BHAGYANAGAR GAS LIMITED

(A JOINT VENTURE OF HPCL & GAIL)

Civil and Architectural Works for development and construction of CNG Mother Stations in Hyderabad GA

UNDER OPEN DOMESTIC COMPETITIVE BIDDING

Volume II of II

Bid Document No.:
BGL/780/2026-27

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GENERAL TERMS & CONDITIONS OF WORKS CONTRACT

1 PRELIMINARY

1.1 This is a Contract for execution of job as defined in tender document at the specified location

1.2 The tenderer for the abovementioned item of work is the company/ proprietary concern/ individual (as per details & address mentioned in the unpriced bid) and undersigned (digitally) is authorized to submit the bid on behalf of tenderer.

1.3 The terms and conditions mentioned hereunder are the terms and conditions of the Contract for the execution of the work mentioned under item 1.1 above.

1.4 It is the clear understanding between BHAGYANAGAR GAS LIMITED and the tenderer that in case the bid of tenderer is accepted by BHAGYANAGAR GAS LIMITED and an intimation to that effect is so issued and also a Procurement Order is on the tenderer this document shall form part of the Contract between the parties and terms and conditions hereunder would govern the parties interest.

1.5 Interpretation of Contract Documents: All documents forming part of the Contract are to be taken mutually explanatory. Should there be any discrepancy, inconsistency, error or omission in the contract, the decision of the Owner/Engineer- in-Charge/Site-in-Charge shall be the final and the contractor shall abide by the decision. The decision shall not be arbitrable. Works shown upon the drawings but not mentioned in the specification or described in the specifications without being shown on the drawings shall nevertheless be deemed to be included in the same manner as if they are shown in the drawings and described in the specifications.

1.6 Special conditions of Contract : The special conditions of contract, if any provided and whenever and wherever referred to shall be read in conjunction with General Terms and Conditions of contract, specifications, drawings, and any other documents forming part of this contract wherever the context so requires. Notwithstanding the subdivision of the documents into separate sections, parts volumes, every section, part or volume shall be deemed to be supplementary or complementary to each other and shall be read in whole. In case of any misunderstanding arising the same shall be referred to decision of the Owner/ Engineer- in-Charge/Site-in-Charge and their decision shall be final and binding and the decision shall not be arbitrable.

It is the clear understanding that wherever it is mentioned that the Contractor shall do/perform a work and/or provide facilities for the performance of the work, the doing or the performance or the providing of the facilities is at the cost and expenses of the Contractor not liable to be paid or reimbursed by the Owner.

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1.7 The Order of Precedence of documents shall be as follows with document at level 1 having the highest precedence

1. Contract Agreement
2. Detailed Letter of Acceptance along with its enclosures
3. Letter of Award / Fax of Acceptance
4. Job Specifications (specific to particular job only)
5. Drawings
6. Special Conditions of Contract
7. Technical Specifications
8. Instructions to Bidders
9. General Conditions of Contract
10. Other Documents

Any amendment / change order issued after signing of formal contract shall take precedence over respective clauses of the formal contract and its annexures

2. DEFINITIONS

In this contract unless otherwise specifically provided or defined and unless a contrary intention appears from the contract the following words and expressions are used in the following meanings;

2.1 The term "Agreement" wherever appearing in this document shall be read as "Contract".

2.2 The "competent Authority" for the purpose of this Contract shall be the **Managing Director** or any other person so appointed or authorised.

2.3 The "**Managing Director**" shall mean the Chairman and Managing Director of BHAGYANAGAR GAS LIMITED or any person so appointed, nominated or designated and holding the office of Chairman & Managing Director.

2.4 The "**Change Order**" means an order given in writing by the Engineer-in-Charge or by Owner to effect additions to or deletion from or alterations into the Work.

2.5 The "**Construction Equipment**" means all appliances and equipment of whatsoever nature for the use in or for the execution, completion, operation or maintenance of the work except those intended to form part of the Permanent Work.

2.6 The "**Contract**" between the Owner and the Contractor shall mean and include all documents like enquiry, tender submitted by the contractor and the procurement order issued by the owner and other documents connected with the issue of the procurement order and orders, instruction, drawings, change orders, directions issued by the Owner/Engineer-in-Charge/Site-in-Charge for the execution, completion and commissioning of the works and the period of contract mentioned in the Contract including such periods of time extensions as may be granted by the owner at the request of the contractor and such period of time for which the work is continued by the contractor for purposes of completion of the work.

2.7 "**The Contractor**" means the person or the persons, firm or Company whose tender has been accepted by the Owner and includes the Contractor's legal heirs, representative, successor(s) and permitted assignees.

2.8 The "**Drawings**" shall include maps, plans and tracings or prints thereof with any modifications approved in writing by the Engineer-in-Charge and such other drawings as may, from time to time, be furnished or approved in writing by the Engineer-in-Charge.

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2.9 The "**Engineer-in-Charge or Site-in-Charge**" shall mean the person appointed or designated as such by the Owner and shall include those who are expressly authorised by the owner to act for and on its behalf.

2.10 "**The Owner**" means the **Bhagyanagar Gas Limited(BGL)** incorporated in India having its Registered office at **Basheerbagh, Hyderabad, Telangana** and Marketing office at the address mentioned for this purpose in the tender header or their successors or assignees.

2.11 The "**Permanent Work**" means and includes works which form a part of the work to be handed over to the Owner by the Contractor on completion of the contract.

2.12 The "**Project Manager**" shall mean the Project Manager of **BGL/ PMC**, or any person so appointed, nominated or designated.

2.13 The "**Site**" means the land on which the work is to be executed or carried out and such other place(s) for purpose of performing the Contract.

2.14 The "**Specifications**" shall mean the various technical and other specifications attached and referred to in the tender documents. It shall also include the latest editions, including all addenda/corrigenda or relevant Indian Standard Specifications and Bureau Of Indian Standards.

2.15 The "Sub-Contractor" means any person or firm or Company (other than the Contractor) to whom any part of the work has been entrusted by the Contractor with the prior written consent of the Owner/Engineer-in-Charge/Site-in- Charge and their legal heirs, representatives, successors and permitted assignees of such person, firm or Company.

2.16 The "Temporary Work" means and includes all such works which are a part of the contract for execution of the permanent work but does not form part of the permanent work confirming to practices, procedures applicable rules and regulations relevant in that behalf.

2.17 The "Tender" means the document submitted by a person or authority for carrying out the work and the Tenderer means a person or authority who submits the tender offering to carry out the work as per the terms and conditions.

2.18 The "Work" shall mean the works to be executed in accordance with the Contract or part thereof as the case may be and shall include extra, additional, altered or substituted works as maybe required for the purposes of completion of the work contemplated under the Contract.

3. SUBMISSION OF TENDER

3.1 Before submitting the Tender, the Tenderer shall at their own cost and expenses visit the site, examine and satisfy as to the nature of the existing roads, means of communications, the character of the soil, state of land and of the excavations, the correct dimensions of the work facilities for procuring various construction and other material and their availability, and shall obtain information on all matters and conditions as they may feel necessary for the execution of the works as intended by the Owners and shall also satisfy of the availability of suitable water for construction of civil works and for drinking purpose and power required for fabrication work etc. Tenderer, whose tender may be accepted and with whom the Contract is entered into shall not be eligible and be able to make any claim on any of the said counts in what so ever manner for what so ever reasons at any point of time and such a claim shall not be raised as a dispute and shall not be arbitrable.

A pre-bid meeting may be held as per the schedule mentioned in the tender.

3.2 The Tenderer shall be deemed to have satisfied fully before tendering as to the correctness and

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sufficiency of his tender for the works and of the rates and prices quoted in the schedule of quantities which rates and prices shall except as otherwise provided cover all his obligations under the contract.

3.3 It must be clearly understood that the whole of the conditions and specifications are intended to be strictly enforced and that no work will be considered as extra work and allowed and paid for unless they are clearly outside the scope, spirit, meaning of the Contract and intent of the Owner and have been so ordered in writing by Owner and/or Engineer-in-Charge/Site-in-Charge, whose decision shall be final and binding.

3.4 Before filling the Tender the Contractor will check and satisfy all drawings and materials to be procured and the schedule of quantities by obtaining clarification from the Owner on all the items as may be desired by the Tenderer. No claim for any alleged loss or compensation will be entertained on this account, after submission of Tender by the Tenderer/Contractor and such a claim shall not be arbitrable.

3.5 Unless specifically provided for in the tender documents or any Special Conditions, no escalation in the Tender rates or prices quoted will be permitted throughout the period of contract or the period of actual completion of the job whichever is later on account of any variation in prices of materials or cost of labour or due to any other reasons. Claims on account of escalation shall not be arbitrable.

3.6 The quantities indicated in the Tender are approximate. The approved schedule of rates of the contract will be applicable for variations upto plus or minus 25% of the contract value. No revision of schedule of rates will be permitted for such variations in the contract value, including variations of individual quantities, addition of new items, alterations, additions/deletions or substitutions of items, as mentioned above. Quantities etc. mentioned and accepted in the joint measurement sheets shall alone be final and binding on the parties.

3.7 Owner reserve their right to award the contract to any tenderer and their decision in this regard shall be final. They also reserve their right to reject any or all tenders received. No disputes could be raised by any tenderer(s) whose tender has been rejected.

