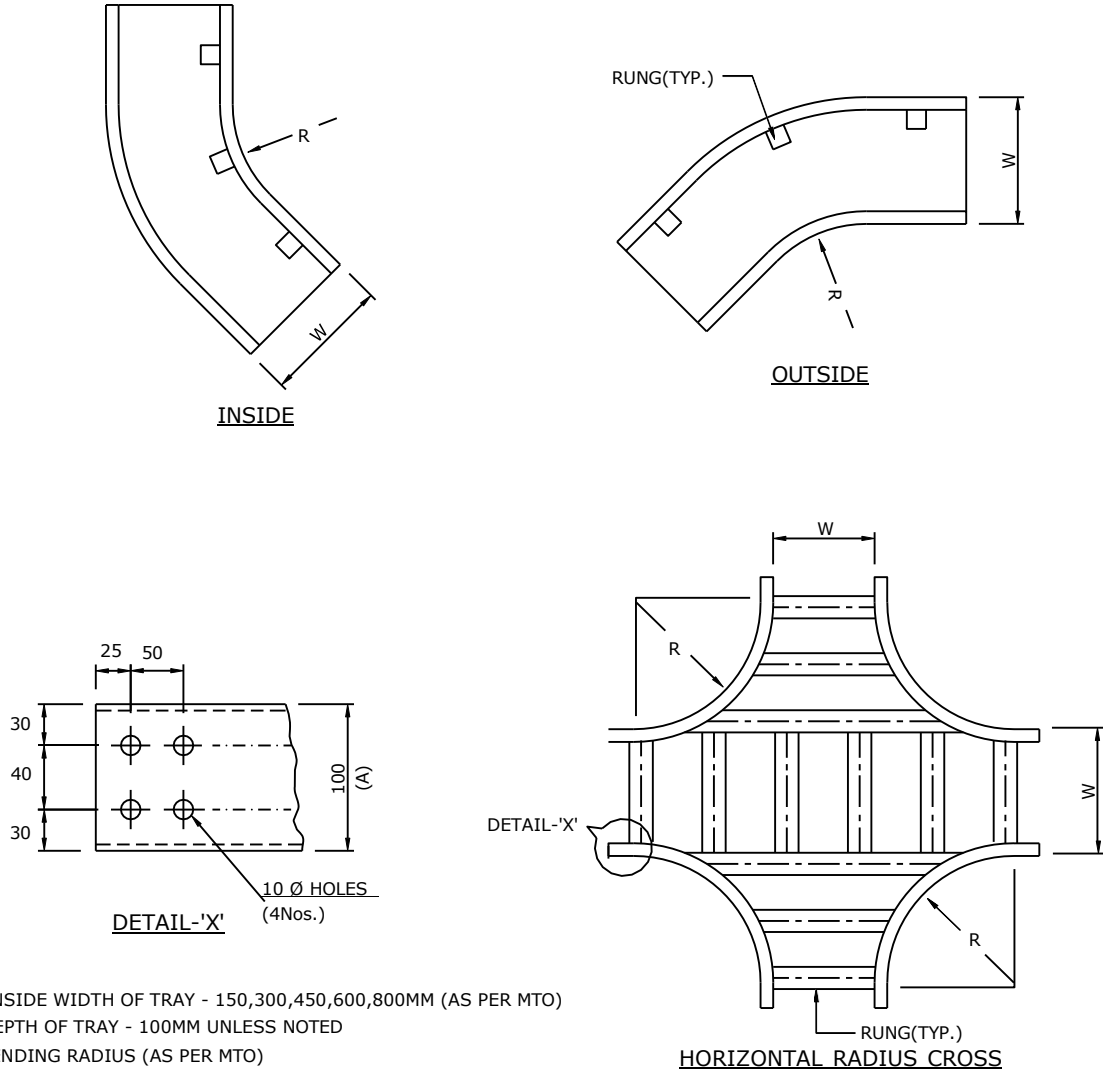
(A) DEPTH OF TRAY - 100MM UNLESS NOTED

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. MATERIAL - 12 GAUGE(2.5MM) M.S. SHEET/G.S/AL/FRP (AS PER MTO).
3. M.S. SHEET SHALL CONFORM TO IS 2062: 1992 OR EQUIVALENT INTERNATIONAL STANDARDS AND HOT DIP GALVANIZING SHALL BE DONE AS PER IS 4759: 1996 OR EQUIVALENT INTERNATIONAL STANDARDS. TRAY FITTINGS SUPPLIED WITH OTHER MATERIAL SHALL CONFORM TO RELEVANT IS/INTERNATIONAL STANDARDS.
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STANDARD DRAWING CABLE TRAY
ACCESSORIES

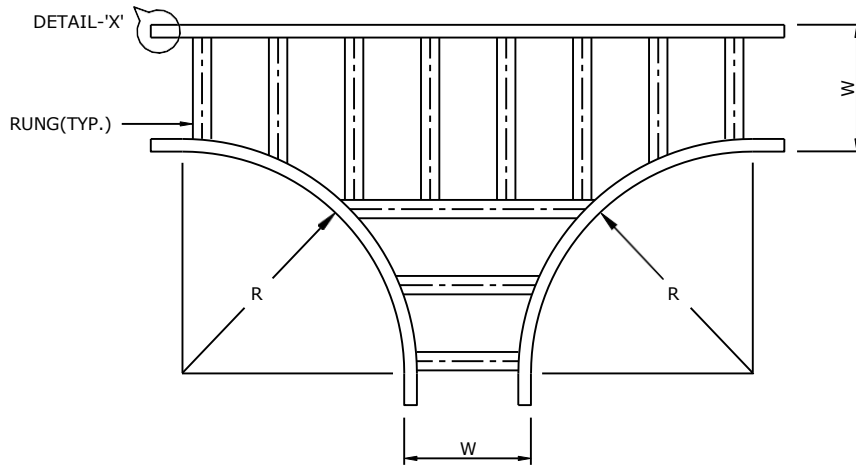
45° VERTICAL RADIUS ELBOW



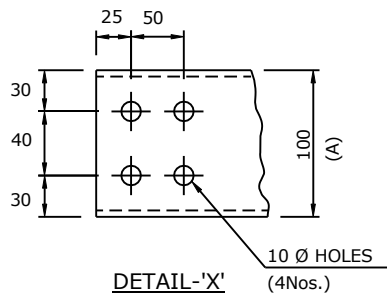
NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. MATERIAL - 12 GAUGE(2.5MM) M.S. SHEET/G.S/AL/FRP (AS PER MTO).
3. M.S. SHEET SHALL CONFORM TO IS 2062: 1992 OR EQUIVALENT INTERNATIONAL STANDARDS AND HOT DIP GALVANIZING SHALL BE DONE AS PER IS 4759: 1996 OR EQUIVALENT INTERNATIONAL STANDARDS. TRAY FITTINGS SUPPLIED WITH OTHER MATERIAL SHALL CONFORM TO RELEVANT IS/INTERNATIONAL STANDARDS.
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STANDARD DRAWING CABLE TRAY
ACCESSORIES



HORIZONTAL RADIUS TEE

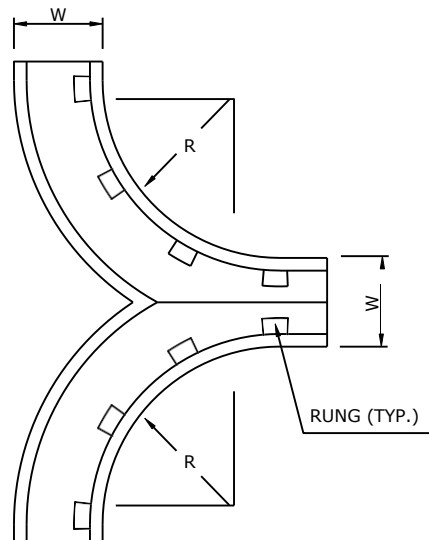


DETAIL-'X'

(W) - INSIDE WIDTH OF TRAY-150,300,450,600,800MM (AS PER MTO)

(A) - DEPTH OF TRAY-100MM UNLESS NOTED

(R) - BENDING RADIUS (AS PER MTO)

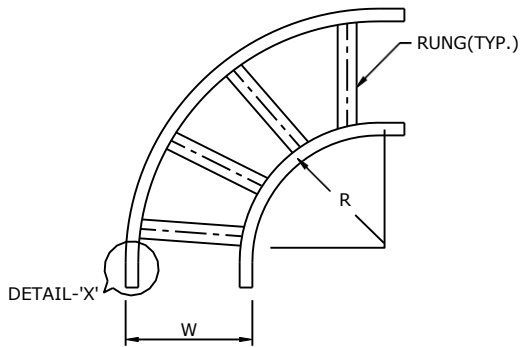


90° VERTICAL RADIUS TEE

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. MATERIAL - 12 GAUGE(2.5MM) M.S. SHEET/G.S/AL/FRP (AS PER MTO).
3. M.S. SHEET SHALL CONFORM TO IS 2062: 1992 OR EQUIVALENT INTERNATIONAL STANDARDS AND HOT DIP GALVANIZING SHALL BE DONE AS PER IS 4759: 1996 OR EQUIVALENT INTERNATIONAL STANDARDS. TRAY FITTINGS SUPPLIED WITH OTHER MATERIAL SHALL CONFORM TO RELEVANT IS/INTERNATIONAL STANDARDS.
4. EACH CABLE TRAY SHALL BE SUPPLIED COMPLETE WITH MATCHING COUPLER PLATES WITH REQUIRE HARDWARE AS PER DRG. No. SD-75-6706.
5. ALL TRAY FITTINGS SHALL BE SUPPLIED COMPLETE WITH MATCHING ANGLE HORIZONTAL COUPLER PLATES AND HARDWARE. ALTERNATIVELY WELDED ASSEMBLY MAY BE SUPPLIED FOR G.S. CABLE TRAY FITTINGS.

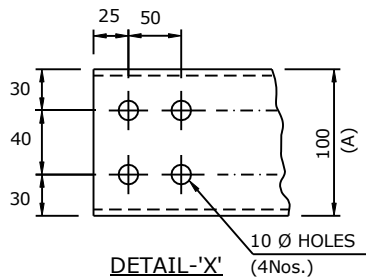
STANDARD DRAWING
CABLE TRAY ACCESSORIES (FRP)



90° HORIZONTAL RADIUS ELBOW

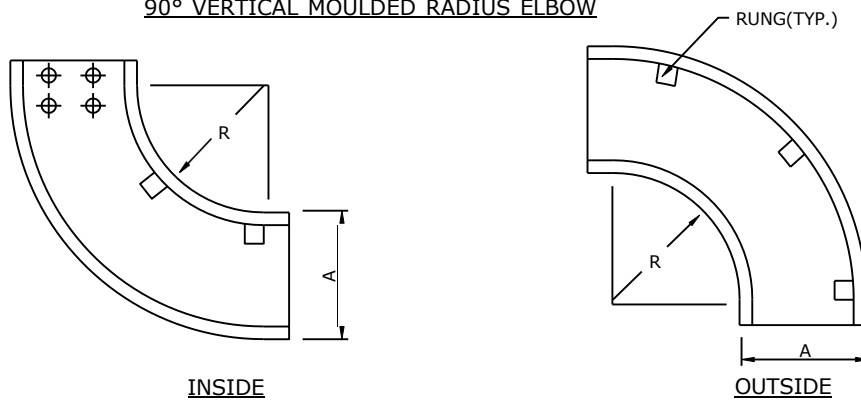


45° HORIZONTAL RADIUS ELBOW



(W) INSIDE WIDTH OF TRAY - 150,300,450,600,800MM (AS PER MTO)
(A) DEPTH OF TRAY - 100MM UNLESS NOTED
(R) BENDING RADIUS (AS PER MTO)

90° VERTICAL MOULDED RADIUS ELBOW

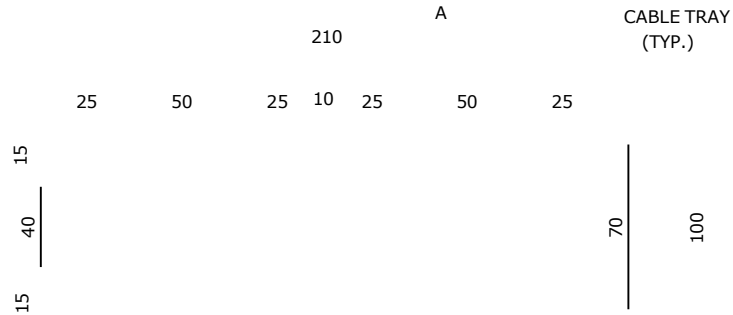


NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. MATERIAL - 12 GAUGE(2.5MM) M.S. SHEET/G.S/AL/FRP (AS PER MTO).
3. M.S. SHEET SHALL CONFORM TO IS 2062: 1992 OR EQUIVALENT INTERNATIONAL STANDARDS AND HOT DIP GALVANIZING SHALL BE DONE AS PER IS 4759: 1996 OR EQUIVALENT INTERNATIONAL STANDARDS. TRAY FITTINGS SUPPLIED WITH OTHER MATERIAL SHALL CONFORM TO RELEVANT IS/INTERNATIONAL STANDARDS.
4. EACH CABLE TRAY SHALL BE SUPPLIED COMPLETE WITH MATCHING COUPLER PLATES WITH REQUIRE HARDWARE AS PER DRG. No. SD-75-6706.
5. ALL TRAY FITTINGS SHALL BE SUPPLIED COMPLETE WITH MATCHING ANGLE HORIZONTAL COUPLER PLATES AND HARDWARE. ALTERNATIVELY WELDED ASSEMBLY MAY BE SUPPLIED FOR G.S. CABLE TRAY FITTINGS.

STANDARD DRAWING
CABLE TRAY COUPLER PLATE

10x30 LONG HOLES (4Nos.) SUITABLE FOR
M8x16 FLAT HEAD WITH SHORT Sq. NECK BOLTS



COUPLER PLATE
TYPICAL FOR LADDER TYPE
AND PERFORATED TYPE TRAYS

8FLAT ROUND HEADED
SS BOLTS WITH WASHERS
& NUTS (TYP.)

CABLE TRAY
(TYP)

DETAIL-X

TWO COUPLER
PLATES

2.5

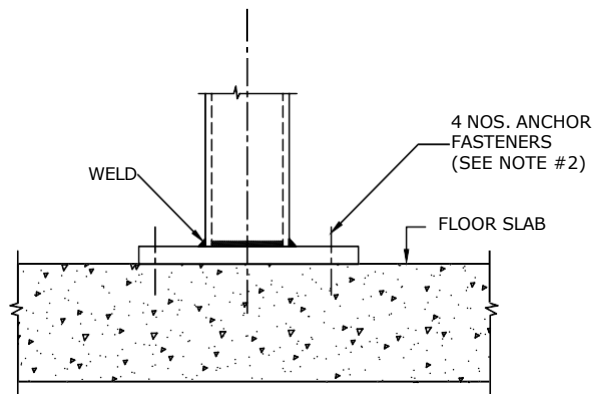
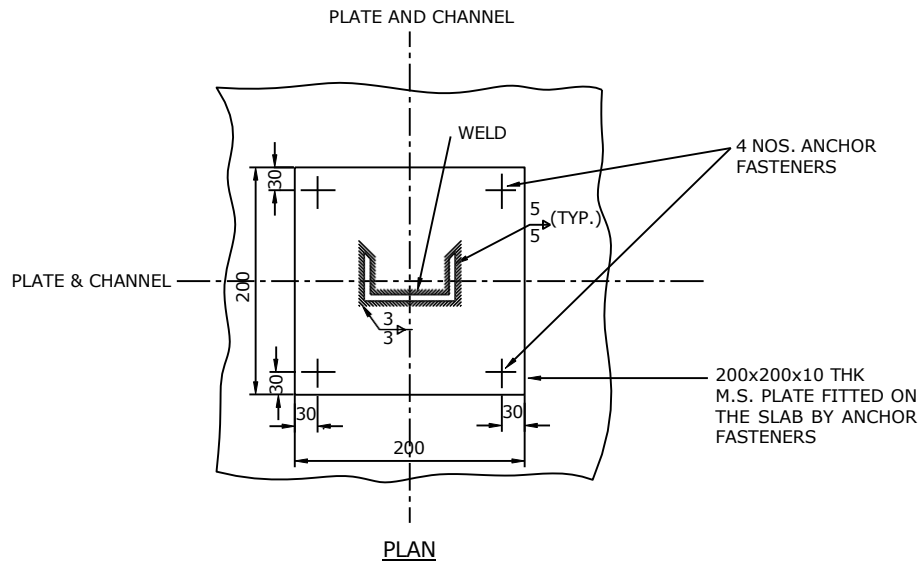
SECTION 'A-A'

DETAIL-X

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. MATERIAL - 3MM M.S. SHEET/G.S/AL/FRP (AS PER MTO).
3. M.S. SHEET SHALL CONFORM TO IS 2062: 1992 OR EQUIVALENT INTERNATIONAL STANDARDS AND HOT DIP GALVANIZING SHALL BE DONE AS PER IS 4759: 1996 OR EQUIVALENT INTERNATIONAL STANDARDS. TRAY FITTINGS OF OTHER MATERIALS SHALL CONFORM TO RELEVANT IS/INTERNATIONAL STANDARDS.
4. NUTS/BOLTS/LOCKNUTS SHALL BE AS PER IS 1363(PART-1,2,3) : 1992/IS 1367(PART-5) : 1980 OR EQUIVALENT INTERNATIONAL STANDARDS.
5. WASHERS SHALL BE AS PER IS 2016 : 1967 OR EQUIVALENT INTERNATIONAL STANDARDS.

**STANDARD DRAWING CABLE TRAY
MOUNTING PLATE**



TYPICAL DETAIL OF FIXING M.S. PLATE TO FLOOR BY ANCHOR FASTENER
FOR WELDING TRAY SUPPORT. (WHEREVER EMBEDDED PLATES OR STRUCTURAL
BEAMS ARE NOT AVAILABLE).

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. THE ANCHOR FASTENER SHALL BE OF HEAVY DUTY TYPE. THE AXIAL HOLDING STRENGTH SHALL BE AS FOLLOWS
BOLT DIAMETER. 16mm -- 5000Kg
FOR ADEQUATE SAFETY FACTOR 25% OF THE ABOVE VALUE SHALL BE USED.
3. SAME DETAILS HOLD GOOD IF THE PLATE ARE FASTENED TO THE UNDERSIDE OF THE FLOOR SLAB.
4. STRUCTURAL STEEL SHALL BE AS PER IS 2062:1992.
5. WELDING SHALL BE DONE AS PER IS 816:1969.



NOTES:

1. WIDTH OF DUCT & NO. OF RACKS AND TRAY IN EACH ROAD CROSSING SHALL BE DECIDED BY ELECTRICAL AS PER THE REQUIREMENT OF ELECT. CABLES AND MAXIMUM AVAILABLE DEPTH OF DUCT w.r.t. F.G.L. AND ROAD LEVEL.
2. IN CASE, SUFFICIENT DEPTH OF DUCT IS AVAILABLE (> 1500MM), THE DUCT CAN BE COVERED WITH FIXED SLAB.
3. CO-ORDINATES OF TRENCHES & RCC DUCT ETC. SHALL BE DECIDED BY CIVIL & SHOWN IN RESPECTIVE AREA DRAWING.
4. IN CASE OF COMPLETE CABLE TRAY SYSTEM ON BOTH SIDES OF ROAD, ARRANGEMENT SHALL BE AS PER LHS ON BOTH SIDES AND IN CASE OF TRENCH SYSTEM IT SHALL BE AS PER RHS ON BOTH SIDES.



STANDARD DRAWING
CABLE TRENCH TYPE - 0707

STANDARD DRAWING NO.

REV.

SIZE

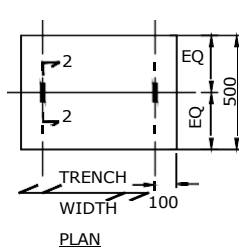
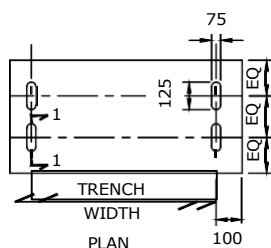
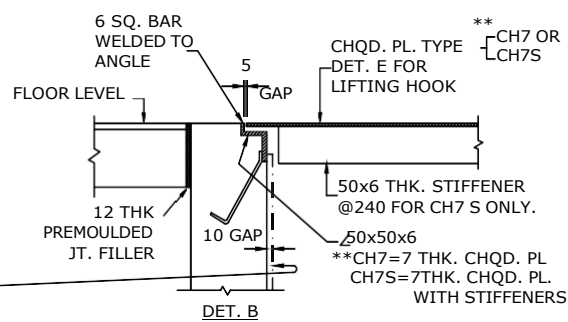
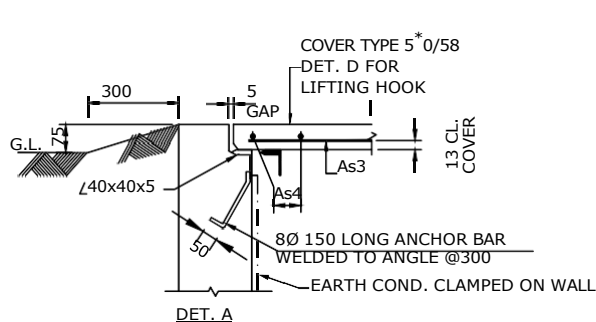
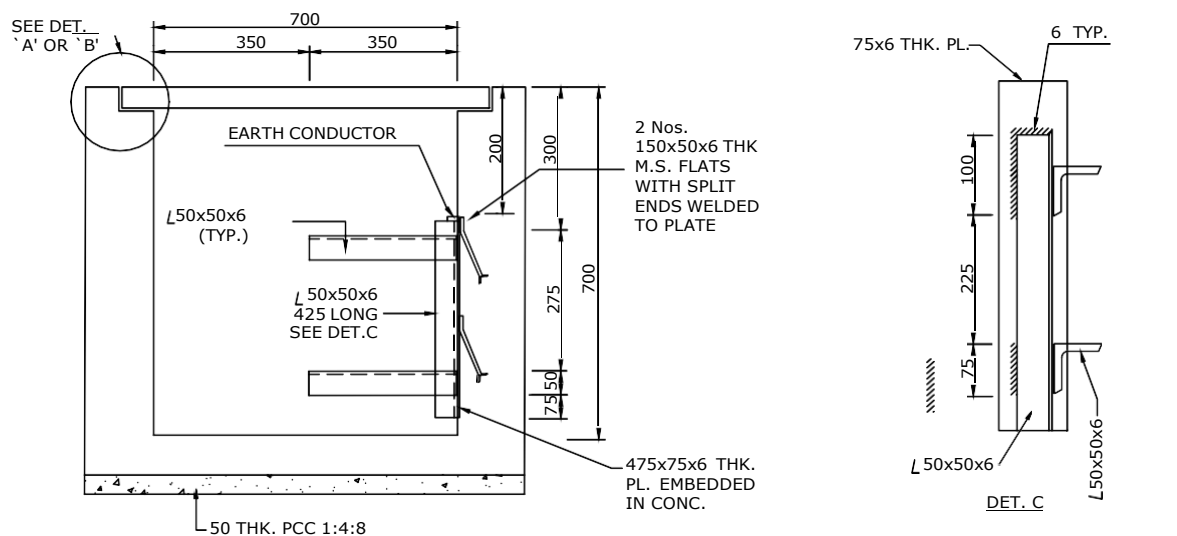
VPC-STD-EL-4316

01

A4

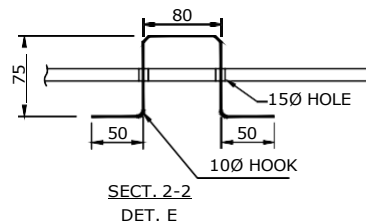
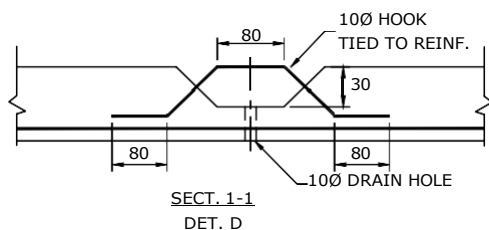
SHEET NO.

1 OF 1



R C COVER TYPE	THICKNESS mm.	As3	As4
50/58	50	7-6Ø	6-6Ø

* 50x58 MEANS 50mm. THK.x58 Kg. COVER WEIGHT OF 600mm COVER WIDTH. PROVIDE TWO COVERS OF 300mm WIDTH FOR EVERY 10m LENGTH OF TRENCH.

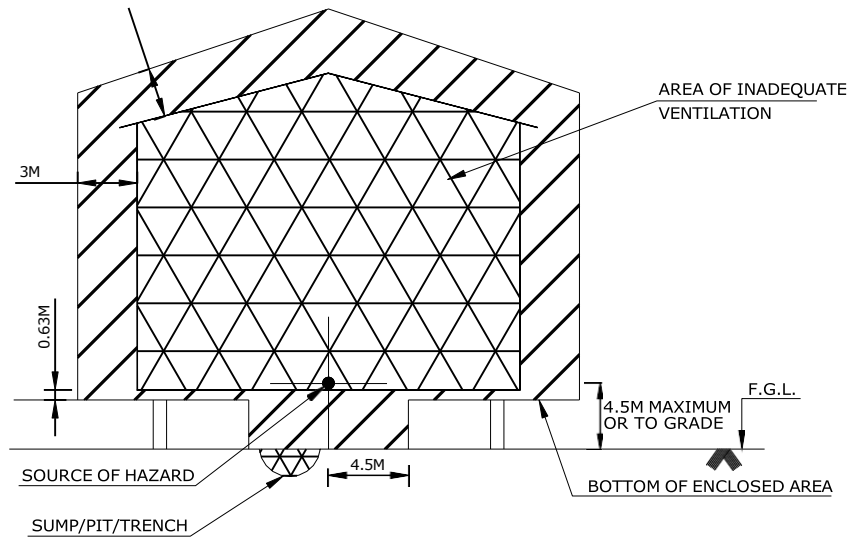


NOTES:

- ALL DIMENSIONS ARE IN MM.
- STRUCTURAL STEEL SHALL BE AS PER IS 2062:1992

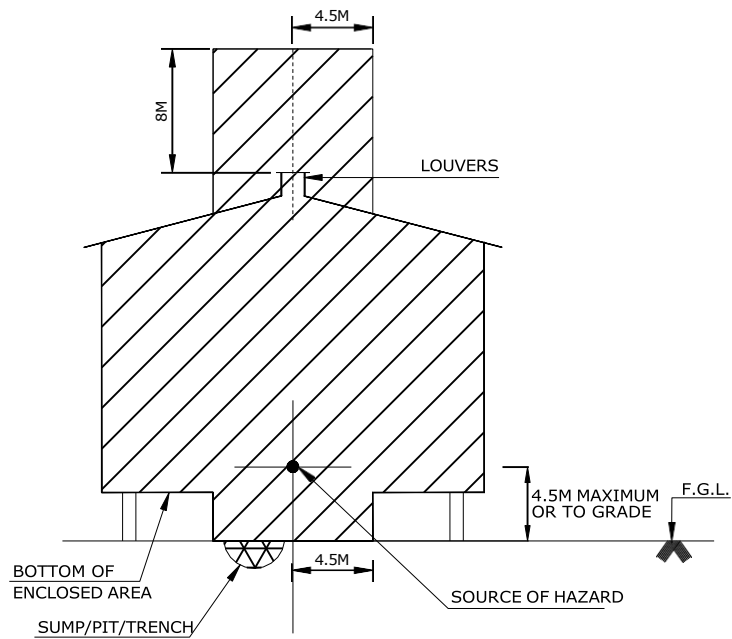
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED B	AUTHORIZED
01	12.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK

DETAILS FOR AREA
CLASSIFICATION (OIL/GAS INSTALLATION)



DETAIL-7

INADEQUATELY VENTILATED COMPRESSOR SHELTER
(LIGHTER THAN AIR GASES OR VAPOURS)



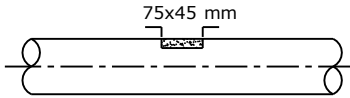
DETAIL-8

ADEQUATELY VENTILATED COMPRESSOR SHELTER
(LIGHTER THAN AIR GASES OR VAPOURS)

NOTES:

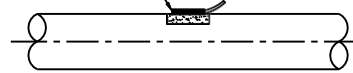
THERMITE WELD CONNECTION DETAILS

REMOVABLE PIPE COATING, FILE TO BRIGHT METAL AND DRY ANY MOISTURE WITH A CLOTH



STEP-1

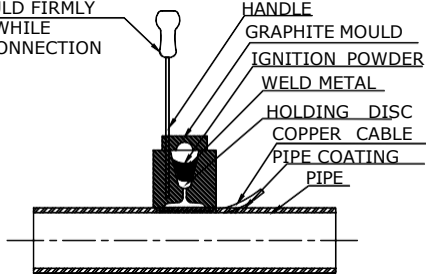
STRIP INSULATION FROM WIRE EQUAL TO LENGTH OF MOULD



STEP-2

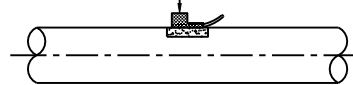
HOLD MOULD FIRMLY IN PLACE WHILE MAKING CONNECTION

HANDLE
GRAPHITE MOULD
IGNITION POWDER
WELD METAL
HOLDING DISC
COPPER CABLE
PIPE COATING
PIPE



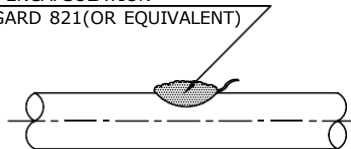
STEP-3

REMOVE SLAG WITH HAMMER/ WIRE BRUSH



STEP-4

EPOXY ENCAPSULATION
INTERGARD 821(OR EQUIVALENT)

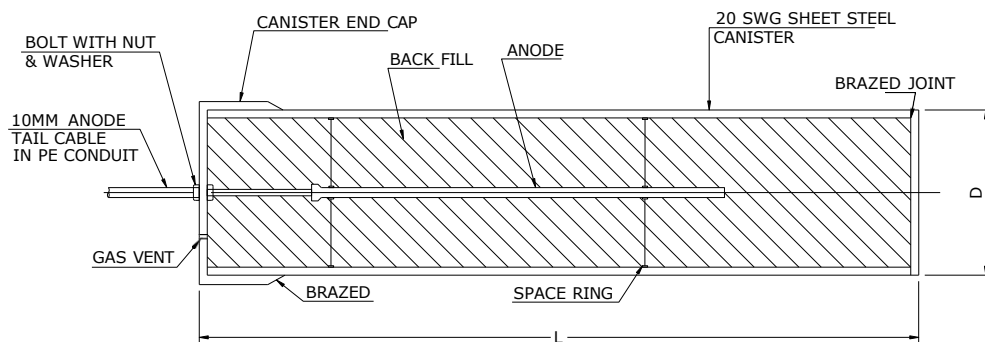


STEP-5

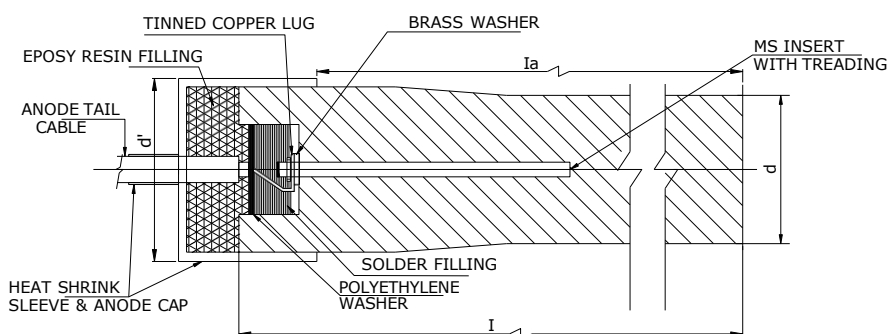
NOTES: GENERAL THERMITE WELDING PROCEDURE

1. REMOVABLE PIPE COATING FILE TO BRIGHT METAL AND DRY ANY MOISTURE WITH A CLOTH.
2. STRIP INSULATION FROM WIRE EQUAL TO LENGTH OF MOULD.
3. INSERT THE CONDUCTOR INTO MOULD.
4. INSERT STEEL DISC IN BOTTOM OF MOULD CAVITY INSIDE MOULD _ DUMP THE METAL INTO MOULD BEING CAREFUL NOT TO UPSET THE STEEL DISC. TAP THE BOTTOM OF THE TUBE TO LOOSEN ALL THE IGNITION POWDER AND SPREAD IT EVENLY OVER THE WELD METAL. PLACE A SMALL MOUNT OF STARTING POWDER ON THE TOP EDGE OF THE MOULD UNDER COVER OPENING FOR EASY IGNITION.
5. CLOSE COVER AND IGNITE WITH THE FLINT GUN MOVE GUN AWAY QUICKLY TO PREVENT FOULING . IF FLINT GUN SHOULD BECOME FOULED , SOAK IT IN HOUSEHOLD AMMONIA.
6. AFTER IGNITION, HOLD THE MOULD IN PLACE FOR 5 SECONDS TO ALLOW THE WELD TO SOLIDIFY, AFTER THE WELD HAS COOLED, REMOVE THE SLAG WITH A CHIPPING HAMMER OR WIRE BRUSH.
7. ENCAPSULATE THE CONNECTION AND ENTIRE PREPARED SURFACE WITH TWO PART EPOXY COMPOUND.
8. REMOVE ALL SLAG'S FROM THE WELDER BEFORE MAKING THE NEXT WELD CLEAN THE COVER EVERY 6 TO 10 WELDS.
9. WET OR DAMP MOULDS WILL PRODUCE POROUS WELDS. MOULDS MUST BE DRIED OUT BEFORE ATTEMPTING TO WELD.
10. CONNECTIONS ARE TO BE PLACED A MINIMUM OF 100mm APART, UNSUCCESSFUL WELDS ARE ABANDONED AND MOVED TO ANOTHER PREPARED SURFACE NOT LESS THAN 100mm AWAY.

**TYPICAL CONSTRUCTION DETAILS OF
HIGH SILICON CAST
IRON ANODE**



PREPACKED CANISTERED ANODE



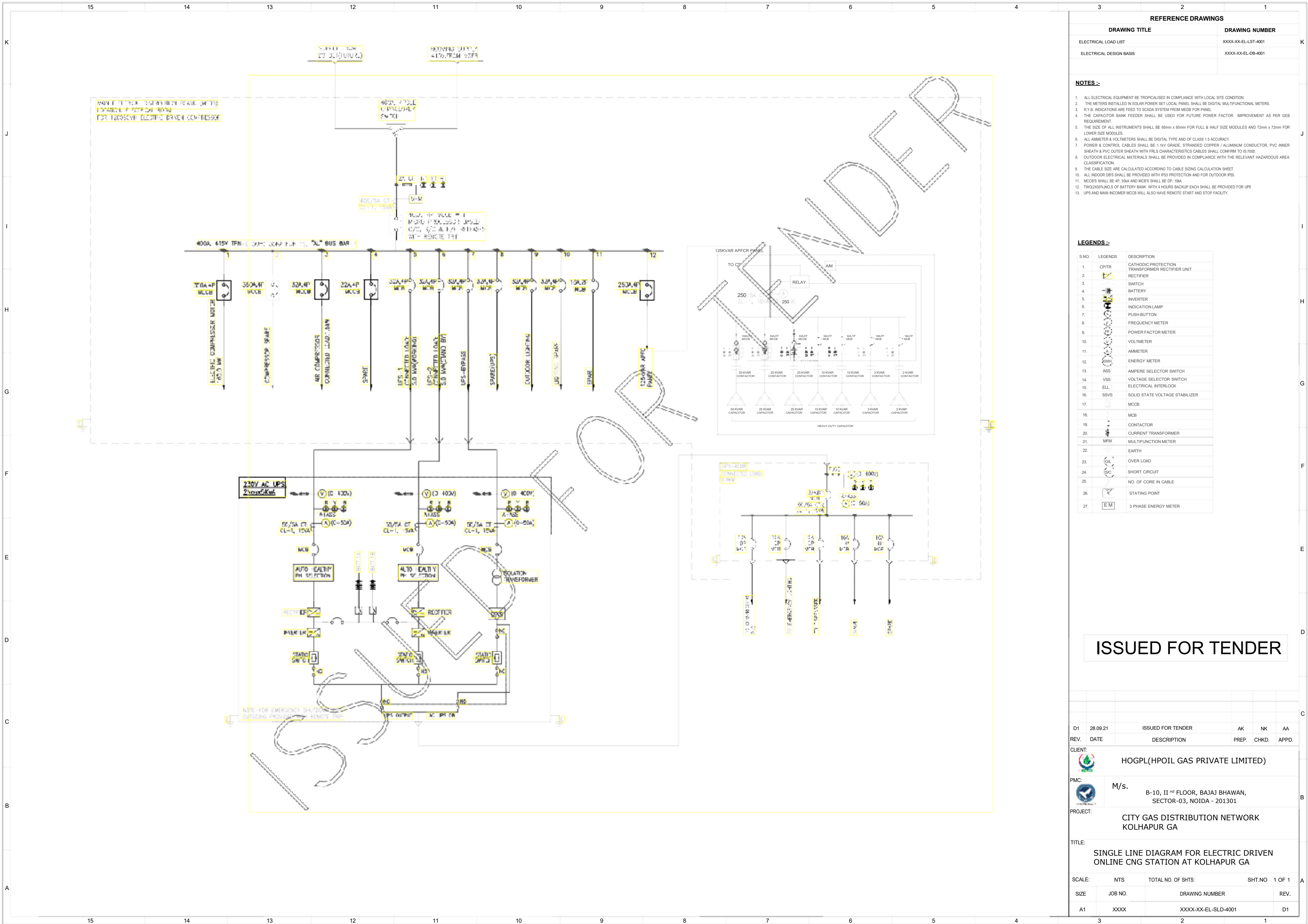
ANODE DETAILS

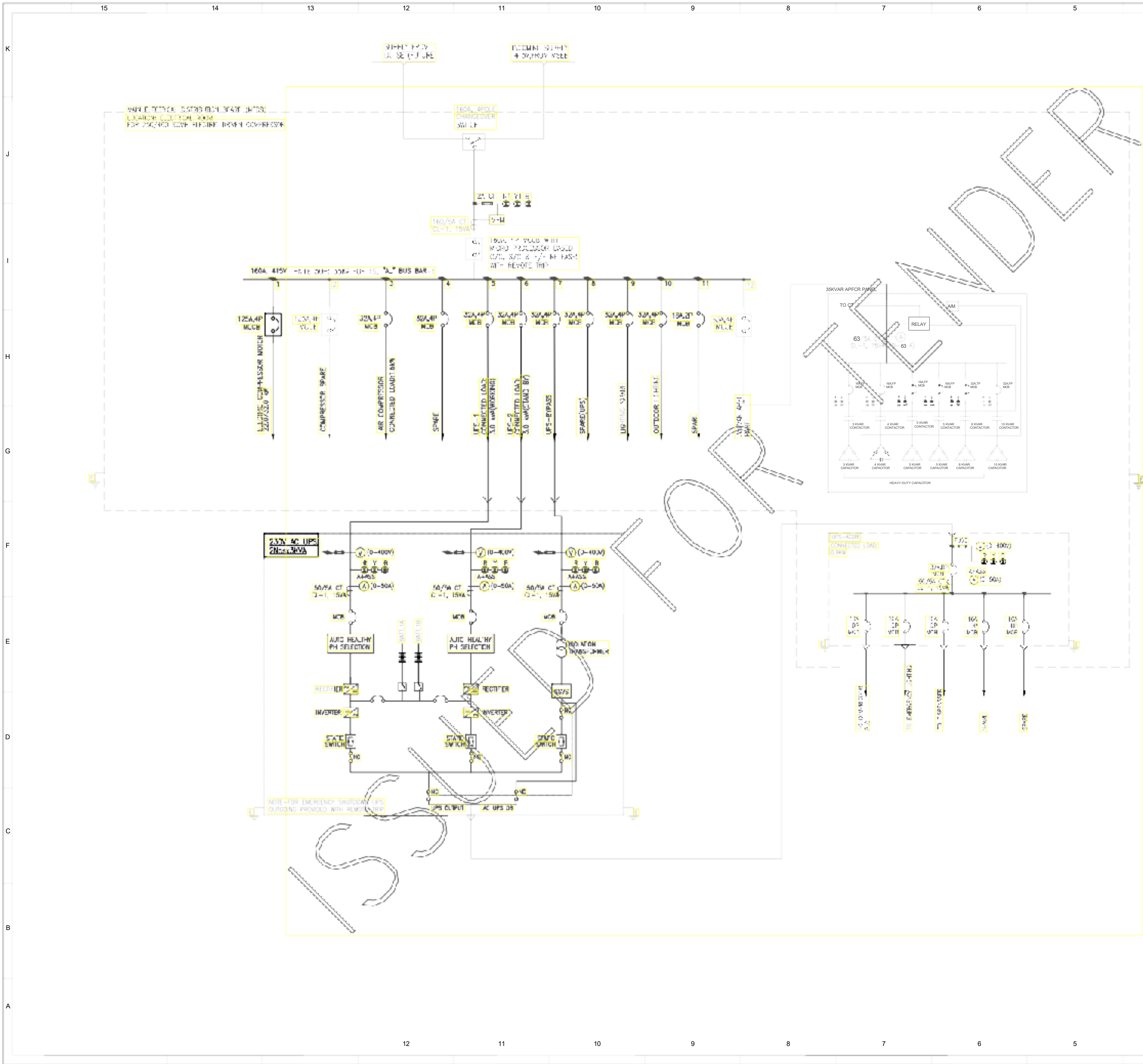
CHEMICAL COMPOSITION OF ANODE (% WEIGHT):-

CARBON	----- : 0.7%-1.1%
MANGANESE	----- : 1.5% max.
SILICON	----- : 14.2%-14.75%
CHROMIUM	----- : 3.25%-5%
MOLYBDYNUM	----- : 0.2%max.
COPPER	----- : 0.5% max
IRON	----- : REMAINDER

NOTES:

1. ANODE FOR SURFACE AND DEEP GROUND BED APPLICATION SHALL BE IDENTICAL EXCEPT FOR BACK FILL PREPACKING.
2. SHEET STEEL ANODE CANISTERS SHALL BE FILLED WITH METALLURGICAL GRADE COKE BREEZE.
3. FLUID PETROLEUM COKE BREEZE BACKFILL SHALL BE PROVIDED IN THE WELL, SURROUNDING ANODES IN DEEP WELL GROUND BEDS.
4. ANODE TAIL CABLE SHALL BE 10 Sq.mm HIGH CONDUCTIVITY, STRANDED COPPER CONDUCTOR, 650V GRADE, PE INSULATED, PVC SHEATHED & UNARMoured.
5. ALL THE DIMENSIONS, NET WEIGHT & GROSS WEIGHT OF THE ANODE SHALL BE FURNISHED BY CONTACTOR.
6. THE ACTIVE LENGTH 'Ia' OF ANODE SHALL BE CONSIDERED FOR CALCULATING THE SIZE / WEIGHT.





REFERENCE DRAWINGS		
DRAWING TITLE		DRAWING NUMBER
ELECTRICAL LOAD LIST		XXXX-XX-EL-LST-4001
ELECTRICAL DESIGN BASIS		XXXX-XX-EL-DB-4001

NOTES :-

1.

ALL ELECTRICAL EQUIPMENT BE TROPICALISED IN COMPLIANCE WITH LOCAL SITE CONDITION.

2.

THE METERS INSTALLED IN SOLAR POWER SET LOCAL PANEL SHALL BE DIGITAL MULTIFUNCTIONAL METERS.

3.

R.Y.B. INDICATIONS ARE FEED TO SCADA SYSTEM FROM MEDB FOR PANEL.

4.

THE CAPACITOR BANK FEEDER SHALL BE USED FOR FUTURE POWER FACTOR IMPROVEMENT AS PER GEB REQUIREMENT.

5.

THE SIZE OF ALL INSTRUMENTS SHALL BE 95mm x 95mm FOR FULL & HALF SIZE MODULES AND 72mm x 72mm FOR LOWER SIZE MODULES.

6.

ALL AMMETER & VOLTMETERS SHALL BE DIGITAL TYPE AND OF CLASS 1.5 ACCURACY.

7.

POWER & CONTROL CABLES SHALL BE 1.1kV GRADE, STRANDED COPPER / ALUMINIUM CONDUCTOR, PVC INNER SHEATH & PVC OUTER SHEATH WITH FRLS CHARACTERISTICS CABLES SHALL CONFIRM TO IS.7000.

8.