3.8 The Rates quoted by the Tenderer shall include Costs and expenses on all counts viz. cost of materials, transportation of machine(s), tools, equipments, labour, power, Administration charges, price escalations, profits, etc. except to the extent of the cost of material(s), if any, agreed to be supplied by Owner and mentioned specifically in that regard in condition of Contract, in which case, the cost of such material if taken for preparation of the Contractor's Bill(s) shall be deducted before making payment of the Bill(s) of the Contractor. The description given in the schedule of quantities shall unless otherwise stated be held to include wastage on materials, carriage and cartage, carrying in and return of empties, hoisting, setting, fitting and fixing in position and all other expenses necessary in and for the full and complete execution and completion of works and in accordance with good practice and recognised principles in that regard.

3.9 Employees of the State and Central Govt. and employees of the Public Sector Undertakings, including retired employees are covered under their respective service conditions/rules in regard to their submitting the tender. All such persons should ensure compliance to the respective/applicable conditions, rules etc. Any person not complying with those rules etc. but submitting the tender in violation of such rules, after being so noticed shall be liable for the forfeiture of the Earnest Money Deposit made with the tender, termination of Contract and sufferance on account of forfeiture of Security Deposit and sufferance of damages arising as a result of termination of Contract.

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3.10 In consideration for having a chance to be considered for entering into a contract with the Owner, the Tenderer agrees that the Tender submitted by him shall remain valid for the period prescribed in the tender conditions, from the date of opening of the tender. The Tenderer shall not be entitled during the said validity period, to revoke or cancel the tender without the consent in writing from the Owner.

In case the tenderer revokes or cancels the tender or varies any of terms of the tender without the Consent of the Owner, in writing, the Tenderer forfeits the right to the refund of the Earnest Money paid along with the tender.

3.11 The prices quoted by the Tenderer shall be firm during the validity period of the bid and Tenderer agrees to keep the bid alive and valid during the said period. The Tenderers shall particularly take note of this factor before submitting their tender(s).

3.12 The works shall be carried out strictly as per approved specifications. Deviations, if any, shall have to be authorised by the Engineer-in-Charge/Site-in-Charge in writing prior to implementing deviations. The price benefit, if any, arising out of the accepted deviation shall be passed on to the Owner. The decision of Engineer- in-Charge shall be final in this matter.

3.13 The contractor shall make all arrangements at his own cost to transport the required materials outside and inside the working places and leaving the premises in a neat and tidy condition after completion of the job to the satisfaction of Owner. All materials except those agreed to be supplied by the Owner shall be supplied by the contractor at his own cost and the rates quoted by the Contractor should be inclusive of all royalties, rents, taxes, duties, statutory levies, if any, etc.

3.14 The Contractor shall not carry on any work other than the work under this Contract within the Owner's premises without prior permission in writing from the Engineer- in- Charge/Site-in-charge.

3.15 The Contractor shall be bound to follow and ensure compliance to all the safety and security regulations and other statutory rules applicable to the area. In the event of any damage or loss or sufference caused due to non-observance of such rules and regulations, the contractor shall be solely responsible for the same and shall keep the Owner indemnified against all such losses and claims arising from the same.

3.16 At any time after acceptance of tender, the Owner reserves the right to add, amend or delete any work item, the bill of quantities at a later date or reduce the scope of work in the overall interest of the work by prior discussion and intimation to the Contractor. The decision of Owner, with reasons recorded therefor, shall be final and binding on both the Owner and the Contractor. The Contractor shall not have right to claim compensation or damage etc. in that regard. The Owner reserves the right to split the work under this contract between two or more contractors without assigning any reasons.

3.17 Contractor shall not be entitled to sublet, sub contract or assign, the work under this Contract without the prior consent of the Owner obtained in writing.

3.18 All signatures in tender document shall be dated as well as all the pages of all sections of the tender documents shall be initialed at the lower position and signed, wherever required in the tender papers by the Tenderer or by a person holding Power of Attorney authorising him to sign on behalf of the tenderer before submission of tender.

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3.19 The tender should be quoted in English, both in figures as well as in words. The rates and amounts tendered by the Tenderer in the Schedule of rates for each item and in such a way that insertion is not possible. The total tendered amount should also be indicated both in figures and words with the signature of tenderer.

If some discrepancies are found between the rates given in words and figures of the amount shown in the tender, the following procedure shall be applied :

(a) When there is a difference between the rates in figures and words, the rate which corresponds to the amount worked out by the tenderer shall be taken as correct.

(b) When the rate quoted by the tenderer in figures and words tallies but the amount is incorrect, the rate quoted by the tenderer shall be taken as correct.

(c) When it is not possible to ascertain the correct rate in the manner prescribed above the rate as quoted in words shall be adopted.

3.20 All corrections and alterations in the entries of tender paper will be signed in full by the tenderer with date. No erasures or over writings are permissible.

3.21 Transfer of tender document by one intending tenderer to the another one is not permissible. The tenderer on whose name the tender has been sent only can quote.

3.22 The Tender submitted by a tenderer if found to be incomplete in any or all manner is liable to be rejected. The decision of the Owner in this regard is final and binding.

DEPOSITS

a) **SECURITY DEPOSIT:**

The tenderer, with whom the contract is decided to be entered into and intimation is so given will have to make a security deposit of two percent (5%) of the total contract value in the form of account payee crossed demand draft drawn in favour of the Owner, within 30 days from the date of intimation of acceptance of their tender, failing which the Owner reserves the right to cancel the Contract and forfeit the EMD.

Demand Draft should be drawn on Scheduled Banks (other than cooperative banks). Composite Performance Bank Guarantee (CPBG) valid upto a period of 3 months beyond the expiry of defect liability period. Demand Draft should be drawn on Scheduled Banks, other than co-operative bank.

All the works shall be executed in strict conformity with the provisions of the contract documents and with such explanatory details, drawings, specifications and instructions as may be furnished from time to time to the Contractor by the Engineer-in-Charge/ Site- in-Charge, whether mentioned in the Contract or not. The Contractor shall be responsible for ensuring that works throughout are executed in the most proper and workman- like manner with the quality of material and workmanship in strict accordance with the specifications and to the entire satisfaction of the Engineer-in- Charge/Site-in-Charge.

The completion of work may entail working in monsoon also. The contractor must maintain the necessary work force as may be required during monsoon and plan to execute the job in such a way the entire project is completed within the contracted time schedule. No extra charges shall be payable for such work during monsoon. It shall be the responsibility of the contractor to keep the construction work site free from water during and off the monsoon period at his own cost and expenses.

For working on Sundays/Holidays, the contractor shall obtain the necessary permission from Engineer Incharge/Site Incharge in advance. The contractor shall be permitted to work beyond the

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normal hours with prior approval of Engineer-In-Charge/Site-In-Charge and the contractors quoted rate is inclusive of all such extended hours of working and no extra amount shall be payable by the owner on this account.

5.a. SETTING OUT OF WORKS AND SITE INSTRUCTIONS

5.a.1. The Engineer-in-Charge/Site-in-Charge shall furnish the Contractor with only the four corners of the work site and a level bench mark and the Contractor shall set out the works and shall provide an efficient staff for the purpose and shall be solely responsible for the accuracy of such setting out.

5.a.2. The Contractor shall provide, fix and be responsible for the maintenance of all necessary stakes, templates, level marks, profiles and other similar things and shall take all necessary precautions to prevent their removal or disturbance and shall be responsible for consequences of such removal or disturbance should the same take place and for their efficient and timely reinstatement. The Contractor shall also be responsible for the maintenance of all existing survey marks, either existing or supplied and fixed by the Contractor. The work shall be set out to the satisfaction of the Engineer-in-Charge/Site-in-Charge. The approval thereof or joining in setting out the work shall not relieve the Contractor of his responsibility.

5.a.3. Before beginning the works, the Contractor shall, at his own cost, provide all necessary reference and level posts, pegs, bamboos, flags ranging rods, strings and other materials for proper layout of the work in accordance with the scheme, for bearing marks acceptable to the Engineer-in-Charge/Site-in- Charge. The Centre longitudinal or face lines and cross lines shall be marked by means of small masonary pillars. Each pillar shall have distinct marks at the centre to enable theodolite to be set over it. No work shall be started until all these points are checked and approved by the Engineer-in-Charge/Site-in- Charge in writing. But such approval shall not relieve the contractor of any of his responsibilities. The Contractor shall also provide all labour, materials and other facilities, as necessary, for the proper checking of layout and inspection of the points during construction.

5.a.4. Pillars bearing geodetic marks located at the sites of units of works under construction should be protected and fenced by the Contractor.

5.a.5. On completion of works, the contractor shall submit the geodetic documents according to which the work was carried out.

5.a.6. The Engineer-in-Charge/Site-in-Charge shall communicate or confirm his instructions to the contractor in respect of the executions of work in a "work site order book" maintained in the office having duplicate sheet and the authorised representative of the contractor shall confirm receipt of such instructions by signing the relevant entries in the book.

5.a.7. All instructions issued by the Engineer-in-Charge/Site-in-Charge shall be in writing. The Contractor shall be liable to carry out the instructions without fail.