OUTDOOR ELECTRICAL MATERIALS SHALL BE PROVIDED IN COMPLIANCE WITH THE RELEVANT HAZARDOUS AREA CLASSIFICATION.

9.

THE CABLE SIZE ARE CALCULATED ACCORDING TO CABLE SIZING CALCULATION SHEET.

10.

ALL INDOOR DB'S SHALL BE PROVIDED WITH IP53 PROTECTION AND FOR OUTDOOR IP55.

11.

MCCB'S SHALL BE 4P, 30A AND MCB'S SHALL BE DP, 10A

12.

TWO(200%) NO.5 OF BATTERY BANK WITH 4 HOURS BACKUP EACH SHALL BE PROVIDED FOR UPS

13.

UPS AND MAIN INCOMER MCCB WILL ALSO HAVE REMOTE START AND STOP FACILITY.

LEGENDS :-

S.NO.	LEGENDS	DESCRIPTION
1.	CPTTR	CATHODIC PROTECTION TRANSFORMER RECTIFIER UNIT
2.		RECTIFIER
3.		SWITCH
4.		BATTERY
5.		INVERTER
6.		INDICATION LAMP
7.		PUSH BUTTON
8.		FREQUENCY METER
9.		POWER FACTOR METER
10.		VOLTMETER
11.		AMMETER
12.		ENERGY METER
13.	ASS	AMPERE SELECTOR SWITCH
14.	VSS	VOLTAGE SELECTOR SWITCH
15.	ELL	ELECTRICAL INTERLOCK
16.	SSVS	SOLID STATE VOLTAGE STABILIZER
17.		MCCB
18.		MCB
19.		CONTACTOR
20.		CURRENT TRANSFORMER
21.	MFM	MULTIFUNCTION METER
22.		EARTH
23.		OVER LOAD
24.		SHORT CIRCUIT
25.		NO. OF CORE IN CABLE
26.		STATING POINT
27.	E M	3 PHASE ENERGY METER

ISSUED FOR TENDER

D1	28.09.21	ISSUED FOR TENDER	AK	NK	AA
REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.

CLIENT:

HOGPL(HPOIL GAS PRIVATE LIMITED)

PMC:



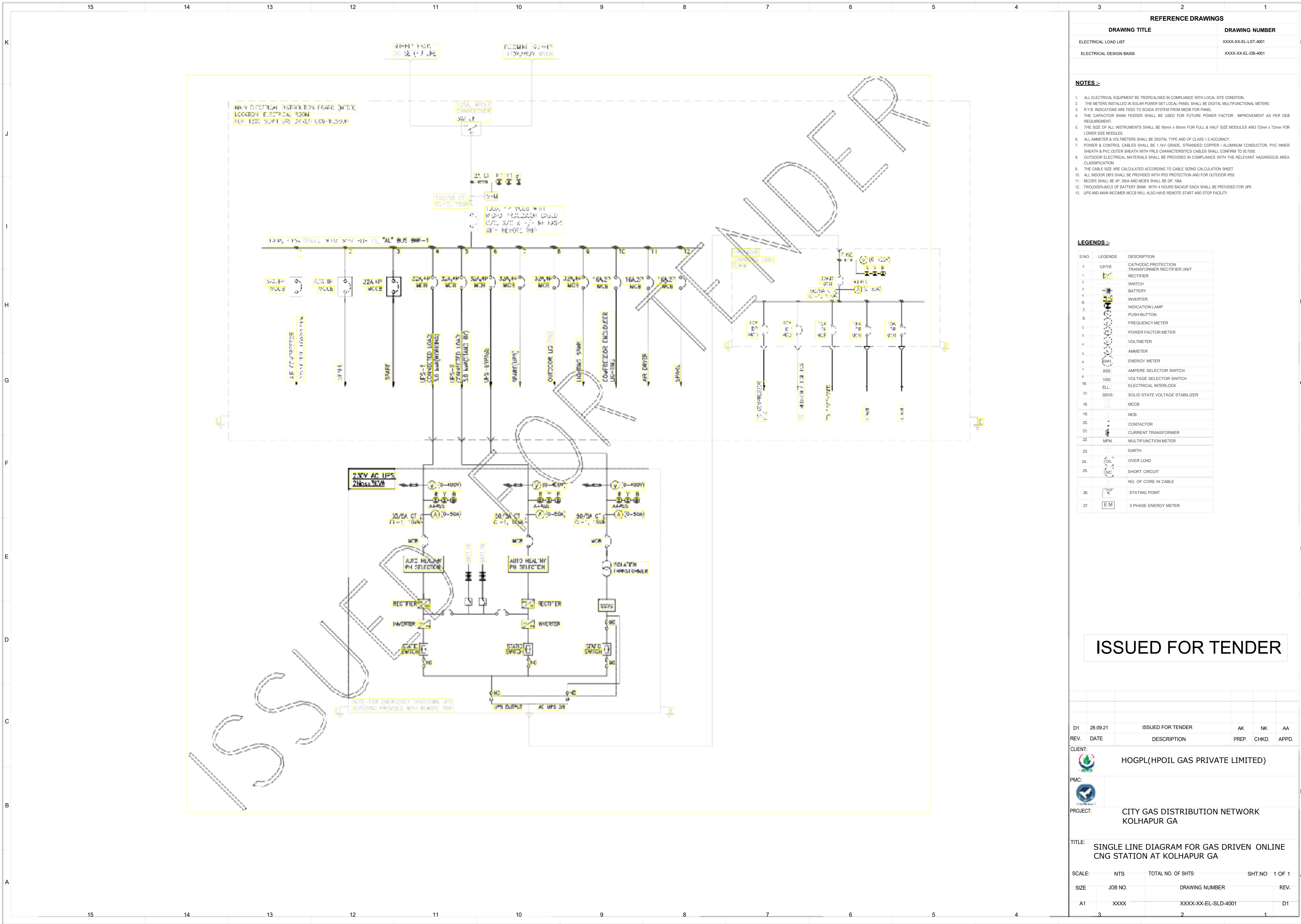
CITY GAS DISTRIBUTION NETWORK KOLHAPUR GA

PROJECT:

SINGLE LINE DIAGRAM FOR ELECTRIC DRIVEN DBS CNG STATION AT KOLHAPUR GA

SCALE: NTS TOTAL NO. OF SHTS: SHT.NO 1 OF 1

SIZE	JOB NO.	DRAWING NUMBER	REV.
A1	XXXX	XXXX-XX-EL-STD-4001	D1
3		2	1



REFERENCE DRAWINGS	
DRAWING TITLE	DRAWING NUMBER
ELECTRICAL LOAD LIST	XXXX-XX-EL-LST-4001
ELECTRICAL DESIGN BASIS	XXXX-XX-EL-DB-4001

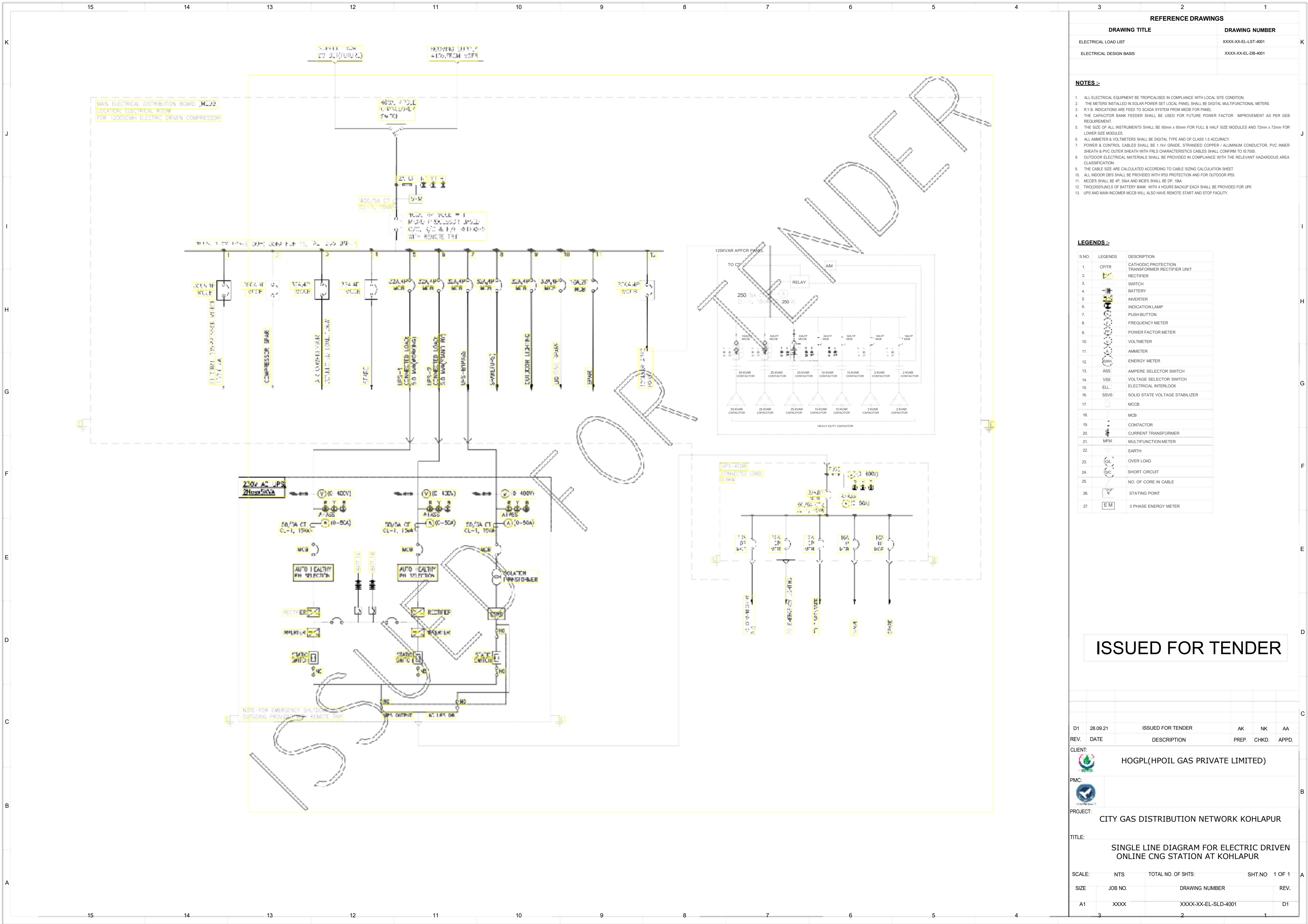
- NOTES :-**
- ALL ELECTRICAL EQUIPMENT BE TROPICALISED IN COMPLIANCE WITH LOCAL SITE CONDITION.
 - THE METERS INSTALLED IN SOLAR POWER SET LOCAL PANEL SHALL BE DIGITAL MULTIFUNCTIONAL METERS.
 - R/Y/B INDICATIONS ARE FEED TO SCADA SYSTEM FROM MDB FOR PANEL.
 - THE CAPACITOR BANK FEEDER SHALL BE USED FOR FUTURE POWER FACTOR IMPROVEMENT AS PER GEB REQUIREMENT.
 - THE SIZE OF ALL INSTRUMENTS SHALL BE 95mm x 95mm FOR FULL & HALF SIZE MODULES AND 72mm x 72mm FOR LOWER SIZE MODULES.
 - ALL AMMETER & VOLTMETERS SHALL BE DIGITAL TYPE AND OF CLASS 1.5 ACCURACY.
 - POWER & CONTROL CABLES SHALL BE 1.1kV GRADE, STRANDED COPPER / ALUMINIUM CONDUCTOR, PVC INNER SHEATH & PVC OUTER SHEATH WITH FRLS CHARACTERISTICS CABLES SHALL CONFIRM TO IS7000.
 - OUTDOOR ELECTRICAL MATERIALS SHALL BE PROVIDED IN COMPLIANCE WITH THE RELEVANT HAZARDOUS AREA CLASSIFICATION.
 - THE CABLE SIZE ARE CALCULATED ACCORDING TO CABLE SIZING CALCULATION SHEET.
 - ALL INDOOR DBS SHALL BE PROVIDED WITH IP63 PROTECTION AND FOR OUTDOOR IP55.
 - MCCBS SHALL BE 4P, 32KA AND MCCBS SHALL BE DP, 10KA
 - TWO(200%) NO.5 OF BATTERY BANK WITH 4 HOURS BACKUP EACH SHALL BE PROVIDED FOR UPS
 - UPS AND MAIN INCOMER MCCBS WILL ALSO HAVE REMOTE START AND STOP FACILITY.

LEGENDS :-

S.NO.	LEGENDS	DESCRIPTION
1.	CPTTR	CATHODIC PROTECTION TRANSFORMER RECTIFIER UNIT
1.	REC	RECTIFIER
2.	SW	SWITCH
3.	BAT	BATTERY
4.	INV	INVERTER
6.	IL	INDICATION LAMP
7.	PB	PUSH BUTTON
8.	FM	FREQUENCY METER
2.	PFM	POWER FACTOR METER
3.	VM	VOLTMETER
4.	AM	AMMETER
5.	EM	ENERGY METER
6.	ASS	AMPERE SELECTOR SWITCH
7.	VSS	VOLTAGE SELECTOR SWITCH
16.	ELL	ELECTRICAL INTERLOCK
17.	SSVS	SOLID STATE VOLTAGE STABILIZER
18.	MCCB	MCCB
19.	MCB	MCB
20.	CT	CONTACTOR
21.	CT	CURRENT TRANSFORMER
22.	MF	MULTIFUNCTION METER
23.	EL	EARTH
24.	OL	OVER LOAD
25.	SC	SHORT CIRCUIT
	NO.	NO. OF CORE IN CABLE
26.	SP	STATING POINT
27.	EM	3 PHASE ENERGY METER

ISSUED FOR TENDER

D1	28.09.21	ISSUED FOR TENDER	AK	NK	AA
REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
CLIENT:					
HOGPL(HPOIL GAS PRIVATE LIMITED)					
PMC:					
PROJECT:					
CITY GAS DISTRIBUTION NETWORK KOLHAPUR GA					
TITLE:					
SINGLE LINE DIAGRAM FOR GAS DRIVEN ONLINE CNG STATION AT KOLHAPUR GA					
SCALE:	NTS	TOTAL NO. OF SHTS:	SHT.NO. 1 OF 1		
SIZE	JOB NO.	DRAWING NUMBER	REV.		
A1	XXXX	XXXX-XX-EL-SLD-4001	D1		



INSPECTION AND TEST PLAN FOR INSULATING JOINTS

**INSPECTION AND TEST PLAN
FOR
INSULATING JOINTS**

ABBREVIATIONS:

CIMFR	Central Institute of Mining & fuel Research	MPT/MT	Magnetic Particle Testing
HT	Heat Treatment	MTC	Material Test Certificate
CE	Carbon Equivalent	MRT	Mechanical Run Test
DFT	Dry Film Thickness	NDT	Non Destructive Testing
DPT	Dye Penetrant Testing	NPSH	Net Positive Suction Head
DHT	De-hydrogen Heat Treatment	PO	Purchase Order
ERTL	Electronics Regional Test Laboratory	PESO	Petroleum Explosive Safety Organization
IGC	Inter Granular Corrosion	PQR	Procedure Qualification Record
VDR	Vendor Data Requirement	PR	Purchase Requisition
WPQ	Welders Performance Qualification	PMI	Positive Material Identification
ITP	Inspection and Test Plan	RT	Radiography Testing
IP	Ingress Protection	WPS	Welding Procedure Specification
IHT	Intermediate Heat Treatment	TC	Test Certificate
IC	Inspection Certificate	TPI or TPIA	Third Party Inspection Agency
UT	Ultrasonic Testing	CEIL	Certification Engineers International Limited

**INSPECTION AND TEST PLAN
FOR
INSULATING JOINTS**

1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of Insulating Joints.

2.0 REFERENCE DOCUMENTS:

PO / PR / Standards referred there in / Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	VCS/TPIA
1.0	Procedure						
1.1	NDT Other Procedures	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	WPS/ PQR /WPQ	Documented procedures.	100%	Procedure Documents	-	H	W- New R- Existing
2.0	Material Inspection						
2.1.	Fittings, Forged Ring, Gasket, Pipe, Insulating Ring, Filling Material, etc.	Chemical / Mechanical Properties, NDT, HT and other requirement as per purchase specification.	100%	MTC & Inspection Record	H	H	R

**INSPECTION AND TEST PLAN
FOR
INSULATING JOINTS**

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	VCS/TPIA
3.0	In Process Inspection						
3.1	Welding	Welding Parameters, NDT (as applicable)	100%	NDT Records	-	W	R
4.0	Final Inspection						
4.1	Hydro Testing, Air Leak test, Vacuum test (As applicable)	Leak Check	100%	Test Report	-	H	H
4.2	Visual and Dimension Check	Visual and Dimension Check	100%	Inspection Report	-	H	RW
4.3	Dielectric Test	Insulating Resistance	100%	Inspection Report	-	W	RW
5.0	Painting						
5.1	Final Painting (As Applicable)	Paint Scheme, Visual & Paint Thickness check	100%	Inspection Report	-	H	-
6.0	Documentation & IC						

**INSPECTION AND TEST PLAN
FOR
INSULATING JOINTS**

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	VCS/TPIA
6.1	Stamping and review of inspection documents, issue of IC	Review of documents for compliance as per PR.	100%	IC	-	-	H
6.2	Review of final documentation	Compilation of documents as per VDR attached with PR records for submission to customer	100%	Dossier/Completion certificate	-	H	H

Legend:

H - Hold (Do not proceed without approval),

P - Perform,

RW - Random Witness [As specified or 10% (min.1 no. of each size and type of Bulk items)],

R - Review,

W - Witness (Give due notice, work may proceed after scheduled date).

**INSPECTION AND TEST PLAN
FOR
INSULATING JOINTS**

NOTES (As applicable):

1. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable.
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred therein/ Job Specification/ Approved Documents.

INSPECTION & TEST PLAN FOR PIPELINE PLUG VALVES (2.0" & ABOVE)

**INSPECTION AND TEST PLAN
FOR PIPELINE PLUG VALVES (2.0" & ABOVE)**

ABBREVIATION

CEIL	Certification Engineers International Limited	MRT	Mechanical Run Test
CIMFR	Central Institute of Mining & Fuel Research	NDT	Non Destructive Testing
CE	Carbon Equivalent	NPSH	Net Positive Suction Head
DFT	Dry Film Thickness	PO	Purchase Order
DPT	Dye Penetrant Testing	PESO	Petroleum Explosive Safety Organization
DHT	De-hydrogen Heat Treatment	PQR	Procedure Qualification Record
ERTL	Electronics Regional Test Laboratory	PR	Purchase Requisition
FCRI	Fluid Control Research Institute	PMI	Positive Material Identification
HT	Heat Treatment	RT	Radiography Testing
HIC	Hydrogen Induced Cracking	SSCC	Sulphide Stress Corrosion Cracking
ITP	Inspection and Test Plan	TC	Test Certificate
IP	Ingress Protection	TPI or TPIA	Third Party Inspection Agency
IHT	Intermediate Heat Treatment	UT	Ultrasonic Testing
IC	Inspection Certificate	VDR	Vendor Data Requirement
IGC	Inter Granular Corrosion	WPS	Welding Procedure Specification
MPT / MT	Magnetic Particle Testing	WPQ	Welders Performance Qualification
MTC	Material Test Certificate	PMC	Project Management Consultant

**INSPECTION AND TEST PLAN
FOR PIPELINE PLUG VALVES (2.0" & ABOVE)**

1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of Pipeline Plug Valves (2" & Above).

2.0 REFERENCE DOCUMENTS:

PO/PR/ Standards referred there in/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

SL. NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIE R	SUPPLIE R	TPIA
1.0	Procedure						
1.1	Hydrostatic Test, NDT, Helium Leak Test and Other Procedures as applicable	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	WPS, PQR & WPQ	Welding Parameters & Qualification Record	100%	WPS, PQR &WPQ	-	H	W-New R-Existing
1.3	Pre-Qualification Test	Fire Safe & Other tests as applicable	As per PR/Purchase Specification	Acceptance Reports	-	H	W-New R-Existing

**INSPECTION AND TEST PLAN
FOR PIPELINE PLUG VALVES (2.0" & ABOVE)**

2.0	Material Inspection						
2.1	Castings & Forgings (Body, Cover, Plug etc.)	Chemical, Mechanical, HT, NDT & Other Properties as applicable	100%	Test Certificates	H	H	R
2.2	Body and Cover Casting	NDT as applicable	As per PR/Purchase Specification	RT Films and NDT Report	H	R	R
2.3	Gasket, fasteners, Gland packing etc.	Physical/Chemical Properties	100%	Test certificates & Lab Report	H	R	R
2.4	Actuators (as applicable)	Routine test, Performance Test, Type Test and Statutory certificates as applicable as applicable	100%	Test certificates & Inspection Report	H	H	R
3.0	In Process Inspection						
3.1	Welding	Welding Parameters as per WPS / PQR	100%	Inspection Report	-	H	-

**INSPECTION AND TEST PLAN
FOR PIPELINE PLUG VALVES (2.0" & ABOVE)**

3.2	Machining of Component (Body, Cover, Plug, Stem. etc)	Visual/ Dimension	100%	Inspection Report	-	H	-
3.3	Plug coating after Machining	ENP Coating /HT	100%	Inspection Report	H	H	R
4.0	Final Inspection						
4.1	Hydrostatic/Pneumatic Test and Helium Leak Test as applicable	Leak Check	100%	Test Report	-	H	RW
4.2	Functional Test for Actuator Operated Valves	Performance test & Opening/Closing Time	100%	Test Report	-	H	RW
4.3	Visual /Dimension	Surface & Dimension Check	100%	Inspection Report	-	H	RW
4.4	PMI (As applicable)	Chemical Check	100%	Inspection Report	-	H	RW
4.5	Final Stamping	Stamping of Accepted Valves	Stamping of valves which are witnessed by Client/TPIA.	Inspection Report	-	H	H

**INSPECTION AND TEST PLAN
FOR PIPELINE PLUG VALVES (2.0" & ABOVE)**

			Balance Valves to have Supplier QC Stamp				
5.0	Painting						
5.1	Surface Cleaning & Painting and colour coding as applicable	Surface Finish & Visual / DFT	100%	Inspection Report	-	H	-
6.0	Documentation & IC						
6.1	Documentation & Inspection Certificate (IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Supplier's TC & IC	-	H	H
6.2	Final Documents & Completeness certificate as applicable	compilation of inspection & test records for submission to customer	As per PR	Final data folder	-	H	H
Legends- H- Hold (Do not proceed without approval), P-Perform, RW Random Witness (as specified or 10% (min) no. Of each size and bulk item), R-Review, W-Witness(Give due notice, work may proceed after schedule date)							

**INSPECTION AND TEST PLAN
FOR PIPELINE PLUG VALVES (2.0" & ABOVE)**

NOTES (As applicable):

1. Non-NACE & Non Hydrogen service carbon steel valves up to size 12"-300# ANSI Class will be accepted on review of Supplier Test Certificates. Supplier Test Certificate along with back up reports to be reviewed by Client/ TPIA.
2. This document describes the generic test requirements. Any additional test or Inspection scope if specified/required in contract documents shall also be applicable (unless otherwise agreed upon).
3. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.
4. Items shall be accepted based on Manufacturer's TC with EN10204 type 3.2 certified from approved suppliers.

INSPECTION AND TEST PLAN FOR VALVES

**INSPECTION AND TEST PLAN
FOR
VALVES**

ABBREVIATIONS:

CIMFR	Central Institute of Mining & fuel Research	MPT/MT	Magnetic Particle Testing
HT	Heat Treatment	MTC	Material Test Certificate
CE	Carbon Equivalent	MRT	Mechanical Run Test
DFT	Dry Film Thickness	NDT	Non Destructive Testing
DPT	Dye Penetrant Testing	NPSH	Net Positive Suction Head
DHT	De-hydrogen Heat Treatment	PO	Purchase Order
ERTL	Electronics Regional Test Laboratory	PESO	Petroleum Explosive Safety Organization
IGC	Inter Granular Corrosion	PQR	Procedure Qualification Record
VDR	Vendor Data Requirement	PR	Purchase Requisition
WPQ	Welders Performance Qualification	PMI	Positive Material Identification
ITP	Inspection and Test Plan	RT	Radiography Testing
IP	Ingress Protection	WPS	Welding Procedure Specification
IHT	Intermediate Heat Treatment	TC	Test Certificate
IC	Inspection Certificate	TPI or TPIA	Third Party Inspection Agency
UT	Ultrasonic Testing	CEIL	Certification Engineers International Limited

**INSPECTION AND TEST PLAN
FOR
VALVES**

1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of Valves.

2.0 REFERENCE DOCUMENTS:

PO / PR / Standards referred there in / Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	VCS/TPIA
1.0	Procedure						
1.1	Hydrostatic Test, Heat Treatment, NDT and Other Procedures	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	WPS,PQR & WPQ	Welding Parameters & Qualification Record	100%	WPS ,PQR & WPQ	-	H	W- New R- Existing
1.3	Pre-Qualification Tests	Fire safe, Cryogenic & Other Test as applicable	As per PR/Purchase Specification	Acceptance Report	-	H	H (If new)

**INSPECTION AND TEST PLAN
FOR
VALVES**

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	VCS/TPIA
2.0	Material Inspection						
2.1.	Castings & Forgings (Body, Bonnet, Disc, Stem, Body ring)	Chemical ,Mechanical , Heat Treatment, NDT,IGC & Other Properties as applicable	100%	Test Certificates	H	R	R
2.2	Castings & Forgings (Body, Bonnet, Disc, Stem, Body ring)	Visual & Dimension	100%	Inspection Report	H	H	-
2.3	Body and Bonnet Castings	Radiography Examination	As per PR / Purchase Specification	Films and report	H	R	R
2.4	Bars for Trim material	Chemical Analysis	Each Heat	Test Certificates& Lab Report	H	R	-
2.5	Gaskets, Gear units, Fasteners, Gland, Packings, etc.	Physical / Chemical Properties	100%	Test Certificates& Lab Report	H	R	-
2.6	Actuators as applicable	Performance , Statutory Certificates as applicable	100%	Test Certificates& Lab Report	H	H	R

**INSPECTION AND TEST PLAN
FOR
VALVES**

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	VCS/TPIA
3.0	In Process Inspection						
3.1	Welding	Welding Parameters as per WPS / PQR	100%	Inspection Reports	-	H	-
3.2	Machining of components	Visual / Dimension	100%	Inspection Reports	-	H	-
4.0	Final Inspection						
4.1	Hydrostatic / Pneumatic Test and Helium Leak test as applicable	Leak Check	As per PR / Purchase Specification	Test Report	-	H	RW (Note 1)
4.2	Visual / Dimension	Surface & Dimension Check	100%	Test Report	-	H	RW (Note 1)
4.3	Functional Test for Actuator Operated Valves	Satisfactory Performance	100%	Test Report	-	H	RW
4.4	PMI Check	Chemical	As per Spec.	Inspection Report	-	H	RW
4.5	Strip Check(As applicable)	Verify Components & Differential hardness if applicable	As per PR / Purchase Specification	Inspection Report	-	H	RW (Note 1)

**INSPECTION AND TEST PLAN
FOR
VALVES**

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	VCS/TPIA
4.6	Final Stamping	Stamping Of Accepted Valves	Stamping of Valves which are witnessed by VCS/TPIA.	Inspection Report	-	H	H (Note -1)
5.0	Painting						
5.1	Painting and Colour coding as applicable	Visual / DFT Check	100%	Inspection Report	-	H	-
6.0	Documentation & IC						
6.1	Documentation & Inspection Certificate(IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Supplier TC & IC	-	H	H

**INSPECTION AND TEST PLAN
FOR
VALVES**

Legend:

H - Hold (Do not proceed without approval),

P - Perform,

RW - Random Witness [As specified or 10% (min.1 no. of each size and type of Bulk items)],

R - Review,

W - Witness (Give due notice, work may proceed after scheduled date).

NOTES (As applicable):

1. For Non-NACE & Non-Hydrogen Service Carbon Steel Valves up to size 12" will be accepted on review of Supplier Test Certificates. Supplier Test Certificate to be reviewed by VCS /TPIA.
2. This document describes the generic test requirements. Any additional test or Inspection scope if specified/ required in contract documents shall also be applicable (unless otherwise agreed upon).
3. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in/ Job Specification/ Approved Documents.
4. Items shall be accepted based on Manufacturer's TC with EN10204 type 3.2 certified from approved suppliers.

	INSPECTION AND TEST PLAN – FORGED, SEAMLESS & WELDED FITTINGS	

INSPECTION AND TEST PLAN – FORGED, SEAMLESS & WELDED FITTINGS		

ABBREVIATIONS

CE	Carbon Equivalent	NPSH	Net Positive Suction Head
DFT	Dry Film Thickness	PO	Purchase Order
DPT	Dye Penetrant Testing	PESO	Petroleum Explosive Safety Organization
DHT	De-hydrogen Heat Treatment	PQR	Procedure Qualification Record
ERTL	Electronics Regional Test Laboratory	PR	Purchase Requisition
FCRI	Fluid Control Research Institute	PMI	Positive Material Identification
HT	Heat Treatment	RT	Radiography Testing
HIC	Hydrogen Induced Cracking	SSCC	Sulphide Stress Corrosion Cracking
ITP	Inspection and Test Plan	TC	Test Certificate
IP	Ingress Protection	TPI or TPIA	Third Party Inspection Agency
IHT	Intermediate Heat Treatment	UT	Ultrasonic Testing
IC	Inspection Certificate	VDR	Vendor Data Requirement
IGC	Inter Granular Corrosion	WPS	Welding Procedure Specification
MRT	Mechanical Run Test	WPQ	Welders Performance Qualification
NDT	Non Destructive Testing	MPT / MT	Magnetic Particle Testing

1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of Forged, Seamless & Welded Fittings.

2.0 REFERENCE DOCUMENTS:

PO/PR/ Standards referred there in/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

SL. NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	TPIA
1.0	Procedure						
1.1	Heat Treatment / NDT	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	WPS, PQR & WPQ	Welding Parameters & Qualification Record	100%	WPS, PQR & WPQ	-	H	W- New R- Existing (Qualified under reputed TPIA)
2.0	Material Inspection						

2.1	Raw Material Identification (Billets, Rounds, Pipes, Coil, Plates, etc.)(** Special services like NACE, H2,HIC, UOP, AXEN, etc)	Review of MTC's for Chemical, Mechanical Properties, size & steel Making process, etc.	100%	Mill test certificate, Supplier's Inspection Report	-	H	RW-For CS W- For AS, SS, LTCS & CS with special services **
3.0	In Process Inspection						
3.1	Forming & Welding	Forming & Welding Parameters	100%	Supplier's records	-	H	-
3.2	Heat Treatment	Stress Relieving, Normalising, Tempering, Solution Annealing, Stabilization Heat Treatment etc. as applicable	100%	HT chart / report	-	H	R
3.3	Ferrite Check Of SS Welds (If Applicable)	% Ferrite Check	100%	Inspection Report	-	H	R
3.4	Identification of Test Samples	Product Chemical, Mechanical, Impact, IGC and Other test as applicable	Lot as per specification	Test Reports	-	H	H
3.5	NDT-RT as applicable	Surface & Internal Imperfections	As per PR/Purchase Specification	RT Film & Reports	-	H	R (Film Review)
3.6	NDT-UT (as applicable)	Surface & Internal Imperfections	As per PR/Purchase Specification	UT Reports	-	H	R

3.7	NDT-DPT / MPT of bevel ends	Surface / sub surface defects	100%	Test Report	-	H	R
3.8	Identification of Test Samples	Product Chemical, Mechanical, Impact, IGC and Other test as applicable	100%	Test Reports	-	H	H
3.9	Product Analysis (As applicable)	Chemical Composition	As per PR/Purchase Specification	Test Reports	-	H	R
3.10	Destructive Testing	Mechanical, Impact, IGC and Other test as applicable	100%	Test Reports	-	H	H
3.11	Galvanizing (If Applicable)	Integrity Of Galvanised Coating	100%	Inspection Report	-	H	-
4.0	Final Inspection						
4.1	Visual and Dimensional	Size, Thickness / Schedule, Dimensions, Surface quality, Marking, etc.	100%	Inspection report	-	H	RW
4.2	Hardness testing on fittings (** Special services like NACE, H2,HIC, UOP,AXEN,etc)	Hardness value of base metal & Weld / HAZ as applicable	Random 10%	Test report	-	H	R-For CS SS & RW- For AS, LTCS & CS with special services **
4.3	PMI Check	Chemical Check	As Per VCS Spec.	Inspection report	-	H	RW
4.4	Final Stamping	Stamping of accepted Items	Stamping of Fittings which are witnessed by VCS/ TPIA	Inspection report	-	H	H

5.0	Painting						
5.1	Shot Blasting Rust Preventive Coating & Colour Coding	Visual & Colour Coding as applicable	100%	Inspection report	-	H	-
6.0	Documentation & IC						
6.1	Documentation & Inspection Certificate(IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Supplier TC & IC	-	H	H

Legend:

H - Hold (Do not proceed without approval),

P - Perform,

RW - Random Witness (As specified or 10% [min.1 no. of each size and type of Bulk item]),

R - Review,

W - Witness (Give due notice, work may proceed after scheduled date).

NOTES (As applicable):

1. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be Applicable (unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.
3. For orders placed on stockist, items shall be accepted based on manufacturer's TC with EN310204 type 3.2 certification from VCS / OWNER approved suppliers.
4. For welded fittings, it is recommended to use low hydrogen consumable for AS, SS 410 fittings & HIC resistant consumable for HIC service fittings.
5. VCS/ TPIA reserves the right to check raw material consumption and traceability records.

**INSPECTION AND TEST PLAN
FOR
SMALL SIZES AND ASSORTED LENGTH PIPES**

**INSPECTION AND TEST PLAN
FOR SMALL SIZE & ASSORTED LENGTH PIPES**

Abbreviations:

CE	Carbon Equivalent	NPSH	Net Positive Suction Head
DFT	Dry Film Thickness	PO	Purchase Order
DPT	Dye Penetrant Testing	PESO	Petroleum Explosive Safety Organization
DHT	De-hydrogen Heat Treatment	PQR	Procedure Qualification Record
ERTL	Electronics Regional Test Laboratory	PR	Purchase Requisition
FCRI	Fluid Control Research Institute	PMI	Positive Material Identification
HT	Heat Treatment	RT	Radiography Testing
HIC	Hydrogen Induced Cracking	SSCC	Sulphide Stress Corrosion Cracking
ITP	Inspection and Test Plan	TC	Test Certificate
IP	Ingress Protection	TPI or TPIA	Third Party Inspection Agency
IHT	Intermediate Heat Treatment	UT	Ultrasonic Testing
IC	Inspection Certificate	VDR	Vendor Data Requirement
IGC	Inter Granular Corrosion	WPS	Welding Procedure Specification
MRT	Mechanical Run Test	WPQ	Welders Performance Qualification
NDT	Non-Destructive Testing	MPT / MT	Magnetic Particle Testing

**INSPECTION AND TEST PLAN
FOR SMALL SIZE & ASSORTED LENGTH PIPES**

1. SCOPE

This Inspection and Test Plan covers the minimum testing requirements of small sizes and Assorted length Pipes.

2. REFERENCE DOCUMENTS:

PO/PR/ Standards referred there in/ Job specifications /Approved documents.

3. INSPECTION AND TEST REQUIREMENTS:

SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	TPIA
1.0	PROCEDURE						
1.1	Hydrostatic Test, Heat Treatment, NDT and Other	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	WPS, PQR & WPQ	Welding Parameters & Qualification Record	100%	WPS, PQR & WPQ	-	H	W- New R- Existing
2.0	Material Inspection						
2.1	Raw Material Inspection	Chemical & Mechanical Properties	100%	Test Certificates	-	H	-
3.0	In Process Inspection						
3.1	Welding	Welding Parameters as per WPS / PQR	100%	Inspection Report	-	H	-

**INSPECTION AND TEST PLAN
FOR SMALL SIZE & ASSORTED LENGTH PIPES**

SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	TPIA
3.2	Heat Treatment	Stress Relieving, Normalising, Tempering, Solution Annealing, Stabilization Heat Treatment etc. as applicable	100%	HT chart	-	H	R
3.3	Ferrite Check of SS Pipes (If Applicable)	% Ferrite Check	Random On Weld	Inspection reports	-	H	R
3.4	NDT As applicable	Surface & Internal Imperfections	PR / Purchase Specification	RT Films/Test Reports	-	H	R
3.5	Identification of Test Samples	Product Chemical, Mechanical, Impact, IGC and Other test as applicable	100%	Test Reports	-	H	H (Note -1)
3.6	Product Analysis	Chemical Composition	PR / Purchase Specification	Test Reports	-	H	R
3.7	Destructive Testing	Mechanical, Impact, IGC and Other test as applicable	PR / Purchase Specification	Test Reports	-	H	H (Note -1)

**INSPECTION AND TEST PLAN
FOR SMALL SIZE & ASSORTED LENGTH PIPES**

SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	TPIA
3.8	Galvanizing (If Applicable)	Integrity of Galvanised Coating	100%	Inspection reports	-	H	R
4.0	Final Inspection						
4.1	Hydrostatic Testing)	Leak Check	100%	Test Report	-	H	R
4.2	Visual and Dimensional Inspection (VDI)	Surface Condition, Straightness, End Finish, Bevel Angle, Root Face, Outer Dia., Thickness, Length, End Finish, Marking etc	100%	Inspection Report	-	H	RW (Note-1)
4.3	Weight Checking as applicable	Weight	100%	Inspection Report	-	H	-
4.4	PMI Check	Chemical Check	As Per EIL Spec. 6-81-0001	Inspection Report	-	H	RW (Note-1)
4.5	Final Stamping	Stamping Of Accepted Pipes	Stamping of Pipes which are witnessed by	Inspection Report	-	H	H (Note-1)

**INSPECTION AND TEST PLAN
FOR SMALL SIZE & ASSORTED LENGTH PIPES**

SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	TPIA
5.0	Painting						
5.1	Rust Preventive Coating & Color Coding	Visual Inspection & Color Coding	100%	Inspection Report	-	H	-
6.0	Documentation & IC						
6.1	Documentation & Inspection Certificate (IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Supplier TC & IC	-	H	H

Legend: H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (min.1 no. of each size and type of Bulk item)), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

NOTES (As applicable):

1. Non NACE & Non Hydrogen Service Carbon Steel Pipes up to size 12" will be accepted on review of Supplier Test Certificates. Supplier Test Certificate along with backup reports to be reviewed by EIL/TPIA.
2. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable.

**INSPECTION AND TEST PLAN
FOR SMALL SIZE & ASSORTED LENGTH PIPES**

3. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred therein /Job Specification /Approved Documents.
4. For orders placed on stockist, items shall be accepted based on manufacturer's TC with EN310204 type 3.2 certification from VCS approved suppliers.

	INSPECTION & TEST PLAN (ITP) FOR INCOMING MATERIAL CHECKING FOR CONTRACTOR'S SUPPLIED MATERIALS

INSPECTION & TEST PLAN

INSPECTION & TEST PLAN (ITP) FOR INCOMING MATERIAL CHECKING FOR CONTRACTOR'S SUPPLIED MATERIALS

**INSPECTION & TEST PLAN (ITP) FOR
INCOMING MATERIAL CHECKING FOR
CONTRACTOR'S SUPPLIED MATERIALS**

ABBREVIATIONS:

ATT	:	Anti Termite Treatment
CGI	:	Corrugated Galvanized Iron
CS	:	Carbon Steel
EOT	:	Electric Operated Traction
FLM	:	Flood Light Mast
HOT	:	Heat Operated Traction
HT	:	High Tension
HV	:	High voltage
IMIR	:	Incoming Material Inspection Report.
IRN	:	Inspection Release Note
ITP	:	Inspection Test Plan
KW	:	Kilo Watt
LR	:	Lorry Receipt
LT	:	Low Tension
LV	:	Low Voltage
LEL	:	Low Explosive Detectors
MOC	:	Material of Construction
MTC	:	Manufacture Test Certificate
NACE	:	National Association of Corrosion Engineers
PLC	:	Programmable Logic Control
PRDS	:	Pressure Reducing and De-Superheating Stations
QAP	:	Quality Assurance Plan
RCC	:	Reinforced Cement Concrete
SS	:	Stainless Steel
TC	:	Test Certificate
TPIA	:	Third Party Inspection Agency

**INSPECTION & TEST PLAN (ITP) FOR
INCOMING MATERIAL CHECKING FOR
CONTRACTOR'S SUPPLIED MATERIALS**

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**INSPECTION & TEST PLAN (ITP) FOR
INCOMING MATERIAL CHECKING FOR
CONTRACTOR'S SUPPLIED MATERIALS**

GENERAL NOTE

1. The enclosed ITP is indicative and shall be followed for developing the job specific ITP for checking of incoming material supplied by contractor. The provisions indicated for stage wise inspection by VCS/ Owner are the minimum and the Engineer-In-Charge may decide to increase Hold Points/ Witness Points. Activities not included in the ITP shall be included by the contractor in job specific ITP and the same to be approved by VCS/Owner before start of the work.
2. Contractor to prepare job specific reporting format with the aid of enclosed sample reporting format and job procedure for inspection coverage as per the ITP. Same shall be submitted to VCS/Owner for approval, before commencement of the job. If the contractor has to deviate from the given ITP for a valid reason, he shall obtain prior written approval of VCS/Owner. Contractor to carry out 100% examination of all activities.

LEGEND

HP : Hold Point

A point which requires inspection/verification and acceptance by Owner/VCS before any further processing is permitted.

The Contractor shall not process the activity/item beyond a Hold Point without written approval by Owner/VCS except where prior written permission for further processing is available.

W : Witness Point

An activity which requires witnessing by Owner/VCS when the activity is performed.

After proper notification has been provided (notification modalities and period shall be finalized before hand), the Contractor is not obliged to hold further processing if Owner/VCS is not available to witness the activity or does not provide comments before the date notified. In such cases basis of acceptance shall be review of Contractor generated report/document as per relevant technical specification.

Rw : Review of Contractor's documentation.

S : Surveillance Inspection by Owner/VCS.

Monitoring or making observations to verify whether or not material/items or services conform to specified requirements. Surveillance activities may include audit, inspections, witness of testing, review of quality documentation & records, personnel qualifications, etc.

WC : 100% Supervision and Examination by Contractor.

**INSPECTION & TEST PLAN (ITP) FOR
INCOMING MATERIAL CHECKING FOR
CONTRACTOR'S SUPPLIED MATERIALS**

S. NO.	ACTIVITY	CONTRACTOR	VCS/ OWNER			Records to be Submitted/ Format No.
			CAT 1	CAT 2	CAT 3	
A	Document Checking					
1	Check whether vendor/ source is approved	WC	HP	Rw	Rw	G-01
2	Availability of QAP/ ITP duly approved by TPIA	WC	Rw	Rw	Rw	G-01
3	Availability of MTC / IRN (Availability of stage wise Inspection Reports/ Certificates in case of inspection by TPIA, Inspection Reports of Contractor)	WC	HP	Rw	Rw	G-01
4	Availability of certificates from statutory bodies, if applicable	WC	HP	Rw	Rw	
5	Delivery challan / LR	WC	Rw	Rw	-	G-01
B	Physical Verification					
1	Checking for Inspection stamp/ Identification mark	WC	W*	S	S	G-01
2	Correlation of MTC w.r.t. Heat nos./ Batch no./ Lot no.	WC	HP	W*	W*	G-01
3	Physical assessment of Quantity	WC	S	S	-	G-01
4	Certification of condition of material	WC	W	S	S	G-01
C	Sampling for field tests / tests from approved laboratories, if applicable	WC	W	W	W	G-01
D	Review of field test reports/ test reports if applicable	WC	Rw	Rw	Rw	G-01
E	Review & Endorsement on MTC/IRN/TC etc.	WC	HP	HP	HP	G-01
F	Endorsement on IMIR	WC	HP	HP	HP	G-01

NOTES:

- (\$) A generic categorization plan could be framed based on following guideline and as per Table A.
- (*) Sampling plan for checking of bulk items shall be as per discretion of VCS.

General:

- 1) VCS /OWNER and contractor shall jointly finalize the list of incoming materials and categorize in line with inspection categorization plan for bought out items. The items not covered in Table A shall be finalized by Engineer In charge / Owner.
- 2) In general SI. no. of the ITP: A (1, 3, 4 & 5) B, E and F shall be applicable to both (#) and

**INSPECTION & TEST PLAN (ITP) FOR
INCOMING MATERIAL CHECKING FOR
CONTRACTOR'S SUPPLIED MATERIALS**

(@) i.e. items with and without TPI/VCS inspection.