5.a.8. If the Contractor after receipt of written instruction from the Engineer-in-Charge/ Site-in-Charge requiring compliance within seven days fails to comply with such drawings or 'instructions' or both as the Engineer-in-Charge/Site-in-Charge may issue, owner may employ and pay other persons to execute any such work whatsoever that may be necessary to give effect to such drawings or `instructions' and all cost and expenses incurred in connection therewith as certified by

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the Engineer-in-Charge/ Site-in-Charge shall be borne by the contractor or may be deducted from amounts due or that may become due to the contractor under the contract or may be recovered as a debt.

5.a.9. The Contractor shall be entirely and exclusively responsible for the horizontal and vertical alignment, the levels and correctness of every part of the work and shall rectify effectually any errors or imperfections therein. Such rectifications shall be carried out by the Contractor, at his own cost.

5.a.10. In case any doubts arise in the mind of the Contractor in regard to any expressions, interpretations, statements, calculations of quantities, supply of material rates, etc. the contractor shall refer the same to the Site-in-Charge/ Engineer-in-Charge for his clarification, instructions, guidance or clearing of doubts. The decision of the Engineer-in-Charge/Site-in-Charge shall be final and the contractor shall be bound by such a decision.

5.a.11. "The Contractor shall take adequate precautions, to ensure that his operations do not create nuisance or misuse of the work space that shall cause unnecessary disturbance or inconvenience to others at the work site".

5.a.12. "All fossils, coins articles of value of antiquity and structure or other remains of geological or archaeological discovered on the site of works shall be declared to be the property of the Owner and Contractor shall take reasonable precautions to prevent his workmen or any other persons from removing or damaging any such articles or thing and shall immediately inform the Owner/ Engineer-in-Charge/Site-in-Charge."

5.a.13. "Contractor will be entirely and exclusively responsible to provide and maintain at his expenses all lights, guards, fencing, etc. when and where even necessary or/as required by the Engineer-in-Charge/Site-in-Charge for the protection of works or safety and convenience to all the members employed at the site or general public."

5.b. COMMENCEMENT OF WORK

The contractor shall after paying the requisite security deposit, commence work within 15 days from the date of receipt of the intimation of intent from the EIC/ Owner informing that the contract is being awarded. The date of intimation shall be the date/day for counting the starting day/date and the ending day/date will be accordingly calculated. Penalty, if any, for the delay in execution shall be calculated accordingly.

Contractor should prepare detailed fortnightly construction programme for approval by the Engineer-in-Charge within one month of receipt of Letter Of Intent. The work shall be executed strictly as per such time schedule. The period of Contract includes the time required for testing, rectifications, if any, re-testing and completion of work in all respects to the entire satisfaction of the Engineer-in-Charge.

A Letter of Intent is an acceptance of offer by the Owner and it need not be accepted by the contractor. But the contractor should acknowledge a receipt of the purchase order within 07 days of mailing of Purchase Order and any delay in acknowledging the receipt will be a breach of contract and compensation for the loss caused by such breach will be recovered by the Owner by forfeiting earnest money deposit/bid bond.

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5.c. SUBLETTING OF WORK

5.c.1. No part of the contract nor any share or interest thereof shall in any manner or degree be transferred, assigned or sublet, by the Contractor, directly or indirectly to any firm or corporation whatsoever, without the prior consent in writing of the Owner.

5.c.2. At the commencement of every month the Contractor shall furnish to the Engineer-in-charge/Site-in-Charge list of all sub-contractors or other persons or firms engaged by the Contractor.

5.c.3 The contract agreement will specify major items of supply or services for which the Contractor proposes to engage sub-Contractor/sub-Vendor. The contractor may from time to time propose any addition or deletion from any such list and will submit the proposals in this regard to the Engineer-in-charge/Designated officer-in-charge for approval well in advance so as not to impede the progress of work. Such approval of the Engineer-in-charge/Designated officer-in-charge will not relieve the contractor from any of his obligations, duties and responsibilities under the contract.

5.c.4. Notwithstanding any sub-letting with such approval as resaid and notwithstanding that the Engineer-in-Charge shall have received copies of any sub-contract, the Contractor shall be and shall remain solely to be responsible for the quality and proper and expeditious execution of the works and the performance of all the conditions of the contract in all respects as if such subletting or sub-contracting had not taken place and as if such work had been done directly by the Contractor.

5.c.5 Prior approval in writing of the Owner shall be obtained before any change is made in the constitution of the contractor/Contracting agency otherwise contract shall be deemed to have been allotted in contravention of clause entitled “sub-letting of works” and the same action may be taken and the same consequence shall ensue as provided in the clause of “sub- letting of works”.

5.d EXTENSION OF TIME

1) If the Contractor anticipates that he will not be able to complete the work within the contractual delivery/ completion date (CDD), then the Contractor shall make a request for

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grant of time extension clearly specifying the reasons for which he seeks extension of time and demonstrating as to how these reasons were beyond the control of the contractor or attributable to the Owner. This request should be made well before the expiry of the Contractual Delivery/ Completion Date (CDD).

2) The concerned CGM of the Owner shall expeditiously decide upon the request for time extension and decide the levy of price reduction within a maximum period of 6 months from the CDD or date of receipt of the request, whichever is earlier.

3) Grant of any extension of time shall be by means of issuance of a Change Order.

4) In order to avoid any cash crunch to the Contractor, a Bank Guarantee could be accepted against Price Reduction, as stated above. Once a decision is taken, the Price Reduction shall be recovered from any pending bills or by encashment of the BG. Any balance sum of Contractor or the BG (if Price Reduction is fully recovered from the bills) shall be promptly refunded/returned to the Contractor.

5.e. SUSPENSION OF WORKS

5.e.1. Subject to the provisions of this contract, the contractor shall if ordered in writing by the Engineer- in-Charge/Site-in-Charge for reasons recorded suspend the works or any part thereof for such period and such time so ordered and shall not, after receiving such, proceed with the work therein ordered to suspended until he shall have received a written order to re-start. The Contractor shall be entitled to claim extension of time for that period of time the work was ordered to be suspended. Neither the Owner nor the Contractor shall be entitled to claim compensation or damages on account of such an extension of time.

5.e.2. In case of suspension of entire work, ordered in writing by Engineer-in- Charge/Site-in-Charge, for a period of 30 days, the Owner shall have the option to terminate the Contract as provided under the clause fortermination. The Contractor shall not be at liberty to remove from the site of the works any plant or materials belonging to him and the Employer shall have lien upon all such plant and materials.

5.e.3. The contractor shall, in case of suspension have the right to raise a dispute and have the same arbitrated but however, shall not have the right to have the work stopped from further progress and completion either by the owner or through other contractor appointed by the owner.

5.f. OWNER MAY DO PART OF WORK

Not withstanding anything contained elsewhere in this contract, the owner upon failure of the Contractor to comply with any instructions given in accordance with the provisions of this contract, may instead of Contract and undertaking charge of entire work, place additional labour force, tools, equipment and materials on such parts of the work, as the Owner may decide or engage another Contractor to carryout the balance of work. In such cases, the Owner shall have the right to deduct from the amounts payable to the Contractor the difference in cost of such work and materials with ten percent overhead added to cover all departmental charges. Should the total amount thereof exceed the amount due to the contractor, the Contractor shall pay the difference to the Owner within 15 days of making demand for payment failing which the Contractor shall be liable to pay interest at 24% p.a. on such amounts till the date of payment.

5.g. INSPECTION OF WORKS

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5.g.1. The Engineer-in-Charge/Site-in-Charge and Officers from Central or State Government will have full power and authority to inspect the works at any time wherever in progress, either on the site or at the Contractor's premises/workshops of any person, firm or corporation where work in connection with the contract may be in hand or where the materials are being or are to be supplied, and the Contractor shall afford or procure for the Engineer-in- Charge/Site-in-Charge every facility and assistance to carryout such inspection. The Contractor shall, at all times during the usual working hours and at all other times at which reasonable notice of the intention of the Engineer-in-Charge/Site-in- Charge or his representative to visit the works shall have been given to the Contractor, either himself be present to receive orders and instructions, or have a responsible agent, duly accredited in writing, present for the purpose. Orders given to the Contractor's agent shall be considered to have the same force as if they had been given to the Contractor himself. The Contractor shall give not less than seven days notice in writing to the Engineer-in-Charge/Site-in-Charge before covering up or otherwise placing beyond reach of inspection and measurement any work in order that the same may be inspected and measured. In the event of breach of above, the same shall be uncovered at Contractor's expense for carrying out such measurement and/or inspection.

5.g.2. No material shall be removed and despatched by the Contractor from the site without the prior approval in writing of the Engineer-in-charge. The contractor is to provide at all times during the progress of the work and the maintenance period proper means of access with ladders, gangways, etc. and the necessary attendance to move and adapt as directed for inspection or measurements of the works by the Engineer-in-Charge/Site-in-Charge.

5.h. SAMPLES

5.h.1. The contractor shall furnish to the Engineer-in-charge/Site-in-Charge for approval when requested or required adequate samples of all materials and finishes to be used in the work.

5.h.2. Samples shall be furnished by the Contractor sufficiently in advance and before commencement of the work so as the Owner can carry out tests and examinations thereof and approve or reject the samples for use in the works. All material samples furnished and finally used/applied in actual work shall fully be of the same quality of the approved samples.