- 3) In general SI. no. of the ITP: A (2), shall be applicable to (@) i.e. items with TPI / VCS inspection.
- 4) In general SI. no. of the ITP: C and D shall be applicable to (#) i.e. items without TPI / VCS inspection.
- 5) All items to be procured from approved vendors / source as per list enclosed in the contract/ approved vendor list. Prior approval for the source / vendor to be taken for items not listed in the contract / approved vendor list.
- 6) Anodization I galvanization shall be ensured in shops having proven track record and samples are to be tested to check galvanizing / anodizing prior to dispatch to sites.

CAT. 1 CRITICAL: The materials requiring long time impact to meet the stipulation of end user. Completely engineered and inspected as per the contract.

CAT. 2 MAJOR: The materials requiring lesser time impact on end user. Specified to Industry standards, lower design category (not fully reviewed of detailed Engg. but all interface checked) and with complete compliance with code, however requiring limited inspection.

CAT. 3 MINOR: Standard items, fit for the purpose with minimal Engg. review.

**INSPECTION & TEST PLAN (ITP) FOR
INCOMING MATERIAL CHECKING FOR
CONTRACTOR'S SUPPLIED MATERIALS**

TABLE- A

S. NO.	CAT. 1 (CRITICAL)	CAT. 2 (MAJOR)	CAT. 3 (MINOR)
Items without TPI / VCS Inspection (#)			
1	Refractory Materials	• Cement • Reinforcement • Structural Steel • Brick and Tile Brick • Asphalt (Bitumen) • Paint • Sanitary Wares • Sanitary Fittings (Pipes & Fittings) • Chemicals for ATT • Acid Resistant Tiles and Mortar • Marble • Mechanical Hardener for Flooring • Grouting Compound • Wood for Doors and Windows • Ventilator • Flush Door • Paneled Door • Roof Treatment Materials • False Ceiling & Flooring Materials • RCC Hume Pipes • Anchor Fasteners • Foundation Bolts	• AC Sheets/ CGI Sheets • Particle Board • Glazing Glass • All Galvanized/ Anodized items like GI Pipes • Door/ Window Frames • Pre-Coated Sheets • Steel Doors • Rolling Shutters • Cable Ducts/ Trays • Lightning Arrestors • Street Light Poles • Earthing items
Items with TPI / VCS Inspection (@)			
1	• All Pumps (with Drive above 110 KW). • Diesel Generators • All Vessels with MOC NACE, Alloy Steel, Clad Steels, Inconel.	• All Types of Pumps, Compressors Excluding Category 1 • Fans, Blowers, Vessels excluding Category 1 • EOT / HOT Crane • Damper, Soot Blowers • Expansion Joint, Gas and Liquid Filters • Pipes/ Piping Material (Flanges, Fittings etc. AS, SS, Clad Steel, Inconel, NACE)	• Hoists • Pipes & Piping Materials (Carbon Steel & Other) excluding Category 2 • Gauges Glass • Pressure Gauges, Temperature Gauges, Draft Gauges • Tape Coat Materials • Gratings • Insulation Materials • All Fasteners, Gaskets.

**INSPECTION & TEST PLAN (ITP) FOR
INCOMING MATERIAL CHECKING FOR
CONTRACTOR'S SUPPLIED MATERIALS**

S. NO.	CAT. 1 (CRITICAL)	CAT. 2 (MAJOR)	CAT. 3 (MINOR)
	• All, Heat exchangers	• All type of Valves • All fire fighting equipment's, including deluge valves LRM, Sprinklers. FLM with Fittings • HV/ MV/ LV Switch Gear, Bus Ducts • Fire Alarm System • HV/ LV Motors • DC System including Consoles • PLC, Batteries & Battery Chargers, Capacitor Banks • Plant Communication System, UPS & Transformer • Tank Level Indicator/ Instruments • All Control Valves, Pressure Relief Valves, • Meter-Flow, Solenoid Valve, Annunciators with Panels, Self-Actuating Pressure Control Valves. • Temperature Sensing Element RTD's • Thermowell and Thermocouple • Mass Flow Meters, Pressure Switches, Flow Switches, Level Switches (Explosion Proof) • Flow Sensing Element Orifice Plate & Flanges, Pitot Tube Analyzers - LEL Detectors, Level Instruments • Transmitters • Flame Arrestors • Panel Control and Accessories • All Cables (Power, Control, Lighting etc.) • All Types of Hazardous area Fittings & Fixtures.	

Note: For any material not covered above, the inspection requirement shall be decided by EIC based on the criticality.

**INSPECTION & TEST PLAN (ITP) FOR INCOMING MATERIAL CHECKING FOR
CONTRACTOR'S SUPPLIED MATERIALS**

Format No: G:01

INCOMING MATERIAL INSPECTION REPORT FORMAT

Report No.

Date:

Project:

Unit:

Name of Work:

Contractor:

Consultant:

Job No:

Work order No.:

P.O. No. & Date:

LR No:

S. NO.	SOR Item	Material Description/ Tag No.	Date of Receipt	Qty. Received	Qty. Accepted	Manufacturer/ Vendor	MTC No./ IRN No. with Date/ Field, Lab Test, etc.	Heat/ Batch No.	Ref. Invoice/ Challan No.	Observation/ Remarks/ Storage Instruction

Notes :

INSPECTION ACTIVITY AT SITE (Tick as applicable)

1. Quantity verified and found in order ☐ the material ☐	2. Material condition appears to be good ☐	3. Heat/Batch/Tag No. mentioned on
4. Color coding done as applicable ☐ IRN/MTC/Lab Tests report ☐	5. Site identification mark on material ☐	6. Correlation w.r.t.
7. TC verification w.r.t. IRN/Spec/QAP, etc. ☐	8. Check for Vendor/Source approval ☐	9. Special Requirement if any

Based on above, materials are accepted.

Contractor Field Engineer

Site In-charge

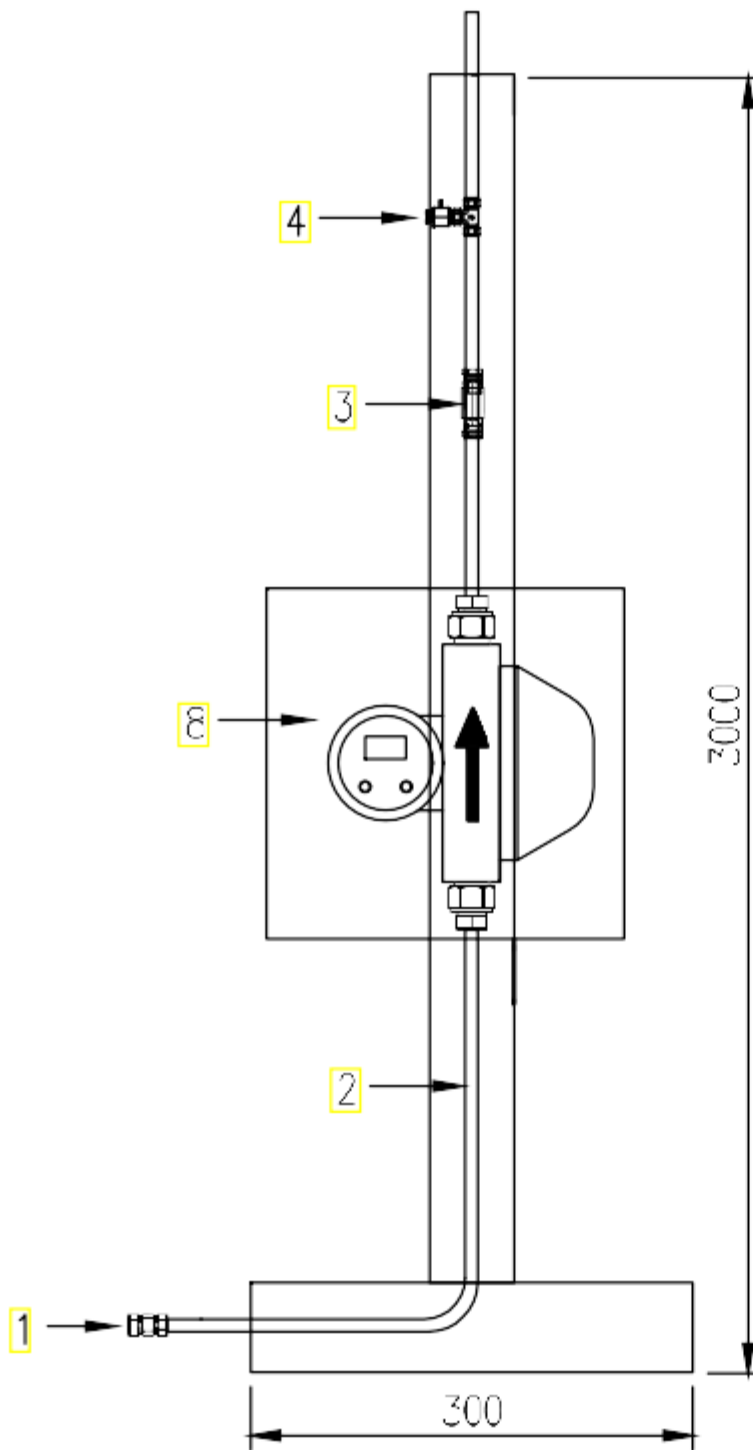


LCV LOADING POST WITH FLOW METER

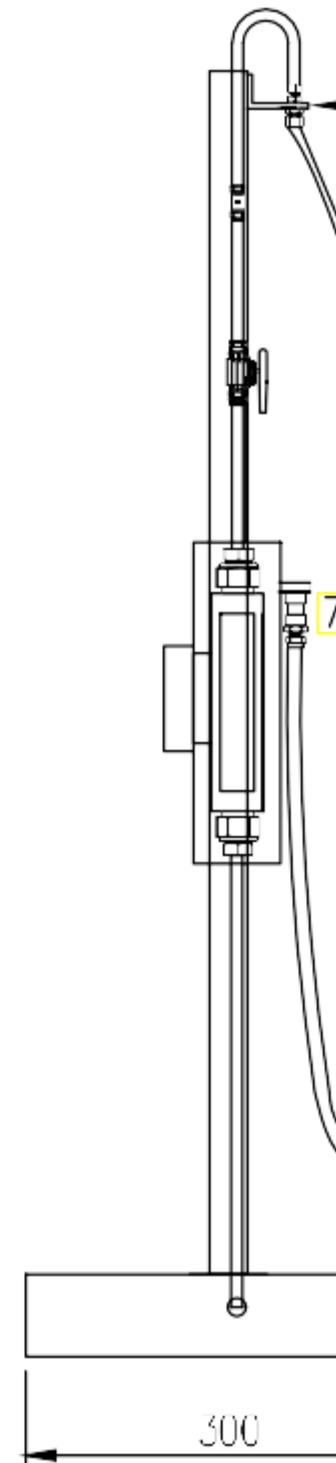
DRAWING

SD-M

SHEET NO.



FRONT VIEW



SIDE VIEW

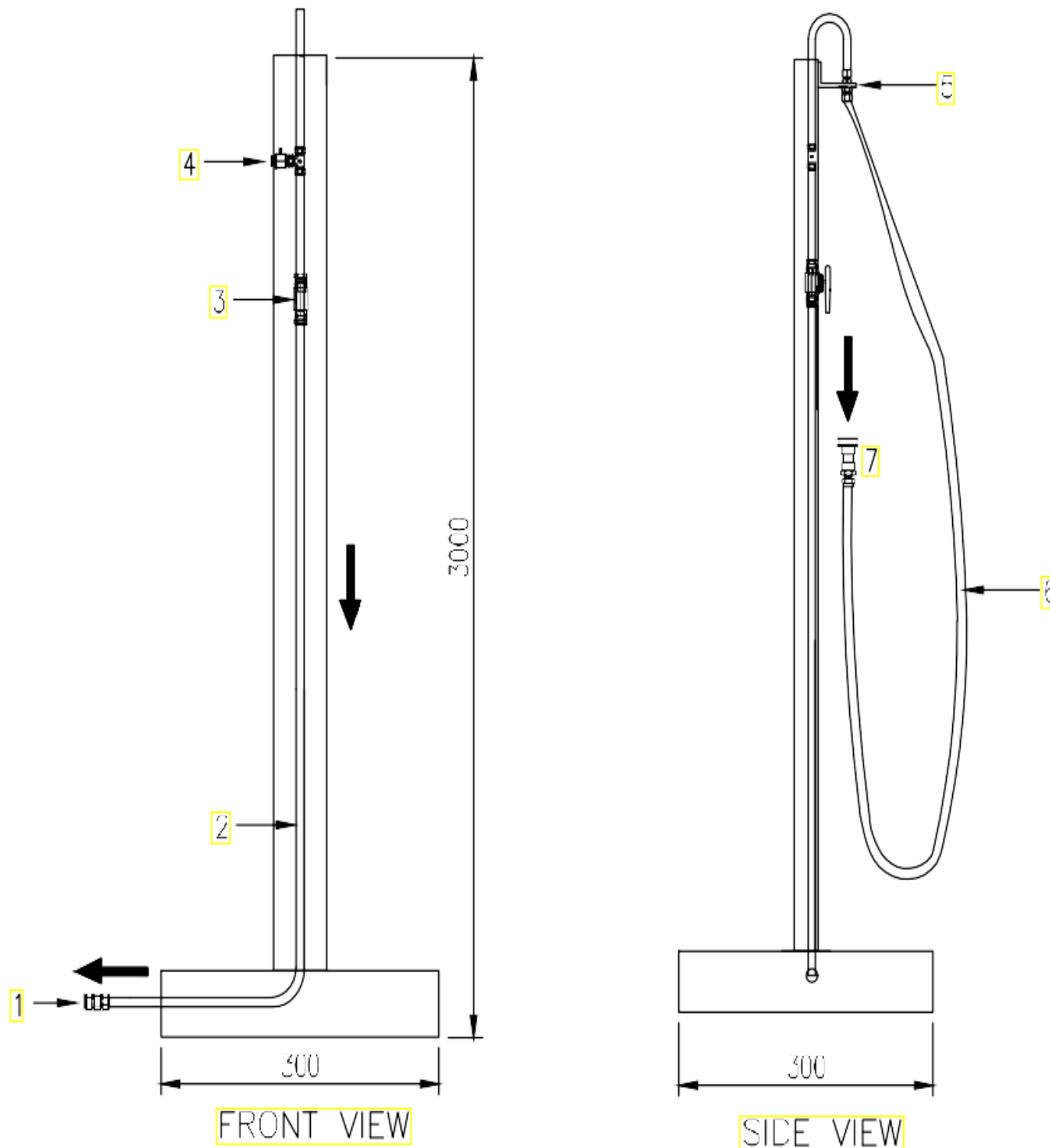
S.NO.	PART NAME	MATERIAL	MAKE/M
1	UNION 3/4" CD	SS 316	SWAGELOK/PARKE
2	TUBE 3/4" OD	A 269/213 TP316	SANDVIK/TUBACEX
3	TWO WAY BALL VALVE 3/4" OD	SS 316	SWAGELOK/PARKE
4	BLEED VALVE 1/4" NPTM	SS 316	SWAGELOK/PARKE
5	BULKHEAD UNION 3/4" CD	SS 316	SWAGELOK/PARKE
6	FILL HOSE 1/2" ID, LENGTH-4Mtr. (SS BRAIDED STAINLESS STEEL)	5000 PSIG	SWAGELOK/TUBAC
7	GRC 1/2" NPTF	SS 316	SWAGELOK/PARKE
8	FLOW METER WITH INTEGRATED DISPLAY (COROLIS TYPE) 0-100 Kg/min.	-	MICRC MOTION /

NOTES :

1. ALL DIMENSIONS IN MM.
2. THIS DWG. IS INDICATIVE ONLY, VENDOR TO FURNISH FINAL DWG. BASED ON A
CNG FILLING FOR APPROVAL POST ORDER.
3. HOSE SHOULD CONFIRM TO NFPA52/CSA NGV 4.2-2014/CSA12.52-2014.

0	24.09.19	ISSUED FOR REVIEW	DK	RR
REV. NO.	DATE	SUBJECT OF REVISION	PREF	C

	LCV UNLOADING POST	DRAWING NO.	
		SD-ME-002	
		SHEET NO.	1 OF 1



S.NO.	PART NAME	MATERIAL	MAKE/MODEL
1	UNION 3/4" CD	SS 316	SWAGELOK/PARKER/ DK LOK
2	TUBE 3/4" OD	A 269/213 TP316	SANDVIK/TUBACEX
3	TWO WAY BALL VALVE 3/4" OD	SS 316	SWAGELOK/PARKER/ DK LOK
4	BLEED VALVE 1/4" NPTM	SS 316	SWAGELOK/PARKER/ DK LOK
5	BULKHEAD UNION 3/4" CD	SS 316	SWAGELOK/PARKER/ DK LOK
6	FILL HOSE 1/2" ID, LENGTH-4Mtr. (SS BRAIDED STAINLESS STEEL)	5000 PSIG	SWAGELOK/TUBACEX/ETON
7	GRC 1/2" NPTF	SS 316	SWAGELOK/PARKER/ DK LOK

NOTES :

- ALL DIMENSIONS IN MM.
- THIS DWG. IS INDICATIVE ONLY, VENDOR TO FURNISH FINAL DWG. BASED ON ARRANGEMENT FOR CNC FILLING FOR APPROVAL POST ORDER.
- HOSE SHOULD CONFORM TO NFPA52/CSA NGV 4.2-2014/CSA12.52-2014.
- BUSTING PRESSURE OF HOSE SHALL BE 20000 PSI.

0	24.09.19	ISSUED FOR REVIEW	DK	RR	AD
REV. NO.	DATE	SUBJECT OF REVISION	PREF	CHKD	APPD

STANDARD DATASHEET-MASS FLOW METERS (CORIOLIS TYPE) FOR DISPENSER					
units	Flow - >CNG		CNG-Kg/Hr Pressure->	Temperature -> °C	Level /Length- >mm
General	1	Tag			
	2	Line No			
	3	Service			
Meter	4	Type			
	5	Function			
	6	Conn size : size & rating			
	7	Facing & Facing			
	8	Body material			
	9	Wetted Parts Material			
	10	Enclosure			
	11	Conduit Connection			
	12	Range			
	13	Accuracy			
Convertor	14	Load resistance – ohms			
	15	Output			
	16	Power supply			
	17	Area classification			
	18	Intrinsically safe /Expl. Proof			
	19	Enclosure			
	20	Conduit connection			
	21	Mounting			
	22	Distance from control room			
Options	23	Filter/Mesh Wire			
	24	Mounting Brackets			
	25	Interconnecting			
	26	Special cabling			
	27	Cable glands			
	28	Accessories for hot tap			
Service Conditions	29	Fluid & state			
	30	Maximum Flow			
	31	Minimum Flow			
	32	Normal Flow			
	33	Pressure – Open. Max.			
	34	Temp. C – Open. Max.			
	35	Oper. S.G. Mol. Wt			
	36	Max. Order Viscosity mpa. s(cp)			
	37	Max. Allowable Pr. Drop			
	38	Model No. Meter c convertor			
	39	Specification Remarks			
	40	Specification Remarks			

	LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS & TPIA

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**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

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**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

A. MECHANICAL & PIPELINE

1.0 CARBON STEEL PIPES

1.1 PIPE CARBON STEEL TO INDIAN STANDARDS

- a. A.S.T. Pipes Pvt. Ltd. (AST Group)
- b. Advance Steel Tube Ltd.
- c. Apl Apollo Tubes Ltd. (Er. Bihar Tubes Ltd.
- d. Asian Mills Pvt. Ltd.
- e. Asrani Tubes Limited
- f. Dadu Pipes (P) Ltd.
- g. Essar Steel Limited(Er Hazira Pipes Mill)
- h. Gaurang Products Pvt Ltd. (Ast Group)
- i. Goodluck Steel Tubes Ltd.
- j. Hi-Tech Pipes Limited
- k. Indus Tube Limited
- l. Jindal Industries Ltd
- m. Jindal Pipes Ltd.
- n. Jindal Saw Ltd (Kosi Works)
- o. Jotindra Steel & Tube Ltd
- p. Lalit Pipes And Pipes Ltd.
- q. Maharashtra Seamless Ltd.
- r. Man Industries (India) Ltd. – Pithampur
- s. Man Industries (India) Ltd. Anjar
- t. Mukat Tanks & Vessels Ltd.
- u. Nezone Tubes Limited
- v. North Eastern Tubes Limited
- w. Pratibha Industries Limited
- x. Pratibha Pipes & Structural Ltd.
- y. Psl Ltd (Chennai)
- z. Psl Ltd (V1, V2 & Nc)
- aa. Rama Steel Tubes Ltd.
- bb. Ratnamani Metals And Tubes Ltd.
- cc. Ravindra Tubes Limited
- dd. Samshi Pipe Industries Limited

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- ee. Surya Roshni Ltd.
- ff. Swastik Pipes Ltd.
- gg. Utkarsh Tubes & Pipes Ltd. (Formly Bmw)
- hh. Welspun Corp. Limited (Dahej)
- ii. Zenith Birla (India) Limited

1.2 PIPE & TUBULARS TO A.P.I. STANDARDS

- a. Arcelormittal Tubular Products Roman Sa, Romania
- b. Bhel (Trichy), India
- c. Dalmine Spa (Enquiry To Tenaris), Uae
- d. Eewkorea Co. Ltd (Germany), Korea
- e. Eew Korea Co. Ltd. (Korea), Korea
- f. Eisenbau Kramer Gmbh, Germany
- g. Hyundai Rb Co. Ltd. South Korea
- h. Ilva Lamiere E Tubi Srl (Enq To Ilva Spa, Italy)
- i. Inox Tech. Spa, Italy
- j. ISMT Ltd. Ahmednagr, India
- k. TATA Steel, India
- l. PSL
- m. Jindal Pipes Ltd., India
- n. Jindal Saw Ltd. (Kosi Works), India
- o. Jindal Saw Ltd. (Nashik Works), India
- p. Lalit Pipes And Pipes Ltd. India
- q. Maharashtra Seamless Ltd., India
- r. Man Industries (I) Ltd. (Pithampur), India
- s. Mukat Tanks & Vessels Ltd., India
- t. Pratibha Industries Limited, India
- u. Ratnamani Metals And Tubes Ltd., India
- v. Siderca S.A.I.C (Enquiry Totenaris), Uae
- w. Sumitomo Metal Ind. Ltd., India
- x. Surya Roshni Ltd., India
- y. Swastik Pipes Ltd, India
- z. Tata Steel Uk Limited (Formerly C702)
- aa. Tubos De Acero De Mexico Sa (Enq. Tenaris), Uae
- bb. Tubos Reunidos Sa Spain

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- cc. Umran Steel Pipe Inc (Turkey), Turkey
- dd. Valcovny Trub Chomutov, Czech Republic
- ee. Vallourec And Mannesmann Tubes, France
- ff. Welspun Corp Limited (Dahej), India

1.3 PIPE/TUBE CS (SEAMLESS) TO ASTM STANDARDS

- a. Arcelormittal Tubular Products Roman Sa, Romania
- b. Bhel (Trichy), India
- c. Changshu Seamless Steel Tube Co. Ltd., China
- d. Dalmine Spa (Enquiry To Tenaris, Uae
- e. Heavy Metals & Tubes Limited (Mehsana), India
- f. Ismt Ltd. Ahmednagr, India
- g. Ismt Ltd. Baramati India
- h. Jfe Steel Corporation, Uae
- i. Jindal Sdaw Ltd (Nashik Works) India
- j. Klt Automotive And Tubular Products Ltd., India
- k. Mahalaxmi Seamless Limited, India
- l. Maharashtra Seamless Ltd, India
- m. Products Tubulares S.A.U, Spain
- n. Ratnadeep Metal Tubes Ltd., India
- o. Staineest Tubes Pvt Ltd., India
- p. Sumitomo Metal Ind. Ltd., India
- q. Tubos Reunidos Sa Spain
- r. Valcovny Trub Chomutov, Czech Republic
- s. Vallourec Andmannesmann Tubes France
- t. Yangzhou Chengde Steel Pipe Co. Ltd Dubai (UAE)

1.4 PIPE CARBON STEEL (WELDED) TO ASTM STANDARDS

- a. Eew Korea Co. Ltd. (Germany), Korea
- b. Eew Korea Co. Ltd. (Korea), Korea
- c. Eisenbau Kramer Gmbh, Germany
- d. Hyundai Rb Co. Ltd., South Korea
- e. Inox Tech. Spa, Italy
- f. Jindal Saw Ltd (Kosi Works), India
- g. Lalit Pipes and Pipes Ltd., India
- h. Man Industries (I) Ltd.(Pithampur), India

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- i. Man Industries (India) Ltd. Anjar, India
- j. Mukat Tanks & Vessels Ltd., India
- k. Ratnamani Metals And Tubes Ltd., India
- l. Sumitomo Metal India Ltd., India
- m. Tata Steel Uk Limited

2.0 VALVES

2.1 GLOBE VALVES

- a. BDK (New Delhi)
- b. Datre Corpn (Calcutta)
- c. KSB Pumps (New Delhi)
- d. L&T (New Delhi)
- e. Neco Schuber & Salzer Ltd. (New Delhi)
- f. Niton Valve (Mumbai)
- g. Ornate Valves (Mumbai)
- h. Panchavati Valves (Mumbai)
- i. AV Valves Ltd.
- j. BHEL (Trichy), India
- k. Econo Valves Pvt Ltd, India
- l. Fouress Engg (I) Ltd (Aurangabad)
- m. Guru Industrial Valves Pvt Ltd
- n. Leader Valves Ltd, India
- o. NSSL Ltd. (Neco Schubert & Salzerltd)
- p. Oswal Industries Ltd, India
- q. Petrochemical Engineering Enterprises, India
- r. Sakhi Engineers Pvt Ltd
- s. Shalimar Valves Pvt Ltd
- t. Steel Strong Valves India Pvt Ltd, India
- u. Petro Valves Pvt. Limited, Ahmedabad
- v. Hawa Engineers Limited, Ahmedabad

2.2 CHECK VALVES

- a. Advance Valves Pvt. Ltd., Noida
- b. Aksons & Mechanical Enterprises, Mumbai
- c. Larsen & Toubro Limited (Audco India Limited, Chennai)

LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS & TPIA

- d. AV valves Ltd., Agra
- e. BDK engineering India Ltd., Hubli
- f. BHEL, OFE&OE Group, New Delhi
- g. Datre Coroportion Limited, Calcutta
- h. Leader Valves Ltd., Jalandhar
- i. Neco schubert & Salzer Ltd., New Delhi
- j. Niton Valves Industries (P) Ltd., Mumbai
- k. Precision Engg. Co., Mumbai
- l. Econo Valves Pvt Ltd, India
- m. Fouress Engg (I) Ltd (Aurangabad)
- n. KSB Pumps Ltd (Coimbatore), India
- o. NSSL Ltd. (Neco Schubert & Salzer Ltd)
- p. Oswal Industries Ltd, India
- q. Panchvati Valves & Flanges Pvt Ltd, India
- r. Petrochemical Engineering Enterprises, India
- s. Sakhi Engineers Pvt Ltd
- t. Shalimar Valves Pvt Ltd
- u. Steel Strong Valves India Pvt Ltd, India
- v. Hawa Engineers Limited, Ahmedabad

2.3 PLUG VALVES

- a. Breda Energia Sesto Industria Spa, Italy
- b. Fisher Sanmar Ltd., Chennai
- c. Larsen & Toubro Ltd., New Delhi
- d. Nordstrom Valves, USA
- e. Serck Audco Valves, UK
- f. Sumitomo Corporation India Pvt. Ltd., New Delhi
- g. Z Corporation, Korea
- h. Hawa Valves (India) Pvt. Ltd., Mumbai
- i. Steel Strong Valves India Pvt. Ltd., Navi Mumbai
- j. Econo Valves
- k. Flow-Serve PTE (Mfr. SERCK), India

2.4 BALL VALVES

- a. Hawa Valves (India) Pvt. Ltd, Navi Mumbai
- b. Larsen & Toubro, Delhi

LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS & TPIA

- c. Microfinish Valves Pvt. Ltd., Noida
- d. Oswal Industries Ltd., Gandhi nagar
- e. Virgo Engineers Ltd., Delhi
- f. Boteli Valve Group Co. Ltd., China
- g. Cameron (Malaysia) SDN BHD, Malaysia
- h. Dafram S.P.A., Italy
- i. Fangyuan Valve Group Co. Ltd., China
- j. Franz Schuck GmbH, Germany
- k. O.M.S. Saleri (Italy)
- l. Pibi Viesse S.P.A (Italy)
- m. Nuovo Pignone (Italy)
- n. Perar S.P.A (Italy)
- o. Pietro Fiorentini (Italy)
- p. Cooper Cameron Valv Italy SRL-FRM, Italy
- q. Petrol Valves SRL
- r. Tormene Gas Technology S.P.A (VALVITALIA)
- s. Petro Valves Pvt. Limited, Ahmedabad
- t. Hawa Engineers Limited, Ahmedabad

3.0 TEE

3.1 FLOW TEE

- a. Coprosider SPA, Italy
- b. GEA Energy System India Limited, Chennai
- c. Multitex Filtration
- d. Pipeline Engineering, UK
- e. Scomark Engg. Limited (U.K.)
- f. Skeltonhall Limited, England(U.K.)
- g. Technospecial SPA, Italy
- h. Tectubi SPA, Italy
- i. RMA Germany
- j. Pipefit Engineers Pvt. Ltd.
- k. Vee Kay Vikram

3.2 SPLIT TEE

- a. Ipsco, Canada

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- b. TD Willamsons, USA

4.0 FLANGES

- a. Aditya Forge Ltd., Vadodara
- b. Amforge Industries Ltd., Mumbai
- c. CD Engineering Co., Ghaziabad
- d. Echjay Forgings Pvt. Ltd. (Bombay), Mumbai
- e. Echjay Industries Ltd., Rajkot
- f. Forge & Forge Pvt. Ltd., Rajkot
- g. Golden Iron & Steel Works, New Delhi
- h. JK Forgings, New Delhi
- i. Metal Forgings Pvt. Ltd., Mumbai
- j. Perfect Marketings Pvt. Ltd., New Delhi
- k. Sky Forge, Faridabad
- l. S&G, Faridabad
- m. Chaudhry Hammer Works Ltd, India
- n. JAV Forgings (P) Ltd, India
- o. Kunj Forgings Pvt Ltd, India
- p. MS Fittings
- q. R.N. Gupta & Co. Ltd, India
- r. R.P. Engineering Pvt Ltd, India
- s. Sanghvi Forgings & Engineering Ltd
- t. Shri Ganesh Forgings Ltd., India
- u. Uma Shankar Khandelwal & Co., India
- v. Sawan Engineers, Baroda
- w. Stewarts & Lloyds of India Ltd., Kolkata
- x. Engineering Services Enterprises
- y. Pipefit Engineers Pvt. Ltd.

5.0 FITTINGS

- a. Commercial Supplying Agency, Mumbai
- b. Dee Development Engineers Ltd.
- c. Eby Industries, Mumbai
- d. Flash Forge Pvt. Ltd., Vishakhapatnam
- e. Gujarat Infra Pipes Pvt. Ltd., Vadodara

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- f. M.S. Fittings Mfg. Co. Pvt. Ltd., Kolkata
- g. Stewarts & Lloyds of India Ltd., Kolkata
- h. Teekay Tubes Pvt. Ltd., Mumbai
- i. Pipe Fit, Baroda
- j. Sky Forge, Faridabad
- k. S&G, Faridabad
- l. Sawan Engineers, Baroda
- m. Eby Fasteners, India
- n. Leader Valves Ltd, India
- o. R.N. Gupta & Co. Ltd, India
- p. Exten Engg Pvt Ltd
- q. Sivananda Pipe & Fittings Ltd
- r. Jindal Forging
- s. Vivial Forges

6.0 PIG LAUNCHERS/ RECEIVERS/ PIG SIGNALERS

- a. Bassi Luigi Fittings B.V., Holland
- b. BRAUN STAHL PIPE TEC, GERMANY
- c. FORAIN, ITALY
- d. Fluidel SRL, ITALY
- e. RMA Maschinen- und, GERMANY
- f. Siiritec Nigi, Itlay
- g. SCHUCK ARMATUREN, GERMANY
- h. T.D. Williamson Inc., USA
- i. Tectubi SPA, Italy
- j. Taylor Forge Engineering System INC, USA
- k. Tormene Americana S.A. (Argentina)
- l. Tormene Gas Technology S.p.A., Italy
- m. PIPELINE ENGINEERING, UNITED KINGDOM
- n. Krohne, Oil & Gas BV, Drive Houston,
- o. Multitex Filtration Engrs. Ltd, New Delhi
- p. BGR ENERGY SYSTEMS LIMITED New Delhi
- q. Glapwell Contracting Services Ltd. UK
- r. FULGOSI GIOVANNI S.n.c di Corrado & C, ITALY
- s. VEEKAY VIKRAM & CO, GUJRAT

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- t. GBM S.R.L, ITALY
- u. Multitex Filtration Engineers Ltd., India
- v. Cardew Ltd., Alexeander
- w. Forain S.R.L.
- x. GD Engineering, India
- y. Pipeline Engineering, UK
- z. Siirtec Nigi SPA

7.0 LONG RADIUS BENDS

- a. Jindal Saw Ltd. (Kosi Works), India
- b. PSL Limited (Gandhidham – Mfrg), India

8.0 CLEAN AGENT SYSTEM

- c. ADN Fire Safety Pvt Ltd (Vashi East, Thane)
- d. Chetan Corporation (Ahmedabad)
- e. Chetan Engineers (Ahmedabad)
- f. Mx Systems International Pvt. Ltd. (Mumbai)
- g. New Fire Engineers (P) Ltd (Sil Vassa)
- h. Nitin Fire Protection Industries Ltd (New Bombay)
- i. Nohmi Bosai (India) Private Limited
- j. Tyco Fire & Security India Pvt. Ltd (Bangalore)
- k. Vimal Fire Controls Pvt Ltd (Vadodara)

9.0 INSULATING JOINTS

- a. IGP Engineers
- b. V K Vikram
- c. Advance Electronics
- d. Oceaneering Products
- e. BVM Engineers Vadodara
- f. Goodrich Gasket Pvt Ltd

10.0 GASKETS

- a. IGP Engineers (P) Ltd., Madras
- b. Madras Industrial Products, Madras
- c. Dikson & Company, Bombay
- d. Banco Products (P) Ltd., Vadodara
- e. Goodrich Gaskets Pvt Ltd

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- f. Starflex Sealing India Pvt Ltd, India
- g. Teekay Meta Flex Pvt Ltd
- h. UNIKLINGER Ltd
- i. HEM Engg. Corp.
- j. Unique Industrial Packing Pvt. Ltd.

11.0 FASTENERS

- a. Nireka Engg. Co. (P) Ltd., Calcutta
- b. Precision Taps & Dies, Bombay
- c. AEP Company, Vithal Udyoung Nagar
- d. Fix Fit Fasteners, Calcutta
- e. Precision Engg. Industries, Baroda
- f. Echjay Forgings Pvt. Ltd., Bombay
- g. Capital Industries, Bombay
- h. Boltmaster India Pvt Ltd, India
- i. Deepak Fasteners Limited, India
- j. Fasteners & Allied Products Pvt Ltd, India
- k. Hardwin Fasteners Pvt Ltd, India
- l. J.J. Industries, India
- m. Multi Fasteners Pvt Ltd, India
- n. Nexo Industries, India
- o. Pacific Forging & Fasteners Pvt Ltd, India
- p. Pioneer Nuts & Bolts Pvt Ltd, India
- q. Precision Auto Engineers, India
- r. President Engineering Works, India
- s. Sandeep Engineering Works, India
- t. Syndicate Engineering Industries, India

12.0 WELDING ELECTRODES FOR PIPELINE/PIPING WORK

- a. Lincon
- b. Böhler
- c. D&H

13.0 STRAINERS

- a. Bombay Chemical Equipments
- b. Gujarat Auto filed

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- c. Multitex Filtration Engineering Limited
- d. Grand Prix Engineering Limited

14.0 COLD APPLIED TAPES

- a. Denso GmbH
- b. Raychem

15.0 HEAT SHRINKABLE SLEEVE/ FIBREGLAS REINFORCED SLEEVE

- a. Seal for life - Covalence
- b. Canusa
- c. CYG Changtong New Material Co. LTD, China

16.0 STUD BOLTS WITH NUTS

- a. Multi Thread Fasteners, Baroda
- b. Darukhanwala
- c. Precision Engineers, Baroda
- d. Unbrako
- e. TVC

17.0 WARNING MAT

- a. Sparco Multiplast Pvt. Ltd., Ahmedabad
- b. Singhal Industries , Ahemdabad
- c. Puja Packing, Mumbai
- d. Bina Enterprises, Mumbai
- e. Shree Vijay Wire & Cable Industries

18.0 HDPE PIPES/ DUCT

- a. Climax Synthetics (P) Ltd., Vadodra
- b. Indian Poly Pipes, Calcutta
- c. Jain Irrigation Systems Ltd., Jalgaon
- d. Kirti Industries (India) Ltd., Indore
- e. Ori Plast Limited, Calcutta
- f. Phoel Industries Limited, Delhi
- g. Sangir Plastics (P) Ltd., Mumbai
- h. Veekay Plast, Jaipur
- i. Kisan Irrigation
- j. Dutron Polymers Ltd.

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- k. Manikya Plastichem (P) Ltd
- l. Himalyan Pipe Industries

19.0 DRY GAS FILTER & FILTER SEPERATOR

- a. Grand Prix Fab (Pvt.) Ltd. (New Delhi)
- b. Perry Equipment, USA
- c. Faudi Filter, Germany
- d. Forain S.r.l., Italy
- e. ABB, Faridabad
- f. Burgess Manning, USA
- g. Multitex Filtration Engineers India
- h. Triveni Plenty Engg. Ltd. (New Delhi)
- i. Siirtec International Contractor S.P.A (Italy)
- j. Flashpoint, Pune india
- k. Filtration Engineers (I) Pvt Ltd, India
- l. Gujarat Otofilt, India
- m. Tormene Gas Technology
- n. Ultrafilter (India) Pvt Ltd, India
- o. Ravi Techno Systems Pvt Ltd, India
- p. Siirtec Nigi S.P.A
- q. Filtan Filter Anlagenbau Gmbh
- r. Fairley Arlon BV
- s. PECO Facet
- t. EPE Epenstenner GMBH
- u. Filtrex srl
- v. Petromar Engineered Soln
- w. Plenty Filter
- x. Eurofilttec
- y. PTI Technologies Inc

20.0 FILTER ELEMENT

- a. Peco – Facet
- b. Velcon
- c. Pall – Filterite
- d. Burgress Manning

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

21.0 NDT AGENCY

- a. NDT Services, Ahmedabad
- b. GEECY Industrial Services Pvt. Ltd., Mumbai
- c. Corrosion Control Services, Mumbai
- d. Perfect Metal Testing & Inspection Agency, Calcutta
- e. Inter Ocean Shipping Co., New Delhi
- f. RTD, Mumbai
- g. Sievert, Mumbai
- h. X-Tech, Vizag
- i. JYOTI NDT INSPECTION CO., Delhi
- j. RXSINGH NDT SERVICES (OPC) PRIVATE LIMITE
- k. Aditya NDT Services
- l. SURYA NDT SERVICES.
- m. NDT & Allied Services, Noida
- n. RIYA NDT ENGINEERS, New Delhi
- o. PD Engineering Inspection Services, Noida
- p. TCR Engineering Services Pvt Ltd
- q. Smart NDT
- r. Technical Testing and Inspection Services
- s. Inspection Technology

22.0 FIRE FIGHTING EQUIPMENT

22.1 FIRE EXTINGUISHERS

- a. Avon Services (Production & Agencies) Pvt. Ltd., Bombay
- b. Kooverji Devshi & Co., Bombay
- c. Reliable (Fire Protection) India Ltd., Bombay
- d. Zenith Fire Services, Bombay
- e. Safex Fire Services, Bombay
- f. Brij Basi Hi
- g. tech Udyog
- h. Bharat Engg Works, India
- i. Gunnebo India Ltd
- j. Nitin Fire Protection Industries Ltd, India
- k. Supremex Equipments, India

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- l. Vimal Fire Controls Pvt Ltd., India

22.2 FIRE HYDRANTS, MONITORS, DELUGE VALVE, NOZZLES

- a. Zenith
- b. Minimax
- c. Newage
- d. HD Fire
- e. Vijay Fire
- f. Asco Strumech Pvt Ltd, India
- g. Brij Basi Hi
- h. tech Udyog
- i. Gunnebo India Ltd
- j. Nitin Fire Protection Pvt Ltd
- k. Shah Bhogilal Jethamal & Brothers
- l. Venus Pumps & Engineering Works

22.3 RRL Hose

- a. Jayshree
- b. Newage

22.4 HOSES

- a. Ashit Sales Corporation, Bombay
- b. Royal India Corporation, Bombay
- c. Gayatri Industrial Corporation
- d. Simplex Rubber Products Ltd., Ahmedabad
- e. Zaverchand Marketing Pvt. Ltd., Baroda
- f. Presidency Rubber Mill, Calcutta
- g. The Cosmopolite, Calcutta
- h. Simplex Rubber Products, Thane

NOTE:

- 1) For procuring bought out items from vendors other than those listed above, the same may be acceptable subject to the following: -
 - a) The vendor/ supplier of bought out item(s) is a manufacturer/ supplier of said item(s) for intended services and the sizes being offered is in their regular manufacturing supply range.
 - b) The vendor / supplier should not be in the Holiday list of CLIENT / VCS / other PSU.

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- c) Should have supplied at least one single random length (i.e. 5.5 meters to 6.5 meters) for item assorted pipes / tubes and for other items, which are to be supplied in quantity on number-basis (other than assorted pipes / tubes) minimum 01 (One) number of same or higher in terms of size and rating as required for intended services. The bidder should enclose documentary evidences i.e. PO copies, Inspection Certificate etc. for the above, along with their bids.
- 2) For any other item(s) for which the vendor list is not provided, bidders can supply those item(s) from vendors/ suppliers who have earlier supplied same item(s) for the intended services in earlier projects and the item(s) offered is in their regular manufacturing/ supply range. The bidder is not required to enclose documentary evidences (PO copies, Inspection Certificate etc.) along with their offer, however in case of successful bidder, these documents shall require to be submitted by them within 30 days from date of Placement of Order for approval to CLIENT / VCS.
- 3) The details of vendors indicated in this list are based on the information available with VCS, Contractor shall verify capabilities of each vendor for producing the required quantity with. PMC does not guarantee any responsibility on the performance of the vendor. It is the contractor's responsibility to verify the correct status of vendor and quality control of each parties and also to expedite the material in time.