5.i. TESTS FOR QUALITY OF WORK

5.i.1. All workmanship shall be of the respective kinds described in the contract documents and in accordance with the instructions of the Engineer-in-Charge / Site- in- Charge and shall be subjected from time to time to such tests at Contractor's cost as the Engineer-in-Charge/Site-in-Charge may direct at the place of manufacture or fabrication or on the site or at all or any such places. The Contractor shall provide assistance, instruments, labour and materials as are normally required for examining, measuring and testing any workmanship as may be selected and required by the Engineer-in-Charge/Site-in-Charge.

5.i.2. All the tests that will be necessary in connection with the execution of the work as decided by the Engineer-in- charge/Site-in-Charge shall be carried out at the contractors cost and expenses.

5.i.3. If any tests are required to be carried out in connection with the work or materials

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or workmanship to be supplied by the owner, such tests shall be carried out by the Contractor as per instructions of Engineer-in-Charge/Site-in-Charge and expenses for such tests, if any, incurred by the contractor shall be reimbursed by the Owner. The contractor should file his claim with the owner within 15 (fifteen) days of inspection/test and any claim made beyond that period shall lapse and be not payable.

5.j. ALTERATIONS AND ADDITIONS TO SPECIFICATIONS, DESIGNS AND WORKS

5.j.1. The Engineer-in-Charge/Site-in-Charge shall have powers to make any alterations, additions and/or substitutions to the schedule of quantities, the original specifications, drawings, designs and instructions that may become necessary or advisable or during the progress of the work and the Contractor shall be bound to carryout such altered/extra/new items of work in accordance with instructions which may be given to him in writing signed by the Engineer-in- Charge/Site- in-Charge. Such alterations, omissions, additions or substitutions shall not invalidate the contract. The altered, additional or substituted work which the Contractor may be directed to carryon in the manner as part of the work shall be carried out by the Contractor on the same conditions in all respects on which he has agreed to do the work. The time for completion of such altered added and/or substituted work may be extended for that part of the particular job. The rates for such additional altered or substituted work under this Clause shall, be worked out in accordance with the following provisions:

5.j.2. If the rates for the additional, altered or substituted work are specified in the contract for similar class of work, the Contractor is bound to carryout the additional, altered or substituted work at the same rates as are specified in the contract.

5.j.3. If the rates for the additional, altered or substituted work are not specifically provided in the contract for the work, the rates will be derived from the rates for similar class of work as are specified in the contract for the work. In the opinion of the Engineer-in- Charge/Site-in-Charge as to whether or not the rates can be reasonably so derived from the items in this contract, will be final and binding on the Contractor.

5.j.4. If the rates for the altered, additional or substituted work cannot be determined in the manner specified above, then the Contractor shall, within seven days of the date of receipt of order to carry out the work, inform the Engineer-in-Charge/ Site-in-Charge of the rate at which he intends to charge for such class of work, supported by analysis of the rate or rates claimed and the Engineer-In-Charge/ Site-in-Charge shall determine the rates on the basis of the prevailing market rates for both material and labour plus 10% to cover overhead and profit of labour rates and pay the Contractor accordingly. The opinion of the Engineer-in- Charge/Site-in-Charge as to current market rates of materials and the quantum of labour involved per unit of measurement will be final and binding on the contractor.

5.j.5. In case of any item of work for which there is no specification supplied by the Owner and is mentioned in the tender documents, such work shall be carried out in accordance with Indian Standard Specifications and if the Indian Standard Specifications do not cover the same, the work should be carried out as per standard Engineering Practice subject to the approval of the Engineer-in-Charge/ Site-in-Charge.

5.k. PROVISIONAL ACCEPTANCE

Acceptance of sections of the works for purposes of equipment erection, piping, electrical work and similar usages by the Owner and payment for such work or parts of work shall not constitute

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a waiver of any portion of this contract and shall not be construed so as to prevent the Engineer from requiring replacement of defective work that may become apparent after the said acceptance and also shall not absolve the Contractor of the obligations under this contract. It is made clear that such an acceptance does not indicate or denote or establish to the fact of execution of that work or the Contract until the work is completed in full in accordance with the provisions of this Contract.

5.l. COMPLETION OF WORK AND COMPLETION CERTIFICATE

As soon as the work is completed in all respects, the contractor shall give notice of such completion to the site in charge or the Owner and within thirty days of receipt of such notice the site in charge shall inspect the work and shall furnish the contractor with a certificate of completion indicating:

a) defects, if any, to be rectified by the contractor

b) items, if any, for which payment shall be made in reduced rates

c) the date of completion.

5.m. USE OF MATERIALS AND RETURN OF SURPLUS MATERIALS

5.m.1. Notwithstanding anything contained to the contrary in any or all of the clauses of this contract, where any materials for the execution of the contract are procured with the assistance of Government either by issue from Government stocks or procurement made under orders or permits or licences issued by Government, the contractor shall use the said materials economically and solely for the purpose of the contract and shall not dispose them of without the permission of the Owner.

5.m.2. All surplus(serviceable) or unserviceable materials that may be left over after the completion of the contract or at its termination for any reason whatsoever, the Contractor shall deliver the said product to the Owner without any demur. The price to be paid to the Contractor, if not already paid either in full or in part, however, shall not exceed the amount mentioned in the Schedule of Rates for such material and in cases where such rates are not so mentioned, shall not exceed the CPWD scheduled rates. In the event of breach of the aforesaid condition the contractor shall become liable for contravention of the terms of the Contract.

5.m.3. The surplus (serviceable) and unserviceable products shall be determined by joint measurement. In case where joint measurement has failed to take place, the Owner may measure the same and determine the quantity.

5.m.4. It is made clear that the Owner shall not be liable to take stock and keep possession and pay for the surplus and unserviceable stocks and the Owner may direct the Contractor to take back such material brought by the Contractor and becoming surplus and which the Owner may decide to keep and not to pay for the same.

5.n. DEFECT LIABILITY PERIOD

The contractor shall guarantee the work executed for a period of 12 months from the date of completion of the job. Any damage or defect that may arise or lie undiscovered at the time of completion of the job shall be rectified or replaced by the contractor at his own cost. The decision of the Engineer In-charge/Site-Incharge/Owner shall be the final in deciding whether the defect has to be rectified or replaced.

Equipment or spare parts replaced under warranty/guarantees shall have further warranty for a mutually agreed period from the date of acceptance.

The owner shall intimate the defects noticed in writing by a Registered or otherwise and the contractor within 15 days of receipt of the intimation shall start the rectification work and complete within the time specified by the owner failing which the owner

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will get the defects rectified by themselves or by any other contractor and the expenses incurred in getting the same done shall be paid by the Contractor under the provision of the Contract.

Thus, defect liability is applicable only in case of job/works contract (civil, mechanical, electrical, maintenance etc.) where any damage of defect may arise in future (i.e. within 12 months from the date of completion of job) or lie undiscovered at the time of completion of job.

In other words, in case of service contracts (like car hire etc.) where there is no question of damage or defect arising in future, the defect liability clause is not applicable.

Equipment or spare parts replaced under warranty/guarantees shall have further warranty for 12 months from the date of acceptance. However, in no case will the warranty exceed 24 months from the date of start of the original warranty.

5.o. DAMAGE TO PROPERTY

5.o.1. Contractor shall be responsible for making good to the satisfaction of the Owner any loss of and any damage to all structures and properties belonging to the Owner or being executed or procured by the Owner or of other agencies within the premises of the work of the Owner, if such loss or damage is due to fault and/or the negligence or willful acts or omission of the Contractor, his employees, agents, representatives or sub-contractors.

5.o.2. The Contractors shall indemnify and keep the Owner harmless of all claims for damage to Owner's property arising under or by reason of this contract.

5.p. LIMITATION OF LIABILITY

Notwithstanding anything contrary contained herein, the aggregate total liability of Seller, excluding his liability towards infringement of patent, trade mark or industrial design rights under the contract or otherwise shall be limited to 100% of value of Purchase order. However, neither party shall be liable to the other party for any indirect and consequential damages, loss of profits or loss of production.

5. DUTIES AND RESPONSIBILITIES OF CONTRACTOR

6. a. EMPLOYMENT LIABILITY TOWARDS WORKERS EMPLOYED BY THE CONTRACTOR

6.a.1 The Contractor shall be solely and exclusively responsible for engaging or employing persons for the execution of work. All persons engaged by the contractor shall be on Contractor's payroll and paid by Contractor. All disputes or differences between the Contractor and his/their employees shall be settled by Contractor.

6.a.2. Owner has absolutely no liability whatsoever concerning the employees of the Contractor. The Contractor shall indemnify Owner against any loss or damage or liability arising out of or in the course of his/their employing persons or relation with his/their employees. The Contractor shall make regular and full payment of wages and on any complaint by any employee of the Contractor or his sub contractor regarding non-payment of wages, salaries or other dues, Owner reserves the right to make payments directly to such employees or sub- contractor of the Contractor and recover the amount

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in full from the bills of the Contractor and the contractor shall not claim any compensation or reimbursement thereof. The Contractor shall comply with the Minimum Wages Act applicable to the area of work site with regard to payment of wages to his employees and also to employees of his sub contractor.