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

B. CIVIL AND STRUCTURAL

Sr. No.	Items/ Name of Products	Make/ Brands/ Manufactures
1.	Reinforcement Steel	TATA, SAIL, RINL, JSW.
2.	Cement	Ambuja, ACC, JK, Grasim, Ultratech, Birla, L&T, Cement Corporation of India
3.	Structural Steel	TATA, SAIL, RINL, IISCO, ESSAR
4.	Structural Steel Tubes ISI Marked	TATA, JINDAL, SURYA
5.	Mineral wool for thermal insulation of ceilings (Under deck insulation)	Rock wool (india) Ltd. Minwool Rock Fibres Ltd., Lloyd Insulation.
6.	Synthetic Enamel Paint (1st quality only)	ICI Paint (Dulux), Asian Paint (Apolite), Berger Paints (Luxol). Goodlass Nerolac Paints (Nerolac), Jenson & Nicholson Paints Ltd (Borolac)
7.	G.I SHEET	ESSAR, JSW, SAIL
8.	Sheeting Screw	Corroshield, Buildex,
9.	Chemical for Antitermite treatment	DE- NOCIL Bombay, Pest Control of India, Trishul
10.	Factory made Panelled Door shutter	Century; Godrej ; M/s Hindustan Housing factory Ltd., New Delhi ; M/s Delhi Construction Eqp, Sadar Bazar, Delhi ; M/s Joinery manufacturing Co., Calcutta;
11.	PVC Panel Door (Solid Core)	Rajshri Plastiwood Limited, Sintex, Hindopan, Marino
12.	Pressed steel door frames/ cupboard and window frames (manufacturers)	M/s SAIL, M/s TATA
13.	Pressed steel door frames/ cupboard and window frames (fabricators)	M/s Loyal safe works Mayapuri, N/Delhi M/s Multiwyn Industrial Corpn Calcutta M/s Metal Window Corpn N/Delhi M/s Chhabra Steel Udyog, 260 Sadar Bazar, Meerut Cantt. M/s Delite safe works, Rani Jhansi Road, N/Delhi
14.	Steel Windows, Ventilators (as per IS- 1038 of 1983) & frames pressed steel door/window	M/S Multiwyn Industrial Corpn, Calcutta ; M/S Metal Window Corp, N/ Delhi ; M/S Chhabra Steel Udyog 260, Sadar Bazar, Meerut Cantt ; Agent steel MFG Pvt Ltd, Ahmedabad ; Godrej ;
15.	AI Section for AI Door/ Window/ Partitions	Hindalco, Ajit India, Jindal
16.	AluminumI Door/ Window/ Glazing Fabricated and	M/s Alumilite Pvt Ltd, M/s Ajit India Pvt Ltd, M/s Ramniklal S Raste Agra, Argent Industries, M/s Aluminium Tech Industries, I-2249 DSIDC Narela,

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

	Anodized	Delhi, M/s VR Associates, GH-14/242 Paschim Vihar, Delhi
17.	Aluminium door and windows Fittings	M/s Elite Enterprises C/6 Shalimar Hardware 133, Jarg Mahal, Dhobitalao Mumbai 400002. M/s Mohan Metal Industries 178/2-A, Bhole Nath Nagar, Shahadara, Delhi 110032. Mepro, Argent New Delhi, Classic, New Delhi. Jindal, Argent New Delhi, Golden Industries Pvt. Ltd. ECIE
18.	Aluminium Grill	Alu Grill, Arihant Aluminium Corporation, Decogrille
19.	Door Closer	Everite, Golden, Gandhi,
20.	Floor Spring	Prabhat, Everite
21.	Plywood for general purpose (IS-303)	National Plywood Inds Pvt Ltd, S Fancy lane, 8th floor, Calcutta-700001, Merino Plywood, Archid Ply, Ply, Swastik, Universal, Century, Greenply, National.
22.	Pre laminated Particle board	Kitply, Bhutan board, Ecoboard, Novapan, Archid ply, Merinova, Merino
23.	Laminated Sheets	Formica, Merino Lam, Greenlam, National, Century
24.	Modular Partitions	Godrej, Blowplast
25.	False Ceiling (Mineral Fibre Board)	Armstrong, Daiken, Luxalon, Llyods, Gypboard, Trac, Aerolite
26.	Aluminium False Ceiling	Lloyds, Armstrong, Luxlon, Trac
27.	Flooring Tiles (Mosaic / Terrazzo / PCC) (1st quality only)	Kajaria Ceramics, NITCO, Royal Tiles, Gem Tiles, Hindustan Tiles, M/S National Tiles & Industries, Ultra Tiles
28.	Glazed Ceramic Tiles, Non-Skid (Floor/Wall), (1st quality only)	Kajaria, Somany, NITCO. Murudeshwar Ceramic Ltd (Navin Diamond tile), Johnson (Marbonite),
29.	Vitrified/ Designer Vitrified Tiles (1st quality only)	Asian, Marbonite (Johnson), Kerrogres (Kajaria), NITCO, Orient
30.	PVC Tiles/Flooring (IS 3461) (1st quality only)	Marblex Tiles, Krishna Tiles, Polyfin, Armstrong, Wonder floor.
31.	False Flooring	Godrej or equivalent
32.	Glass Mosaic Tiles (1st quality only)	Paladio, Coral, Accura, Bisazza, Italia, Mridul.
33.	Designer Paver Tiles/ Interlocking tiles ISI marked/ Grass-jointed Tiles. (1st quality only)	Pavit, Ultra, Hindustan, Eurocon, Vyara, National Tiles, Gem, Unistone, Konkrete, Unitile
34.	Wall care Putty for Base preparation (1st quality only)	Birla Wall care putty, Berger, Jenson & Nicholson, JK White

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

35.	White Cement (1st quality only)	Birla, JK
36.	Cement based Paints (1st quality only)	Super Snowcem, Duracem, Super Acrocem.
37.	Dry Distemper / Oil bound Distemper (1st quality only)	Goodlass Nerolac Paint, Shalimar Paint, Jenson & Nicholson, Asian Paint, Berger. ICI Dulux
38.	Acrylic Washable Distemper (1st quality only)	Asian, Berger, ICI Dulux, Jenson & Nicholson, Nerolac, Shalimar, Garware & Goodlass
39.	Plastic Emulsion Paint (1st quality only)	Asian, Berger, ICI, Nerolac, Jenson & Nicholson, Shalimar, Garware & Goodlass
40.	Exterior Acrylic Emulsion (1st quality only)	ICI (Weathercoat), Excel (Nerolac), Apex (Asian), Berger, Jenson & Nicholson, Shalimar, Garware & Goodlass
41.	Polymer based Paint	STP, CICO
42.	Textured Paint / Wall Tile (1st quality only)	Unitile, Heritage, Spectrum, Iokos, Acropaints, Asian
43.	Flexible board for Expansion joint	STP or equivalent
44.	Grout	Shrinkomp, Fosroc, Fairmate
45.	Integral water proofing compound	STP, Pidilite, Fosroc, CICO, Sika.
46.	Concrete Admixture	Pidilite, Fosroc, CICO, Sika.
47.	Water proofing for cementations surface IS-2645	Acrocrete & Acrocote, CICO, Fosroc, STP
48.	Bituminous Product	M/s Faridabad Spinning & Woolen Mills Pvt Ltd, 837, SP Mukherjee Marg Delhi, M/s STP Ltd (Formerly Shalimar Tar Products) M/s Bitufelt Pvt Ltd 123/377 Fazalm Ganj Kanpur 208012, Texas, Texas India Ltd, Multiplas
49.	Hardeners	Ironite, Ferrok, Hardonate
50.	Construction Chemicals	Choksey, CICO, Forsroc, Sika
51.	Stainless Steel Cladding	Jindal
52.	Punch Tape Concertina Coil	Global Technocrat, S.G. Engineers Delhi
53.	Stainless Steel Railing	Jindal
54.	FRP/ HDPE Garbage Bins	Sintex, Swift, Nutech, Sheetal
55.	Sanitary ware	Neycer Kermag (standard), Hindustan Sanitary Ware (Ist quality), Parryware (superfine), Cera (Ist quality), Classica (Ist / standard)

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

56.	WC seat cover ISI Marked	Parryware, Neycer Kermag (standard), Hindustan Sanitary Ware (Ist quality), Cera (Ist quality), Classica (Ist / standard)
57.	PVC Flushing Cistern IS: 774-1984 (ISI Certified)	Parryware, Hindustan Sanitary Wares, Cera.
58.	Faucets & Taps, Stop Valves & Pillar Taps, Surgical basin mixer, Shower rose etc.	Gem, Parko, Parryware, HSW, Jaquar
59.	Kitchen Stainless Steel Sink	Diamond, Nirali, Neel Kanth, Jayna
60.	Looking Mirror	Saint Gobain, Modi Float, Triveni Float Glass, Crown, Atul.
61.	Readymade Bathroom Cabinets	Commander Gratings (I) Pvt Ltd, Gratology Cabinet, A- 4 Sector Viii Noida-202701, Alpina, Cera.
62.	Float Valve	Leader, Bombay Metal & Alloy Co, Bombay superflow.
63.	SGSW Pipes (IS-651) ISI Marked	Perfect Agra, Devraj Ind Gaziabad, Buran, RK, Prince,
64.	CI (Centrifugally Cast) Pipes for sewage disposal ISI marked	NICCO, SRIF, A-1 Singhal Casting Co Agra, Jindal Saw, Kesoram, NECO
65.	PVC rain water/sewage pipes (IS-4985)	Reliance, Finolex, Supreme, Kisan, Prince, Hindustan Plastic & machine corporation, Polypack industries (P) Ltd.
66.	HDPE Water storage tanks (Rotational Moulded)	Sintex, Swift, Nutech, Sheetal
67.	Cast Iron Pipes and Fittings	Hindustan Engineering Products Company Calcutta, S.L.C., Standard approved manufacturers of any other brand of fittings having ISI marking, RIF, BIS
68.	RCC Pipes	Indian Hume Pipe Company, Delhi / Allahabad / Chandigarh / Lucknow; Hindustan Pressure Pipes, Kolhapur; Dhere Concrete Products, Pune or any other approved manufacturer conforming B.I.S. Standard
69.	Brass Fittings	Leader Engineering Works, Jalandhar; L & K Mathura; Luster Sanitary, Jalandhar; Annapurna Metal Works, Calcutta; Neta Metal Works, Jalandhar
70.	C.P. Fittings	Ego Metal Works, Ballabgarh; Jaquar Industries, Delhi; Soma Plumbing Fixtures Limited, Calcutta; Gem Sanitary Appliances Pvt. Ltd., Delhi; Essco Sanitations, Delhi.
71.	Stone Ware (Salt-Glazed) Pipes	Hind Ceramics Limited, Orissa; Ceramic Industries Limited, Sambalpur; Shrikamakshi Agencies, Madras; Binary Udyog Pvt. Limited, Howrah; Tirumati Moulds Limited, Nagpur.
72.	Asbestos Cement Pipes and Fittings	Ganga Asbestos Limited, U.P.; Hyderabad Asbestos Cement Products Limited; J.K. Super Pipe Industries, Nanded; Konark Cement and Asbestos Limited, Orissa; Maharashtra Asbestos Limited, Bombay.

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

List of Recommended Vender/Suppliers of Major Bought-Out Items: Unless otherwise specifically mentioned in the Schedule of Items, Contractor has to use materials as listed below, of only these brand names/Company's names, which are mentioned in the RECOMMENDED list for structural items thereon.

Sl. No.	Items/Name of Products	Makes/Brands/Manufactures
1	Structural Steel	SAIL / TATA / RINL / IISCO / ESSAR / ISPAT
2	Structural Steel Tubes ISI Marked	TATA / JINDAL / SURYA / SWASTIK
3	Synthetic Enamel Paint 1st Quality only	ICI Paint (Deluxe), Asian Paint (Apolite), Shalimar Paint (Superlac), Goodlass, Nerolac Paint (Nerolac), Berger Paints

Any materials not fully specified in these specifications and which may be offered for use in the works shall be subject to approval of Engineer, without which it shall not be used anywhere in the construction works.

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

C. ELECTRICAL

LIST OF SUPPLIERS OF MAJOR BOUGHT-OUT ITEMS

1.0 AIR CONDITIONER

- a. O General.
- b. Daikin.
- c. Hitachi.
- d. LG.
- e. Samsung.
- f. Blue star.
- g. Haier.
- h. Voltas.
- i. Videocon.

2.0 BATTERIES (LEAD ACID)

- a. Amco Batteries Ltd.
- b. Exide Industries Ltd.
- c. HBL Power System Ltd.
- d. Amara Raja Batteries Ltd.
- e. Luminous Power Technologies Pvt Ltd.
- f. Su-Kam Power Systems Ltd.
- g. Base Corporation Ltd.
- h. Okaya Power Ltd.
- i. Southern Batteries Pvt Ltd.
- j. True Power International Ltd.
- k. Evolute Solutions Pvt Ltd.
- l. Greenvision Technologies Pvt Ltd.
- m. Artheon Electronics Ltd.

3.0 BATTERIES (NICKEL CADMIUM)

- a. Amco Batteries Ltd.
- b. HBL Power Systems Ltd.
- c. SAFT.

4.0 BATTERY CHARGER/DC-DC CONVERTER

- a. Amara Raja Power System(P)Ltd.

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- b. BCH.
- c. Chhabi Electricals Pvt. Ltd..
- d. Caldyne Automatics Limited.
- e. Dubas.
- f. HBL Nife Power Systems Ltd..
- g. Universal Industries Products.
- h. Universal Instrument Mfg. Co Pvt Ltd.
- i. Hitachi HI-REL Power Electronics P. Ltd
- j. Mass-Tech Controls Pvt Ltd
- k. Dubas Engineering Pvt Ltd
- l. Chloride Power Systems & Solutions Ltd

5.0 CABLE – FIRE ALARM & COMMUNICATION CABLES

- a. Cords Cable Industries Ltd.
- b. CMI.
- c. Delton cables Ltd.
- d. ELKAY Telelinks.
- e. KEI Industries Ltd.
- f. Reliance Engineers Ltd.

6.0 CABLE – HT(XLPE)

- a. Universal Cable Ltd.
- b. KEI Industries Ltd.
- c. Industrial Cables.
- d. NICCO Corporation Ltd.
- e. Uniflex.
- f. Polycab.
- g. Torrent cables Ltd.

7.0 CABLE – LT / MV POWER AND CONTROL

- a. Cords Cable Industries Ltd.
- b. Universal Cable Ltd.
- c. KEI Industries Ltd.
- d. Havells.
- e. Delton.
- f. Elkay Telelinks.

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- g. Evershine Electricals.
- h. Ecko.
- i. Ravin.
- j. Rallison.
- k. Suyog.
- l. Netco.
- m. Uniflex.
- n. Paramount.
- o. Gloster.
- p. Associated cables Pvt Ltd.
- q. CMI.
- r. Gemscab.
- s. Industrial cables.
- t. NICCO.
- u. Polycab.
- v. Torrent.

8.0 CABLE – GLAND

- a. Baliga.
- b. Comet.
- c. Flexpro.
- d. Flameproof.
- e. FCG.
- f. Electro Werke.
- g. Dowels.
- h. CCI.
- i. Sudhir Switchigear
- j. Keyson Techno Equipments,

9.0 CABLE – LUGS & TERMINAL BLOCKS

- a. Dowels.
- b. Jainson.
- c. Sharma Electrical
- d. Punitam
- e. Yamuna Powers

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- f. Rapid Manufacturer
- g. Varun Controls.

10.0 CABLE – TRAY

- a. Ercon Composites.
- b. Yamuna Power & Infrastructure Ltd.
- c. MEM
- d. Bharti
- e. Profab.
- f. Ratan.
- g. Slotco.

11.0 CABLE TERMINATION AND JOINTING KIT

- a. CCI.
- b. Raychem.
- c. M-Seal.

12.0 CEILING/EXHAUST/PEDESTAL FANS & CIRCULATORS

- a. Bajaj Electricals Ltd.
- b. Crompton Greaves Ltd.
- c. Khaitan Electricals Ltd.
- d. Havell's.

13.0 CONTRACTORS – AC POWER

- a. Andrew Yule.
- b. ABB.
- c. BHEL.
- d. C&S.
- e. Havell's.
- f. L&T.
- g. Schneider.
- h. Siemens Ltd.
- i. Telemecanique.

14.0 CONTROL TRANSFORMER

- a. AE.
- b. Indushree.

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- c. Intra Vidyut.
- d. Kalpa Electricals.
- e. Transpower Industries Ltd.
- f. Siemens.

15.0 GAS/DG Set

- a. Sterling and Wilson.
- b. Jackson Limited.
- c. Sudhir Gensets.
- d. Power Engineering (India) Pvt Ltd.
- e. Prasha Technologies Limited.
- f. Kumar Generator house.
- g. Ashok Leyland Ltd.
- h. Powerica Limited.
- i. Supernova Engineers Limited.
- j. Bhaskar Power Products (P) Ltd.
- k. Caterpillar India (P) Ltd.
- l. Cummins India Ltd.
- m. Escorts Ltd.
- n. Greaves Cotton Ltd.
- o. Kirloskar Ltd.
- p. Mahindra & Mahindra Ltd.
- q. Honda.
- r. Perkins.
- s. Eicher.
- t. Tata Motors.
- u. Ashok Leyland.

16.0 EARTHING MATERIALS

- a. Rukmani Electrical & Components Pvt Ltd.
- b. Indiana Grating Pvt Ltd.
- c. Jef Techno Solutions Pvt Ltd.
- d. Flame proof LDB's/ JB,s/Control Station/ switches
- e. FCG
- f. Sudhir

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- g. Prompt Engineering Works
- h. Flame Proof equipments pvt. Ltd.
- i. Baliga Lighting Equipments Pvt. Ltd.
- j. Flexpro Electricals Pvt. Ltd.

17.0 FLAME PROOF LDB'S/ JB'S/CONTROL STATION/ SWITCHES

- a. FCG.
- b. Sudhir switchgears.
- c. Prompt Engineering Works
- d. Flame Proof equipments pvt. Ltd.
- e. Baliga Lighting Equipments Pvt. Ltd.
- f. Flexpro Electricals Pvt. Ltd.
- g. Exprotecta, Beroda.
- h. FFLP Control Gears.
- i. Sterling.

18.0 HIGH MAST

- a. Bajaj Electricals Limited.
- b. Crompton Greaves Limited.
- c. Philips India Limited.
- d. Surya Roshani.

19.0 HIGH VOLTAGE PCC/ MCC PANELS

- a. BHEL.
- b. Control and Switchgear.
- c. Siemens.
- d. Tricolite Electrical Industries.
- e. Schneider.
- f. CGL.
- g. L&T.
- h. ABB.

20.0 INDICATING LAMPS

- a. Alstom Ltd.
- b. BCH.
- c. L&T Ltd.
- d. Siemens Ltd.

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- e. Vaishno Electricals.
- f. Tecknik
- g. ABB

21.0 INDICATING METERS

- a. ABB.
- b. AMCO.
- c. AE.
- d. Alstom Ltd. (EE).
- e. Conzerv/Schneider
- f. Elecon Measurement Pvt. Ltd.
- g. HPL Electric & Power Pvt. Ltd.
- h. MECO Instruments Ltd.
- i. Minilec.
- j. Rishabh Instruments Pvt. Ltd.
- k. Trinity energy system.
- l. Kaycee.
- m. Salzer.

22.0 LIGHTING FIXTURES

- a. GE Lighting Pvt. Ltd.
- b. Bajaj Electricals Ltd.
- c. Crompton Greaves Ltd.
- d. Philips India Ltd.

23.0 LIGHTING FIXTURES – FLAMEPROOF

- a. Bajaj Electricals Ltd.
- b. Baliga Lighting Equipment Pvt. Ltd.
- c. Crompton Greaves Ltd.
- d. CEAG Flameproof Controlgear Pvt. Ltd.
- e. Flexpro Electricals Pvt. Ltd.
- f. Philips India Ltd.
- g. Sudhir Switchgears Pvt. Ltd.
- h. FCG.

24.0 MINIATURE CIRCUIT BREAKERS (MCBS) AND LIGHTING DB

- a. ABB.

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- b. Hagger.
- c. Havell's India Ltd.
- d. Indo Asian Fusegear Ltd.
- e. Legrand.
- f. MDS Switchgear Ltd.
- g. Schneider.
- h. Siemens Ltd..
- i. HPL.
- j. L & T

25.0 MOULDED CASE CIRCUIT BREAKER (MCCBS)

- k. ABB.
- l. Andrew Yule.
- m. Larsen & Toubro.
- n. Schneider.
- o. Siemens.
- p. Control and Switchgear.
- q. Indo Asian,
- r. Hager.
- s. Merlin Gerin.
- t. Havell's India Ltd

26.0 PROTECTION RELAYS – THERMAL

- a. BCH.
- b. L&T Ltd.
- c. Siemens Ltd.
- d. Tele-mechanique & Controls (India) Ltd.

**27.0 LOW/MEDIUM VOLTAGE POWER CONTROL CENTER (PCC)/ MCC/
PDB/ MLDB/ LDB**

- a. ABB.
- b. BCH.
- c. BHEL.
- d. C & S.
- e. Elecmech Switchgear & Instrumentation.
- f. KMG ATOZ.

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- g. L&T.
- h. Pyrotech Electronics Pvt. Ltd.
- i. Risha control Engineers Pvt. Ltd.
- j. UDKAM PROCESS EQUIPMENT INDIA PVT. LTD
- k. Tricolite Electrical Industries.
- l. Unilec Engineers Ltd.
- m. Vidyut Control India Pvt. Ltd.
- n. Control and Schematic.
- o. Zenith Engineering.
- p. Schneider Electric,
- q. AEG,
- r. HAVELL'S,
- s. MDS.
- t. SUPER TECHNICAL INDIA PRIVATE LIMITED
- u. SAS Automation
- v. Active Power Control
- w. Microtech

28.0 PUSH BUTTONS

- a. BCH.
- b. Alstom Ltd.
- c. L&T.
- d. Siemens Ltd.
- e. Tele-Menchanique & Controls (India) Ltd.
- f. Vaishno Electricals.

29.0 SWITCHES-CONTROL

- a. BCH.
- b. Easum Reyrolle Relays & Devices Ltd.
- c. Alstom.
- d. Kaycee Industries Ltd..
- e. L&T.
- f. Siemens Ltd.

30.0 SWITCHES – 5/15A PIANO/ PLATE, SWITCH SOCKET

- a. Anchor Electronics & Electricals Pvt. Ltd.

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- b. Kingal Electricals Pvt. Ltd.
- c. North-West Switchgear Ltd.

31.0 SWITCH SOCKET OUTLETS (INDUSTRIAL)

- a. Alstom Ltd.
- b. Best & Crompton Engineering Ltd.
- c. BCH.
- d. Crompton Greaves Ltd.
- e. Essen Engineering Company Pvt. Ltd.

32.0 SOLAR POWER SYSTEM MODULES

- a. Tata Power Solar Systems Ltd
- b. REIL,
- c. CEIL,.
- d. HBL Power.
- e. Vikram Solar.
- f. Waaree Solar.
- g. Solar Semiconductor.
- h. Sonali.

33.0 SOLAR STREET LIGHTING

- a. Tata BP Solar (I) Ltd.
- b. REIL, Jaipur.
- c. CEIL, Sahibabad.
- d. HBL.

34.0 TERMINALS BLOCKS

- a. Connectwell.
- b. Controls & Switchgear Co. Ltd.
- c. Elmex Controls Pvt. Ltd.
- d. Essen Engineering Co. Pvt. Ltd.

35.0 TRANSFORMERS

- a. ABB.
- b. Andrew Yule.
- c. Areva.
- d. BHEL.

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- e. Bharat Bijlee
- f. Crompton Greaves.
- g. EMCO Ltd..
- h. Intra Vidyut.
- i. Indushree.
- j. Indcoil
- k. Kirloskar.
- l. Skippers Electricals.
- m. Transformers & Rectifiers (I) Ltd.
- n. Voltamp.