6.a.3. The Contractor shall advise in writing or in such appropriate way to all of his employees and employees of sub-contractors and any other person engaged by him that their appointment/employment is not by the Owner but by the Contractor and that their present appointment is only in connection with the construction contract with Owner and that therefore, such an employment/appointment would not enable or make them eligible for any employment/appointment with the Owner either temporarily or/and permanent basis.

6.b. NOTICE TO LOCAL BODIES

The contractor shall comply with and give all notices required under any Government authority, instruction, rule or order made under any act of parliament, state laws or any regulations or by-laws of any local authority relating to the works.

6.c. FIRST AID AND INDUSTRIAL INJURIES

6.c.1 Contractor shall maintain first aid facility for his employees and those of his sub-contractors.

6.c.2. Contractor shall make arrangements for ambulance service and for the treatment of all types of injuries. Names and telephone numbers of those providing such services shall be furnished to Owner prior to start of construction and their name board shall be prominently displayed in Contractor's field office.

6.c.3. All industrial injuries shall be reported promptly to owner and a copy of contractor's report covering each personal injury requiring the attention of a physician shall be furnished to the Owner.

6.d. SAFETY CODE

6.d.1. The Contractor shall at his own expenses arrange for the Safety provisions as may be necessary for the execution of the work or as required by the Engineer-in-Charge in respect of all labours directly or indirectly employed for performance of the works and shall provide all facilities in connections therewith. In case the contractor fails to make arrangements and provide necessary facilities as aforesaid, the Owner shall be entitled to do so and recover the cost thereof from the Contractor.

6.d.2. From the commencement to the completion of the works, the contractor shall take full responsibility for the care thereof and of all the temporary works (defined as meaning all temporary works of every kind required in or for the execution, completion or maintenance of the works). In case damage, loss or injury shall happen to the works or to any part thereof or to temporary works or to any cause whatsoever repair at his (Contractor's) own cost and make good the same so that at the time of completion, the works shall be in good order and condition and in conformity in every respect with the requirement of the contract and Engineer-in-Charge's instructions.

6.d.3. In respect of all labour, directly or indirectly employed in the work for the performance

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of the Contractor's part of this agreement, the contractor shall at his own expense arrange for all the safety provisions as per relevant Safety Codes of C.P.W.D Bureau of Indian Standards, the Electricity Act/I.E. Rules. The Mines Act and such other Acts as applicable.

6.d.4. The Contractor shall observe and abide by all fire and safety regulations of the Owner. Before starting construction work, the Contractor shall consult with Owner's Safety Engineer or Engineer-in-Charge/Site-in-Charge and must make good to the satisfaction of the Owner any loss or damage due to fire to any portion of the work done or to be done under this agreement or to any of the Owner's existing property.

6.d.5. The Contractor will be fully responsible for complying with all relevant provisions of the Contract Labour Act and shall pay rates of Wages and observe hours of work/conditions of employment according to the rules in force from time to time.

6.d.6. The Contractor will be fully responsible for complying with the provision including documentation and submission of reports on the above to the concerned authorities and shall indemnify the Corporation from any such lapse for which the Government will be taking action against them.

6.d.7. Owner shall on a report having been made by an inspecting Office as defined in the Contract Labour Regulations have the power to deduct from the money due to the Contractor any sum required or estimated to be required for making good the loss suffered by a worker(s) by reasons of non-fulfillment of conditions of contract for the benefit of workers no-payment of wages or of deductions made from his or their wages which are not justified by the terms of contract or non observance of the said contractor's labour Regulation.

6.e. INSURANCE AND LABOUR

Contractor shall at his own expense obtain and maintain an insurance policy with a Nationalised Insurance Company to the satisfaction of the Owner as provided hereunder.

6.e.1. EMPLOYEES STATE INSURANCE ACT

i. The Contractor agrees to and does hereby accept full and exclusive liability for the compliance with all obligations imposed by Employees State Insurance Act, 1948, and the Contractor further agrees to defend indemnify and hold Owner harmless from any liability or penalty which may be imposed by the Central, State or local authority by reason of any asserted violation by Contractor, or sub-contractor of the Employees' State Insurance Act, 1948 and also from all claims, suits or proceedings that may be brought against the Owner arising under, growing out of or by reason of the work provided for by this contract whether brought by employees of the Contractor, by third parties or by Central or State Government authority or any political sub-division thereof.

ii. The Contractor agrees to file with the Employees State Insurance Corporation, the Declaration forms and all forms which may be required in respect of the Contractor's or sub-contractor's employee whose aggregate emuneration is within the specified limit and who are employed in the work provided or those covered by ESI Act under any amendment to the Act from time to time.

The Contractor shall deduct and secure the agreement of the sub- contractor to deduct the employee's contribution as per the first schedule of the Employee's

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State Insurance Act from wages and affix the employee's contribution cards at wages payment intervals. The Contractor shall remit and secure the agreement of the sub contractor to remit to the State Bank of India, Employee's State Insurance Corporation Account, the Employee's contribution as required by the Act.

ii. The Contractor agrees to maintain all records as required under the Act in respect of employees and payments and the Contractor shall secure the agreement of the sub contractor to maintain such records. Any expenses incurred for the contributions, making contribution or maintaining records shall be to the Contractor's or sub-contractor's account.

iv. The Owner shall retain such sum as may be necessary from the total contract value until the Contractor shall furnish satisfactory proof that all contributions as required by the Employees State Insurance Act, 1948, have been paid.

v. **WORKMAN'S COMPENSATION AND EMPLOYEE'S LIABILITY INSURANCE**

Provide Insurance for all the Contractor's employees engaged in the performance of this contract. If any of the work is sublet, the Contractor shall ensure that the sub contractor provides workmen's compensation and Employer's Liability Insurance for the latter's employees who are not covered under the Contractor's insurance.

vi. **AUTOMOBILE LIABILITY INSURANCE**

Contractor shall take out an Insurance to cover all risks to Owner for each of his vehicles plying on works of this contract and these insurances shall be valid for the total contract period. No extra payment will be made for this insurance. Owner shall not be liable for any damage or loss not made good

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by the Insurance Company, should such damage or loss result from unauthorised use of the vehicle. The provisions of the Motor Vehicle Act would apply.

vii. **FIRE INSURANCE**

Contractor shall within two weeks after award of contract insure the Works, Plant and Equipment and keep them insured until the final completion of the Contract against loss or damage by accident, fire or any other cause with an insurance company to be approved by the Employer/Consultant in the joint names of the Employer and the Contractor (name of the former being placed first in the Policy). Such Policy shall cover the property of the Employer only.

6.e.2. ANY OTHER INSURANCE REQUIRED UNDER LAW OR REGULATION OR BY

i. Contractor shall also provide and maintain any and all other insurance which may be required under any law or regulations from time to time. He shall also carry and maintain any other insurance which may be required by the Owner.

ii. The aforesaid insurance policy/policies shall provide that they shall not be cancelled till the Engineer-in-Charge has agreed to their cancellation.

iii. The Contractor shall satisfy to the Engineer-in-Charge/Site-in-Charge from time to time that he has taken out all insurance policies referred to above and has paid the necessary premium for keeping the policies alive till the expiry of the defects liability period.

iv. The contractor shall ensure that similar insurance policies are taken out by his sub-contractor (if any) and shall be responsible for any claims or losses to the Owner resulting from their failure to obtain adequate insurance protections in connection thereof. The contractor shall produce or cause to be proceed by his sub-contractor (if any) as the case may be, the relevant policy or policies and premium receipts as and when required by the Engineer-in-Charge/Site-in-Charge.

v. Contractor shall at his own expense cover all the workmen engaged under him under “Pradhan Mantri Surksha Bima Yojana (PMSBY)” and submit proof of the same to BGL.

6.e.3. LABOUR AND LABOUR LAWS

i. The contractor shall at his own cost employ persons during the period of contract and the persons so appointed shall not be construed under any circumstances to be in the employment of the Owner.

ii. All payments shall be made by the contractor to the labour employed by him in accordance with the various rules and regulations stated above. The contractor shall keep the Owner indemnified from any claims whatsoever inclusive of damages/costs or otherwise arising from injuries or alleged injuries to or death of a person employed by the contractor or damages or alleged damages to the property.

iii. No labour below the age of eighteen years shall be employed on the work.

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The Contractor shall not pay less than what is provided under the provisions of the contract labour (Regulations and Abolition) Act, 1970 and the rules made thereunder and as may be amended from time to time. He shall pay the required deposit under the Act appropriate to the number of workman to be employed by him or through sub contractor and get himself registered under the

Act. He shall produce the required Certificates to the Owner before commencement of the work. The Owner recognises only the Contractor and not his sub contractor under the provisions of the Act. The Contractor will have to submit daily a list of his workforce. He will also keep the wage register at the work site or/and produce the same to the Owner, whenever desired. A deposit may be taken by the Owner from the Contractor to be refunded only after the Owner is satisfied that all workmen employed by the Contractor have been fully paid for the period of work in Owner's premises at rates equal to or better than wages provided for under the Minimum Wages Act. The contractor shall be responsible and liable for any complaints that may arise in this regard and the consequences thereto.

iv. The Contractor will comply with the provisions of the Employee's Provident Fund Act and the Family Pension Act as may be applicable and as amended from time to time.

v. The Contractor will comply with the provisions of the payment of Gratuity Act, 1972, as may be applicable and as amended from time to time.

vi. **IMPLEMENTATION OF APPRENTICES ACT, 1961**

The Contractor shall comply with the provisions of the Apprentices Act, 1961 and the Rules and Orders issued thereunder from time to time. If he fails to do so, his failure will be a breach of the contract and the Engineer-in- Charge may, at his discretion, cancel the contract. The Contractor shall also be liable for any pecuniary liability arising on account of any violation by him of the provision of the Act.

vii. **MODEL RULES FOR LABOUR WELFARE**

The Contractor shall at his own expenses comply with or cause be complied with Model rules for Labour Welfare as appended to those conditions or rules framed by the Government from time to time for the protection of health and for making sanitary arrangements for worker employed directly or indirectly on the works. In case the contractor fails to make arrangements as aforesaid the Engineer-in-Charge/Site-in-Charge shall be entitled to do so and recover the cost thereof from the contractor.

6.f. DOCUMENTS CONCERNING WORKS

6.f.1. All documents including drawings, blue prints, tracings, reproducible models, plans, specifications and copies, thereof furnished by the Owner as well as all drawings, tracings, reproducibles, plans, specifications design calculations etc. prepared by the contractor for the purpose of execution of works covered in or connected with this contract shall be the property of the Owner and shall not be used by the contractor for any other work but are to be delivered to the Owner at the completion or otherwise of the contract.

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6.f.2. The Contractor shall keep and maintain secrecy of the documents, drawings etc. issued to him for the execution of this contract and restrict access to such documents, drawings etc. and further the Contractor shall execute a SECRECY agreement from each or any person employed by the Contractor having access to such documents, drawings etc. The Contractor shall not issue drawings and documents to any other agency or individual without the written approval by the Engineer-in-Charge/Site- in-Charge.

6.f.3. Contractor will not give any information or document etc. concerning details of the work to the press or a news disseminating agency without prior written approval from Engineer-in-charge/Site-in-Charge. Contractor shall not take any pictures on site without written approval of Engineer-in-Charge/Site-in-Charge.

6. PAYMENT OF CONTRACTOR'S BILLS

7.1. Payments will be made against Running Accounts bills certified by the Owner's Engineer- in-Charge/Site-in-Charge within 15 days from the date of receipt of the bill.

7.2. Running Account Bills and the final bill shall be submitted by the Contractor together with the duly signed measurements sheet(s) to the Engineer-in-Charge/ Site-in-C h a r g e of the Owner in quadruplicate for certification.

The Bills shall also be accompanied by quantity calculations in support of the quantities contained in the bill along with cement consumption statement, actual/theoretical, wherever applicable duly certified by the Engineer-in-Charge/ Site-in- Charge of the Owner.

7.3. All running account payments shall be regarded as on account payment(s) to be finally adjusted against the final bill payment. Payment of Running Account Bill(s) shall not determine or affect in any way the rights of the Owner under this Contract to make the final adjustments of the quantities of material, measurements of work and adjustments of amounts etc. in the final bill.

7.4. The final bill shall be submitted by the Contractor within one month of the date of completion of the work fully and completely in all respects. If the Contractor fails to submit the final bill accordingly Engineer-in-Charge/Site-in-Charge may make the measurement and determine the total amount payable for the work carried out by the Contractor and such a certification shall be final and binding on the Contractor. The Owner/Engineer-in-Charge/Site-in-Charge may take the assistance of an outside party for taking the measurement, the expenses of which shall be payable by the Contractor.

7.5. Payment of final bill shall be made within 30 days from the date of receipt of the certified bill by the Disbursement Section of the owner.

7.6 Wherever possible, payment shall be tendered to the contractor in electronic mode (e-payment) through any of the designated banks. The contractor will comply by furnishing full particulars of Bank acount (mandate) to which the payments will be routed. Owner reserves the right to make payment in any alternate mode also.

7.a. MEASUREMENT OF WORKS

7.a.1. All measurements shall be in metric system. All the work will be jointly measured by the representative of the Engineer-in-Charge/Site-in-Charge and the Contractor or their

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authorised agent progressively. Such measurement will be recorded in the Measurement Book/Measurement Sheet by the Contractor or his authorised representative and signed in token of acceptance by the Owner or their authorised representative.

7.a.2. For the purpose of taking joint measurement, the Contractor/representative shall be bound to be present whenever required by the Engineer-in-Charge/Site- in-Charge.

If, however, they are absent for any reasons whatsoever, the measurement will be taken by the Engineer-in-Charge/Site-in-Charge or his representative and the same would be deemed to be correct and binding on the Contractor.

7.a.3. In case of any dispute as to the mode of measurement for any item of work, the latest Indian Standard Specifications shall be followed. In case of any further dispute on the same the same shall be as per the certification of an outside qualified Engineer/ Consultant. Such a measurement shall be final and binding on the Owner and the Contractor.

7.b. BILLING OF WORKS EXECUTED

The Contractor will submit a bill in approved proforma in quadruplicate to the Engineer- in-Charge/Site-in-Charge of the work giving abstract and detailed measurement for the various items executed during a month, before the expiry of the first week of the succeeding month. The Engineer-in-Charge/Site-in-Charge shall take or cause to be taken the requisite measurements for the purpose of having the bill verified and/or checked before forwarding the same to the disbursement office of the Owner for further action in terms of the Contract and payment thereafter. The Engineer-in-Charge/Site-in- Charge shall verify the bills within 7 days of submission of the Bill by the Contractor.

7.c. RETENTION MONEY

5% of the total value of the Running Account and Final Bill will be deducted and retained by the Owner as retention money on account of any damage/defect liability that may arise for the period covered under the defect liability period clause of the Contract free of interest. Any damage or defect that may arise or lie undiscovered at the time of issue of completion certificate connected in any way with the equipment or materials supplied by contractor or in workmanship shall be rectified or replaced by the contractor at his own expense failing which the Owner shall be entitled to rectify the said damage/defect from the retention money. Any excess of expenditure incurred by the Owner on account of damage or defect shall be payable by the Contractor. The decision of the Owner in this behalf shall not be liable to be questioned but shall be final and binding on the Contractor.

Thus, deduction towards retention money is applicable only in case of job/works contracts (civil, mechanical, electrical, maintenance etc.) where any damage or defect may arise in future (i.e. within 12 months from the date of completion of job) or lie undiscovered at the time of issue of completion certificate.

7.d. STATUTORY LEVIES

7.d.1 The Contractor accepts full and exclusive liability for the payment of any and all taxes, duties, cess, levies and statutory payments payable under all or any of the statutes etc.

Variations of taxes and duties arising out of the amendments to the Central / State enactments, in respect of sale of goods / services covered under this bid shall be to BGL's

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account, so long as :

- They relate to the period after the opening of the price bid, but before the contracted completion period (excluding permitted extensions due to delay on account of the contractors, if any) or the actual completion period, whichever is earlier; and
- The vendor furnishes documentary evidence of incurrence of such variations, in addition to the invoices/documents for claiming Cenvat /Input Tax credit, wherever applicable.

All contributions and taxes for unemployment compensation, insurance and old age pensions or annuities now or hereafter imposed by Central or State Governmental authorities which are imposed with respect to or covered by the wages, salaries or other compensations paid to the persons employed by the Contractor and the Contractor shall be responsible for the compliance with all obligations and restrictions imposed by the Labour Law or any other law affecting employer-employee relationship

and the Contractor further agrees to comply and to secure the compliance of all sub-contractors with all applicable Central, State, Municipal and local laws, and regulations and requirements of any Central, State or Local Government agency or authority.

Contractor further agrees to defend, indemnify and hold harmless from any liability or penalty which may be imposed by the Central, State or Local authorities by reason of any violation by Contractor or sub-contractor of such laws, regulations or requirements and also from all claims, suits or proceedings that may be brought against the Owner arising under, growing out of, or by reasons of the work provided for by this contract by third parties, or by Central or State Government authority or any administrative sub-division thereof. The Contractor further agrees that in case any such demand is raised against the Owner, and Owner has no way but to pay and pays/makes payment of the same, the Owner shall have the right to deduct the same from the amounts due and payable to the Contractor. The Contractor shall not raise any demand or dispute in respect of the same but may have recourse to recover/receive from the concerned authorities on the basis of the Certificate of the Owner issued in that behalf.

7.d.2. The rates quoted should be inclusive of all taxes. However, wherever a tax to be deducted at source the same will be deducted from the bills of the Contractor and paid to the concerned authorities. The proof of such payments of tax on works contract will be furnished to the contractor.

The vendor shall comply with all the provisions of the GST Act/Rules/requirements like providing of tax invoices, payment of taxes to the authorities within the due dates, filing of returns within the due dates etc. to enable BGL to take Input Tax Credit. In case of imports, vendor shall provide import documents and invoice fulfilling the requirement of Customs Act and Rules. Vendor will be fully responsible for complying with the Customs provisions to enable BGL to take Input Tax Credit.

In case BGL is not able to take Input Tax Credit due to any noncompliance/default/negligence of the seller of goods/service provider, the same shall be recovered from the pending bills/dues (including security deposit, BG etc.)