36.0 UPS SYSTEM AND INVERTER

- a. DB Power.
- b. Keltron.
- c. Hi-Rel/HITACHI.
- d. Dubas.
- e. Toshiba Corporation.
- f. Fuji Electric Co Ltd.
- g. Emerson.
- h. Synergy System.
- i. Eaton.
- j. Industrial Power Solution
- k. Mark Electricals
- l. Active Power Control
- m. Microtech
- n. Eaton Power Quality India
- o. Innovative Power Solutions

37.0 GI-OCTAGONAL POLE

- a. Bajaj.
- b. Transrail.
- c. Wipro.
- d. K.L. Industries.

38.0 ELECTRICAL MOTORS

- a. Siemens.

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- b. Crompton Greaves.
- c. Kirloskar.
- d. BHEL.
- e. Bharat Bijlee.
- f. Hindustan motors.
- g. Alstom.
- h. Texmo.
- i. GE India.
- j. National Motors.
- k. ABB.

39.0 LIST OF RECOMMENDED MANUFACTURERS FOR HEATER

- a. Escorts Limited, Faridabad, Haryana.
- b. Spherehot / Kanti Lal Chuni Lal & Sons Appliances Pvt Ltd.Surat.
- c. Kerone, Bhayander(E), Thane – 401105.
- d. Excel Heaters, Andheri (West), Mumbai - 400 053, India.
- e. Nirmal Industrial Controls Pvt. Ltd., Mulund(W), Mumbai - 400 080.

40.0 CATHODIC PROTECTION AGENCIES/CONTRACTOR/ VENDERS

- a. Raychem-RPG Private Limited.
- b. CALTECH Engineering Service.
- c. Universal Corrosion Prevention India.
- d. Cathodic Technology Limited.
- e. Cathodic Control Company Pvt. Ltd.
- f. CORRTECH International Pvt Ltd.
- g. MITCORR Cathodic Protection Pvt Ltd.
- h. Underground Pipeline & NDTs Pvt. Ltd.
- i. JG Corrosion Solution.
- j. Mercury Cathodic Protection Service.
- k. UNDTs Corrosion Service.

41.0 PERMANENT REFERENCE CELL

- a. PERMACELL/ HARCO (USA)
- b. CORRTECH (ZULU), INDIA
- c. TINKER RASOR, USA
- d. SILVION, UK

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

42.0 CP CABLES

- a. Brooks Cables.
- b. Nicco Corporation Ltd.
- c. CCI Ltd.
- d. Delton Cables Ltd.
- e. KEI Industries.
- f. Torrent Cables.
- g. Universal cables.
- h. Victor Cables.
- i. Associated Flexible & Wires Pvt Ltd.
- j. Asain Cables (RPG Cables).
- k. Fort Gloster (Gloster Cables Ltd).
- l. Finolex Cable.
- m. Rediant Cables.
- n. NETCO Cables Pvt Ltd.
- o. Havells Ltd.

43.0 CP SACRIFICIAL ANODES

- a. Scientific Metals Engineers Pvt. Ltd., Karaikudi
- b. PSL Holding Pvt. Ltd., Mumbai.
- c. Cathodic Controls, Bangalore.
- d. BHEL, Bhopal.
- e. Nippon Corrosion, Japan.
- f. AFIC, KSA.
- g. Platt Bros. and Company, USA
- h. Wilson Walton International.
- i. Impalloy International.
- j. Corrpro International.
- k. HOCKWAY, UK
- l. NAKABOHTEC, Japan .
- m. Cortech International
- n. Titanor Component

44.0 CP PORTABLE REFERENCE CELL

- a. MC Miller (USA) .

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- b. Borin, USA
- c. Krick
- d. corrtech.

45.0 CP PERMANENT REFERENCE CELL

- a. Borin Manufacturer USA
- b. MC Miller USA
- c. Corrttech
- d. Krick

46.0 CPTR (AC OPERATED)

- a. Canara Electric
- b. (Raychem RPG Ltd)
- c. CATHODIC CONTROL COMPANY PVT LTD.
- d. Raychem RPG Ltd
- e. Kriston Systems

47.0 PIN BRAZING

- a. SAFETRACK, SWEDEN
- b. BAC, UK

48.0 THERMITWELD

- a. ERICO, USA
- b. THERMOWELD, USA
- c. ERICO, EUROPE

49.0 CP SURGE DIVERter/SPARK GAP ARRESTOR (EX-D)

- a. Dhen, OBO
- b. Corrpro system
- c. Sohne

50.0 DIGITAL MULTIMETER

- a. MOTWANE,
- b. Rishabh,
- c. Fluke .

51.0 CTSU

- a. Kriston systems .

52.0 CP SOLID STATE POLARISATION CELL.

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- a. Dairyland
- b. Corrpro systems
- c. Mc Miller
- d. Krik Engineering

53.0 PETROLEUM COKE BREEZE:

- a. Goa Carbon , Goa
- b. India carbon, Durgapur (WB)

54.0 PIN BRAZING

- a. BAC
- b. Safetrack

55.0 CP ANODE (MMO TYPE):

- a. corrttech
- b. Scientific Metal Engineers Karaikudi
- c. Titanor Component Ltd., Goa, India.
- d. Denora Permelic S.P.A (Italy). .
- e. Oronzio De Nora S.A. Ingano Switzerland
- f. CER Anode Technologies International USA
- g. ACTEL, UK
- h. ELTECH System Corporation, Texas
- i. MAGNETO-CHEMIE, Netherlands
- j. MATCOR (USA)

56.0 BACKUP AGENCY FOR DOING CP SURVEY

- a. PLE Germany
- b. Vendor Velde
- c. Nippon Japan
- d. SSS India CIPL / interference survey.
- e. Balslev Denmark, .
- f. SSS Germany

57.0 CP ANODE BACKFILL MATERIAL

- a. Goa Carbon (Goa).
- b. India Carbon (Calcutta),
- c. Petro carbon & Chemical Company (Haldia).

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

58.0 HEAT SHRINK CAP FOR CP ANODE

- a. RAYCHEM
- b. MATCOR (USA) To Cable Joint

59.0 ER- PROBE (EXTERNAL CORROSION)

- a. Rose Corrosion Services UK
- b. Metal Samples, USA. .
- c. Monitoring) Roharbak Cosasco USA
- d. Caproco UK

60.0 ER- PROBE & CORROSION COUPON

- a. Rose Corrosion Services UK
- b. Metal Samples
- c. USA Assembly. .
- d. Roharbak Cosasco, USA
- e. Caproco, UK

61.0 HEAT SHRINK CAP FOR ANODE TO CABLE JOINT

- a. Raychem, USA
- b. Matcor (USA)

62.0 MMO WIRE ANODES (WITH FACTORY PRE-PACKED COKE BREEZE)

- a. Matcor (USA)
- b. Covalence (USA)
- c. Berry Plastics (USA) – (Seal for Life Industries)

63.0 MMO WIRE ANODES (WITHOUT FACTORY PRE-PACKED COKE BREEZE)

- a. GROUPPO DENORA, GOA, INDIA
- b. CERANODE TECHNOLOGIES, USA
- c. TELPRO, USA

64.0 MMO TUBULAR/ STRIP/ RIBBON ANODES

- a. GROUPPO DENORA, GOA, INDIA
- b. ORANZIO DE NORA, ITALY
- c. MAGNETOCHEMIE, HOLLAND
- d. ACTEL LTD., U.K.

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- e. ELTECH SYSTEMS CORPORATION, USA
- f. CERANODE TECHNOLOGIES, USA
- g. MATCOR (USA)

Note: -

For any other brought out item(s) for which the vendor list is not provided in the tender , bidders can supply those item(s) from vendors/ suppliers who have earlier supplied similar item(s) for the intended services in earlier Oil and Gas projects and the item(s) offered is in their regular manufacturing/ supply range.

- 1) The vendor/supplier should not be in the Holiday list of OWNER/ CONSULTANT/other PSU
- 2) The bidder is not required to enclose documentary evidences (PO copies, Inspection & Completion with satisfactory working certificates etc.) along with their offer, however in case of successful bidder, these documents shall required to be submitted by them within 30 days from date of Placement of Order for approval to OWNER / CONSULTANT.

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

D. INSTRUMENTATION

**LIST OF RECOMMENDED VENDER/SUPPLIERS OF MAJOR BOUGHT-
OUT ITEMS**

1.0 PRESSURE GAUGES

- a. AN Instruments Pvt Ltd
- b. Badotherm Process Instruments B.V.
- c. Baumer Bourdon Haenni S.A.S
- d. British Rototherm Co Ltd
- e. Budenberg Gauge Co Ltd
- f. Dresser Inc
- g. Forbes Marshall (Hyd) Pvt Ltd
- h. General Instrument Consortium
- i. H. Guru Instruments (South India) Pvt Ltd
- j. Manometer (India) Pvt Ltd
- k. Nagano Keiki Seisakusho Ltd
- l. Hirlekar Precision, India
- m. Waaree Instruments Ltd
- n. Walchandnagar Industries Ltd (Tiwac Divn)
- o. Wika Alexander Wiegand & Co GmbH
- p. Wika Instruments India Pvt Ltd
- q. Ashcroft India Pvt Ltd.

2.0 TEMPERATURE GAUGES

- a. AN Instruments Pvt Ltd.
- b. Badotherm Process Instruments B.V.
- c. Bourdon Haenni S.A.
- d. Dresser Inc.
- e. General Instruments Consortium
- f. H. Guru Instruments (South India) Pvt Ltd
- g. Nagano Keiki Seisakusho Ltd
- h. Solartron ISA
- i. Walchandnagar Industries Ltd (Tiwac Divn)
- j. Wika Alexander Wiegand & Co GmbH
- k. Wika Instruments India Pvt Ltd

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- l. Pyro Electric, Goa
- m. Ashcroft India Pvt Ltd.

3.0 TEMPERATURE ELEMENTS, THERMO-WELLS

- a. ABB Automation Ltd
- b. Altop Industries Ltd
- c. Bourdon Haenni S.A.
- d. Detriv Instrumentation & Electronics Ltd
- e. General Instruments Consortium
- f. Japan Thermowell Co Ltd
- g. Tecnomatic S.P.A
- h. TempSEN Instrument India Ltd
- i. Thermo Electric Co. Inc.
- j. Thermo-Couple Products Co
- k. Thermo-Electra B.V.
- l. Wika Alexander Wiegand & Co GmbH
- m. Altop Industries Ltd., Baroda
- n. Nagman Sensors (Pvt.) Ltd.
- o. Pyro Electric, Goa

4.0 POSITIVE DISPLACEMENT FLOW METERS

- a. RMG (Germany)
- b. Elster Instromet
- c. Romet
- d. Dresser
- e. Itron
- f. FMG
- g. Common
- h. Metreg
- i. Raychem RPG
- j. Vemmtec

5.0 TURBINE FLOW METER

- a. Daniel
- b. Elster Instromet
- c. Itron

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- d. RMG
- e. Rockwin

6.0 ELECTRONIC VOLUME CORRECTOR

- a. Elgas
- b. Itron
- c. Plum
- d. Pietro Fiorentini

7.0 ORIFICES (METER RUN, FLOW CONDITIONER, ORIFICE PLATE AND ASSEMBLY)

- a. Emerson
- b. FMC, USA
- c. Pietro Fiorentini S.P.A (Italy)
- d. Canalta Controls, Canada

8.0 FIELD INSTRUMENTS (P, DP, F, L, T)

- a. ABB Ltd
- b. Honeywell
- c. Fuji Electric Instruments Co Ltd
- d. Yokogawa
- e. Invensys India Pvt.Ltd

9.0 PRESSURE REGULATOR AND SLAM SHUT VALVE

- a. Pietro Fiorentini S.P.A. (Italy)
- b. Emerson
- c. RMG-Regel Messtechnik (Germany)
- d. Mokveld Valves BV (Netherlands)
- e. Schlumberger (USA)
- f. Gortter Controls B V (Netherlands)
- g. Instromet International NV
- h. Nirmal Industrial Controls Pvt Ltd. (up to 6" size only)
- i. ESME Valves Ltd
- j. Kaye & Macdonald Inc.
- k. Nuovo Pignone S.P.A (Italy) (GE Oil Co.)
- l. Richards Industries (Formerly Treloar)
- m. Samson AG Mess-und Regeltechnik

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- n. Tormene Gas Technology
- o. Dresser Inc, USA (upto 8" size, 300# class only)

10.0 PRESSURE SAFETY VALVES

- a. Keystone Valves (India) Pvt. Ltd.
- b. Larson & Toubro Ltd.
- c. Lesser GmbH & Co KG
- d. Mekaster Engg Ltd..
- e. Tyco Sanmar Ltd. (New Delhi)
- f. Anderson Greenwood Crosby
- g. BHEL (Trichy)
- h. Curtiss Wright Flow Control Corporation
- i. Dresser Inc.
- j. Fukui Seisakusho Co. Ltd
- k. Nakakita Seisakusho Co Ltd
- l. Nuovo Pignone S.P.A (Italy) (GE Oil co)
- m. Parcol S.P.A
- n. Safety Systems UK Ltd
- o. Tai Milano S.P.A
- p. Weir Valves & Controls France
- q. Bliss Anand Pvt Ltd.

11.0 CONTROL PANEL & ACCESSORIES

- a. Keltron Controls Ltd., Kerala
- b. Elechmec Corporation Ltd., Mumbai
- c. Industrial Controls & Appliances Pvt. Ltd.,
- d. Alstom System Ltd., Noida
- e. Emerson Process Management (I) Pvt. Ltd.
- f. ABB Instruments Ltd., New Delhi
- g. Larsen & Toubro Ltd.
- h. Control & Automation, New Delhi
- i. GE Fanuc Systems Pvt. Ltd., New Delhi
- j. Rockwell Automation (I) Ltd., Ghaziabad
- k. Honeywell Automation Ltd.
- l. Rittal

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- m. Pyrotech Elcronics Pvt Ltd.
- n. Positronics Pvt Ltd.
- o. Electronics Corporation of India Ltd.

12.0 JUNCTION BOXES AND CABLES GLANDS

- a. Ex-Protecta
- b. Flameproof Control Gears
- c. Baliga
- d. Flexpro Electricals

13.0 CONTROL AND SIGNAL CABLES

- a. Associated Cables
- b. Brook
- c. Associated Flexibles & Wires (Pvt) Ltd
- d. Universal Cables Ltd, India
- e. Delton Cables Ltd, India
- f. KEI Industries Ltd INDIA
- g. CMI Limited
- h. Cords Cable Industries Ltd, India
- i. Elkay Telelinks (P) Ltd., India
- j. Udey Pyrocables Pvt Ltd, India
- k. Goyolene Fibres (I) Pvt Ltd, India
- l. Netco Cable Industries Pvt Ltd, India
- m. Nicco Corporation Ltd, India
- n. Paramount Communications Ltd, India
- o. Polycab Wires Pvt Ltd, India
- p. Radiant Cables Pvt Ltd, India
- q. Reliance Engineers Ltd., India
- r. Suyog Electricals Ltd, India
- s. Thermo Cables Ltd

14.0 SS FITTINGS, INSTRUMENT VALVES & MANIFOLDS

14.1 FOR CNG WORK:

- a. DK-LOK
- b. Swagelok Co.
- c. Parker

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

14.2 EXCEPT CNG WORK:

- a. Swagelok Co.
- b. Parker
- c. Aura INC.
- d. HOKE
- e. Excelsior Engineering works
- f. Swastik Engineering works India
- g. Comfit and valves pvt ltd
- h. Arya craft and engineering Pvt ltd
- i. DK lok

15.0 SS TUBES

15.1 FOR CNG WORK:

- a. Swagelok Co.
- b. Parker
- c. Sandvik

15.2 EXCEPT CNG WORK:

- a. Swagelok Co.
- b. Parker
- c. Sandvik
- d. Heavy metal and tube limited
- e. Nuclear fuel complex India
- f. Scorodite
- g. Ratnamani Metals and Tubes
- h. Jindal Saw

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

E. SHOP & FIELD PAINTING

LIST OF RECOMMENDED VENDER/SUPPLIERS OF MAJOR BOUGHT-OUT ITEMS

1.0 INDIAN VENDORS

- a. Asian Paints (I) Ltd.
- b. Berger Paints Ltd.
- c. Goodlass Nerlolac Paints Ltd.
- d. Jenson And Nicholson Paint Ltd & chokuGu Jenson & Nicholson Ltd.
- e. Shalimar Paints Ltd.
- f. Sigma Coating, Mumabai
- g. CDC Carboline Ltd.
- h. Premier Products Ltd.
- i. Coromandel Paints & Chemicals Ltd.
- j. Anupam Enterprises
- k. Grand Polycoats
- l. Bombay Paints Ltd.
- m. Vanaprabha Esters & Glycer, Mumbai
- n. Sunil Paints and Varnishes Pvt. Ltd.
- o. Courtaulds Coating & Sealants India (Pvt.) Ltd.
- p. Mark-chem Incorporated, Mumbai (for phosphating chemicals only)
- q. VCM Polyurethane Paint (for polyurethane Paint only)

2.0 FOREIGN VENDORS FOR OVERSEAS PRODUCTS

- a. Sigma Coating, Singapore
- b. Ameron, USA
- c. Kansai Paint, Japan
- d. Hempel Paint, USA
- e. Valspar Corporation, USA
- f. Courtaulds Coating, UK.

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

Notes:

1. Bidder can select equipment of two different makes, selected from this VENDOR LIST and mention the same in the checklist for technical evaluation attached with the tender. The offered bid must include filled datasheet indicating make, model, size, rating of offered instrument/ equipment duly supported by sizing calculation of offered equipment (wherever applicable).
2. Vendors who have already supplied above equipment in other terminals of client, shall also be considered qualified for this tender provided the supplied equipment are commissioned and running successfully and they have not been put on holiday.
3. Equipment / Instruments of any make which is offered by one bidder and acceptable to client shall be accepted for other bidder also. After placement of order, on request of the successful bidder list of other qualified makes for a particular item (for which successful bidder wants to change the vendor) shall be provided.
4. Bidder shall take prior approval of the make / model no of the offered item and it shall be from the list given above. However additional vendors will be considered in exceptional cases, provided they have supplied for similar application to reputed gas transmission/distribution companies, in quantities at least half the numbers being supplied for this tender, and working satisfactorily for minimum 6 months. Documentary evidence substantiating above shall be submitted for taking approval.

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

F. LIST OF RECOMMENDED TPIA

1. Tata Projects Ltd.
2. Bax counsel Inspection Bureau Pvt. Ltd.
3. Germanischer Lloyd
4. ABS Industrial Verification Ltd., Mumbai
5. Certification Engineers International Ltd.
6. Dalal Mott MacDonald
7. International Certification Systems
8. SGS India Pvt. Ltd
9. Intertek Moody
10. TUV SUD South Asia
11. TUV Rheinland (India) Pvt. Ltd.
12. Vincott International India Assessment Service Pvt. Ltd.
13. Meenar Global Consultants
14. TUV Nord Group
15. DET NORSE VERITAS (DNV)
16. LLOYD Register

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

G. FOR PE & LMC WORK (GI/CU)

1.0 MDPE FITTINGS & MDPE VALVES

- a. Aliaxis,
- b. George Fischer,
- c. Al-Aziz,
- d. Kimplas,
- e. Banides,
- f. Agru,
- g. Friatech,
- h. Plasson

2.0 GI PIPE

- a. Swastik Pipe Ltd.
- b. Jindal Industries Ltd.
- c. Vishal Pipes Ltd.
- d. Indus Tubes Ltd
- e. Advance steel Tubes Ltd.
- f. Good Luck Tubes Ltd.
- g. Surya Roshni Limited
- h. APL Apollo Tubes Limited
- i. Jindal Pipes Limited
- j. RK Steel Manufacturing Company Private Limited

3.0 CASTING GI FITTINGS

- a. Sarin Industries Ltd.
- b. Jupiter Metal Industries Ltd.
- c. Jainsons Industries Ltd.
- d. Jinan Meide Casting Co. Ltd.
- e. Green Malleable Pvt. Ltd.

4.0 FORGED GI FITTING (FOR HIGH RISE SEGMENT)

- a. Jainsons Industries
- b. B.M. Meters Pvt. Ltd.

5.0 COPPER TUBES & FITTINGS

- a. Jay Banas Mehta Tubes Limited- Trade Mark "MEXFLOW"

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

- b. Rajco metal (Tubes & Fittings)
- c. Paras Industries
- d. MERCURE METAL & ALLOYS PVT LTD

6.0 BRASS FITTINGS

- a. Chandan Enterprises
- b. Paras Industries Ltd.

7.0 BRASS VALVES

- a. Universal srl, Italy
- b. Tiemme Raccorderie Sede, Italy
- c. Enolgas Bonimu s.a.s., Italy
- d. Fratelli Fortis s.r.l, Italy
- e. Giacomo Climbrio, Italy
- f. Parker Hannifin S.P.A., USA
- g. Singapore Valve & Amp; Fittings Pte Limited, Singapore /Bengaluru
- h. Rubinetterie Utensilerie Bonomi (RUB), Italy
- i. Zhegiang Valogin Technology Co. Ltd., China,
- j. Ningbo Zhiqing Industrial Co. Ltd., China,
- k. Zhegiang Dunan Valve Co. Ltd.,
- l. Ningbo Huaping, China.

8.0 BRASS FITTINGS

- a. Chandan Enterprises
- b. Paras Industries Ltd.
- c. Chokhawala Distributors – Brass Adaptor.

9.0 STEEL RE-INFORCED RUBBER HOSE (TYPE-4)

- a. Super Seal Flexible Hose Ltd.
- b. Suraksha Products Pvt. Ltd.
- c. Vansh Industries
- d. T & L Gases

10.0 CORRUGATED FLEXIBLE METAL HOSES (ANACONDA)

- a. KPC Flex Tubes
- b. Vestas Hose Division
- c. Alpha Flexi Tubes

**LIST OF RECOMMENDED VENDORS FOR
BOUGHT OUT ITEMS & TPIA**

d. Chandan Enterprises

Note:

1. Vendor may procure material from any of approved vendors listed.
2. For equipment/components other than the above, vendor shall submit past track record for the proposed sub-vendors and obtain written approval from Owner / Consultant before placing order.
3. In case of exigencies like long delivery periods from approved vendors, the contractor shall list down the proposed suppliers/vendors for such items and submit the same for owner review/approval along with necessary documents/PTR.
4. Non-acceptance of a particular proposed vendor due to any reasons whatsoever shall not be a cause of schedule and cost implication. If equipment is sourced from outside India, vendor shall obtain prior approval for make of equipment before placement of order.

Above mentioned vendor list is tentative and further addition/deletion may be done as per discretion of Owner.