Vendor shall be responsible to indemnify the Corporation for any loss, direct or implied accrued to the Corporation on account of supplier/service provider failure to discharge his statutory liabilities like paying taxes on time, filing appropriate returns within the

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prescribed time etc.

7.d.3. Income tax will be deducted at source as per rules at prevailing rates, unless certificate, if any, for deduction at lesser rate or nil deduction is submitted by the Contractor from appropriate authority.

7.d.4 The contractor shall provide accurate particulars of PAN number as required, under Section 206AA of Income Tax Act 1961.

7.d.5 The contractors having their 'tax residency status' outside India shall provide Tax Residency Certificate (TRC), issued by Government of the Country or the specified territory where the Contractor is a Resident. Rule 21AB of the Income Tax Rules, 1962 has prescribed the contents of a TRC. This would enable the Corporation to deduct tax at source by duly considering the 'treaty relief', if any, under Double Taxation Avoidance Agreement (DTAA) entered into between GOI and the respective country/specified territory in which the Contractors' 'tax residency status' is currently in force.

7.d.6 Anti-Profiteering Clause – GST Act anti-profiteering provisions mandates that any reduction in tax rates or benefits of input tax credits be passed on to the consumer by way of commensurate reduction in prices. Vendors to take note of the same and pass such benefits while quoting their price**.**

7.e. MATERIALS TO BE SUPPLIED BY CONTRACTOR

7.e.1. The Contractor shall procure and provide the whole of the materials required for construction including tools, tackles, construction plant and equipment for the completion and maintenance of the works except the materials viz. steel and cement which may be agreed to be supplied as provided elsewhere in the contract. The contractor shall make arrangement for procuring such materials and for the transport thereof at their own cost and expenses.

7.e.2. The Owner may give necessary recommendation to the respective authority if so desired by the Contractor but assumes no responsibility of any nature. The Contractor shall procure materials of ISI stamp/certification and supplied by reputed suppliers borne on DGS&D list.

7.e.3. All materials procured should meet the specifications given in the tender document. The Engineer-in-charge may, at his discretion, ask for samples and test certificates for any batch of any materials procured. Before procuring, the Contractor should get the approval of Engineer-in-Charge/Site-in-Charge for any materials to be used for the works.

7.e.4. Manufacturer's certificate shall be submitted for all materials supplied by the Contractor. If, however, in the opinion of the Engineer-in-Charge/Site-in-Charge any tests are required to be conducted on the material supplied by the Contractor, these will be arranged by the Contractor promptly at his own cost.

7.f. MATERIALS TO BE SUPPLIED BY THE OWNER

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7.f.1. Steel and Cement maybe supplied by the Owner to the contractor against payment by Contractor from either godown or from the site or within work premises itself and the contractor shall arrange for all transport to actual work site at no extra cost.

7.f.2. The contractor shall bear all the costs including loading and unloading, carting from issue points to work spot storage, unloading, custody and handling and stacking the same and return the surplus steel and cement to the Owner's storage point after completion of job.

7.f.3. The contractor will be fully accountable for the steel and cement received from the Owner and contractor will give acknowledgement/receipt for quantity of steel and cement received by him each time he uplifts cement from Owner's custody.

7.f.4. For all computation purposes, the theoretical cement consumption shall be considered as per CPWD standards.

7.f.5. Steel and Cement as received from the manufacturer/stockists will be issued to the contractor. Theoretical weight of cement in a bag will be considered as 50 Kg. Bags weighing upto 4% less shall be accepted by the contractor and considered as 50 Kg. per bag. Any shortage in the weight of any cement bag by more than 4% will be to the Owner's account only when pointed out by the Contractor and verified by Engineer-in-Charge/Site in Charge at the time of Contract or taking delivery.

7.f.6. The contractor will be required to maintain a stock register for receipt, issuance and consumption of steel and cement at site. Cement will be stored in a warehouse at site. Requirement of cement on any day will be taken out of the warehouse. Cement issued shall be regulated on the basis of FIRST RECEIPT to go as FIRST ISSUE.

7.f.7. Empty cement bag shall be the property of the Contractor. Contractor shall be penalised for any excess/under consumption of cement. The penal rate will be twice the rate of issue of cement for this work.

7.f.8. All the running bills as well as the final bills will be accompanied by cement consumption statements giving the detailed working of the cement used, cement received and stock-on-hand.

7.f.9. The Contractor will be fully responsible for safe custody of cement once it is received by him and during transport. Owner will not entertain any claims of the contractor for theft, loss or damage to cement while in their custody.

7.f.10. The contractor shall not remove from the site any cement bags at any time.

7.f.11. The Contractor shall advise Engineer-in-charge/Site-in-charge in writing atleast 21 days before exhausting the Cement stocks already held by Contractor to ensure that such delays do not lead to interruptions in the progress of work.

7.f.12. Cement shall not be supplied by the Owner for manufacturing of mosaic tiles, precast cement jali and any other bought out items which consume cement and for temporary works.

7.f.13. Cement in bags and in good usable condition left over after the completion of work shall be returned by the contractor to the Owner. The Owner shall make payment to the Contractor at the supply rate for such stocks of cement they accept and receive. Any

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refused stock of cement shall be removed by the Contractor from the site at his cost and expenses within 15 days of completion of the work.

7. PAYMENT OF CLAIMS AND DAMAGES

8.1. Should the Owner have to pay money in respect of claims or demands as aforesaid the amount so paid and the costs incurred by the Owner shall be charged to and paid by the Contractor and the Contractor shall not be entitled to dispute or question the right of the Owner to make such payments notwithstanding the same may have been without his consent or authority or in law or otherwise to the contrary.

8.2. In every case in which by virtue of the provisions of Workmen's Compensation Act, 1923, or other Acts, the Owner is obliged to pay Compensation to a Workman employed by the Contractor in execution of the works, the Owner will recover from the Contractor the amount of compensation so paid and without prejudice to the rights of Owner under the said Act. Owner shall be at liberty to recover such amount or any part thereof by deducting it from the security deposit or from any sum due to the Contractor whether under this contract or otherwise. The Owner shall not be bound to contest any claim made under Section 12 sub section (1) of the said Act, except on the written request of the Contractor and upon his giving to the Owner full security for all costs for which the owner might become liable in consequence of contesting such claim.

8.a. ACTION AND COMPENSATION IN CASE OF BAD WORK

If it shall appear to the Engineer-in-Charge/Site-in-Charge that any work has been executed with bad, imperfect or unskilled workmanship, or with materials, or that any materials or articles provided by the Contractor for execution of the work are not of standards specified/inferior quality to that contracted for, or otherwise not in accordance with the contract, the CONTRACTOR shall on demand in writing from the Engineer-in- Charge/Site-in-Charge or his authorised representative specifying the work, materials or articles complained of, notwithstanding that the same may have been inadvertently passed, certified and paid for, forthwith rectify or remove and reconstruct the work so specified and at his own charge and cost and expenses and in the event of failure to do so within a period of 15 days of such intimation/ information/knowledge, the Contractor shall be liable to pay compensation equivalent to the cost of reconstruction by the Owner. On expiry of 15 days period mentioned above, the Owner may by themselves or otherwise rectify or remove and re-execute the work or remove and replace with others, the materials or articles complained of as the case may be at the risk and expenses in all respects of the Contractor. The decision of the Engineer- in- Charge/ Site-in-Charge as to any question arising under this clause shall be final and conclusive and shall not be raised as a dispute or shall be arbitrable.

8.b. INSPECTION AND AUDIT OF CONTRACT AND WORKS

This project is subject to inspection by various Government agencies of Government of India. The contractor shall extend full cooperation to all the Government and other agencies in the inspection of the works, audit of the Contract and the documents of Contract Bills, measurements sheets etc. and examination of the records of works and make enquiries interrogation as they may deem fit, proper and necessary. Upon inspection etc. by such agencies if it is pointed out that the contract work has not been carried out according to the prescribed terms and conditions as laid down in the tender documents and if any recoveries are recommended, the same shall be recovered from the contractors running bills/final

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bill/from ordered/suggested Security Deposit/retention money. The Contractor shall not rise any dispute on any such account and the same shall not be arbitrable.

8. CONTRACTOR TO INDEMNIFY THE OWNER

The Contractor shall indemnify the Owner and every member, officer and employee of the Owner, also the Engineer-in-Charge/Site-in-Charge and his staff against all the actions, proceedings, claims, demands, costs, expenses, whatsoever arising out of or in connection with the works and all actions, proceedings, claims, demands, costs, expenses which may be made against the Owner for or in respect of or arising out of any failure by the Contractor in the performance of his obligations under the contract. The Contractor shall be liable for or in respect of or in consequence of any accident or injury to any workmen or other person in the employment of the Contractor or his sub contractor and Contractor shall indemnify and keep indemnified the Owner against all such damages, proceedings, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

9. Price reduction

i) In case of any delay in completion of the work beyond the CDD, the Owner shall be entitled to be paid Price Reduction by the Contractor. The price reduction shall be initially at the rate of 0.5% (half percent) of the total contract value for every week of the delay subject to a maximum of 5% of the total contract value. The price reduction shall be recovered by the Owner out of the amounts payable to the Contractor or from any Bank Guarantees or Deposits furnished by the Contractor or the Retention Money retained from the Bills of the Contractor, either under this contract or any other contract.

ii) The Contractor shall be entitled to give an acceptable unconditional Bank Guarantee in lieu of such a deduction if Contractor desires any decision on a request for time extension.

iii) Once a final decision is taken on the request of the Contractor or otherwise, the price reduction shall be applicable only on the basic cost of the contract and on each full completed week(s) of delay (and for part of the week, a pro-rata price reduction amount shall be applicable).

iv) This final calculation of price reduction shall be only on the value of the unexecuted portion/quantity of work as on the CDD.

v) Contractor agrees with the Owner, that the above represents a genuine pre- estimate of the damages which the Owner will suffer on account of delay in the performance of the work by Contractor. The Contractor further agrees that the price reduction amount is over and above any right which owner has to risk purchase under Clause 12.4 and any right to get the defects in the work rectified at the cost of the contractor.

10. DEFECTS AFTER TAKING OVER OR TERMINATION OF WORK CONTRACT BY OWNER

The Contractor shall remain responsible and liable to make good all losses or damages that may occur/appear to the work carried out under this Contract within a period of 12 months from date of issue of the Completion Certificate and/or the date of Owner taking over the work, whichever is earlier. The Contractor shall issue a Bank Guarantee to the Owner in the sum of 10% of the work entrusted in the Contract, from a bank from the

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list of banks whose bank guarantees are acceptable to the Owner (list enclosed) and if however, the Contractor fails to furnish such a Bank Guarantee the Owner shall have right to retain the Security Deposit and Retention Money to cover the 10% of the Guarantee amount under this clause and to return/refund the same after the expiry of the period of 12 months without any interest thereon**.** (Please refer to clause 4. Deposits)

11. TERMINATION OF CONTRACT

11.1 The owner may terminate the contract at any stage of the construction for reasons to be recorded in the letter of termination.

11.2 The Owner inter alia may terminate the Contract for any or all of the following reasons that the contractor

a) has abandoned the work/Contract.
b) has failed to commence the works, or has without any lawful excuse under these conditions suspended the work for 15 consecutive days.
c) has failed to remove materials from the site or to pull down and replace the work within 15 days after receiving from the Engineer written notice that the said materials or work were condemned and/or rejected by the Engineer under specified conditions.
d) has neglected or failed to observe and perform all or any of the terms acts, matters or things under this Contract to be observed and performed by the Contractor.
e) has to the detriment of good workmanship or in defiance of the Engineer's instructions to the contrary sub-let any part of the Contract.
f) has acted in any manner to the detrimental interest, reputation, dignity, name or prestige of the Owner.
g) has stopped attending to work without any prior notice and prior permission for a period of 15 days.
h) has become untraceable.
i) has without authority acted in violation of the terms and conditions of this contract and has committed breach of terms of the contract in best judgement of the owner.
j) has been declared insolvent/bankrupt.
k) in the event of sudden death of the Contractor.

11.3 The owner on termination of such contract shall have the right to appropriate the Security Deposit, Retention Money and invoke the Bank Guarantee furnished by the contractor and to appropriate the same towards the amounts due and payable by the contractor as per the conditions of Contract and return to the contractor excess money, if any, left over.

11.4 In case of Termination of the contract, Owner shall have the right to carry out the unexecuted portion of the work either by themselves or through any other contractor(s) at the risk and cost of the Contractor. In view of paucity of time, Owner shall have the right to place such unexecuted portion of the work on any nominated contractor(s). However, the overall liability of the Contractor shall be restricted to 100 % of the total contract value.

11.5 The contractor within or at the time fixed by the Owner shall depute his authorised representative for taking joint final measurements of the works executed thus far and submit the final bill for the work as per joint final measurement within 15 days of the date of joint final measurement. If the contractor fails to depute their representative for joint measurement, the owner shall take the measurement with their Engineer-in- Charge/Site-in-Charge or any other outside representatives. Such a measurement shall be final and binding on the Parties and shall not be questioned by the Contractor and no dispute can be raised by the Contractor on the same.

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11.6 The Owner may enter upon and take possession of the works and all plant, tools, scaffoldings, sheds, machinery, power operated tools and steel, cement and other materials of the Contract at the site or around the site and use or employ the same for completion of the work or employ any other contractor or other person or persons to complete the works. The Contractor shall not in any way object or interrupt or do any act, matter or thing to prevent or hinder such actions, other Contractor or other persons employed for completing and finishing or using the materials and

plant for the works. When the works shall be completed or as soon thereafter the Engineer shall give a notice in writing to the Contractor to remove surplus materials and plant, if any, and belonging to the Contractor except as provided elsewhere in the Contract and should the Contractor fail to do so within a period of 15 days after receipt thereof the Owner may sell the same by public auction and shall give credit to the contractor for the amount realised. The Owner shall thereafter ascertain and certify in writing under his hand what (if anything) shall be due or payable to or by the Owner for the value of the plant and materials so taken possession and the expense or loss which the Owner shall have been put to in procuring the works, to be so completed, and the amount if any, owing to the Contractor and the amount which shall be so certified shall thereupon be paid by the Owner to the Contractor or by the Contractor to the Owner, as the case may, and the Certificate of the Owner shall be final and conclusive between the parties.

11.7 When the contract is terminated by the Owner for all or any of the reasons mentioned above the Contractor shall not have any right to claim compensation on account of such termination.

12. FORCE MAJEURE

Circumstances leading to force majeure

(a) act of terrorism;

(b) riot, war, invasion, act of foreign enemies, hostilities (whether war be declared or not), civil war, rebellion, revolution, insurrection of military or usurped power;

(c) ionising radiation or contamination, radio activity from any nuclear fuel or from any nuclear waste from the combustion of nuclear fuel, radioactive toxic explosive or other hazardous properties of any explosive assembly or nuclear component;

(d) epidemics, earthquakes, flood, fire, hurricanes, typhoons or other physical natural disaster, but excluding weather conditions regardless of severity; and

(e) freight embargoes, strikes at national or state-wide level or industrial disputes at a national or state-wide level in any country where Works are performed, and which affect an essential portion of the Works but excluding any industrial dispute which is specific to the performance of the Works or the Contract.

For the avoidance of doubt, inclement weather, third party breach, delay in supply of materials (other than due to a nationwide transporters' strike) or commercial hardship shall not constitute a Force Majeure event.

- Notification of Force Majeure

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Contractor shall notify within [10(ten)] days of becoming aware of or the date it ought to have become aware of the occurrence of an event of Force Majeure giving full particulars of the event of Force Majeure and the reasons for the event of Force Majeure preventing the Affected Party from, or delaying the Affected Party in performing its obligations under the Contract.

- Right of either party to terminate

  If an event of Force Majeure occurs and its effect continues for a period of 180 (one hundred eighty days) or more in a continuous period of 365 (three hundred sixty-five) days after notice has been given under this clause, either Party may terminate the Contract by issuing a written notice of 30 (thirty) days to the other Party.

- Payment in case of termination due to Force Majeure

  The Contract Price attributable to the Works performed as at the date of the commencement of the relevant event of Force Majeure.

The Contractor has no entitlement and Owner has no liability for:

a) any costs, losses, expenses, damages or the payment of any part of the Contract Price during an event of Force Majeure; and
b) any delay costs in any way incurred by the Contractor due to an event of Force Majeure.

Time extension for such cases will be worked out appropriately.

13. DISPUTE RESOLUTION

(A) Discussions and Resolution

i) The parties shall attempt to resolve all dispute and difference arising out of or relating to this contract through negotiations in good faith. If any dispute or difference remains unresolved, then all such unresolved disputes or differences shall be referred to the Executive Director/SBU Head of BGL of the concerned department and the Director/ Owner / authorized Senior Official of the contractor/supplier for an amicable solution.

ii) If any dispute or difference remains unsettled within sixty (60) days from the date on which either Party has served a written notice on the other Party making claims and for discussions, then the provisions of Part B (i.e. Conciliation) of this Clause shall apply.

(B) CONCILIATION

(i) All disputes and differences covered under the Conciliation Rules, 2019 arising out of or relating to this contract including its performance or interpretation, shall be fully and finally settled through Conciliation as per

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the Conciliation Rules, of BGL, as amended from time to time.

(ii) The Conciliation Rules of BGL and any modification thereof shall be binding upon the Parties

(iii) The language of the conciliation shall be English;

(iv) The governing law of this contract shall be of India.

(v) In case the Conciliation fails, or if there are any disputes or differences which are not covered under Conciliation Rules, 2019, then the parties shall be free to take appropriate legal remedies for adjudication of their disputes.

(vi) The Courts having jurisdiction over the place where the contract was performed, except for enforcement of decree/judgment, shall be the court having jurisdiction to adjudicate the disputes between the parties.

14. **GENERAL**

15.1. Materials required for the works whether brought by the or supplied by the Owner shall be stored by the contractor only at places approved by Engineer-in- Charge/Site-in-Charge. Storage and safe custody of the material shall be the responsibility of the Contractor.

15.2. Owner and/or Engineer-in-Charge/Site-in-Charge connected with the contract, shall be entitled at any time to inspect and examine any materials intended to be used in or on the works, either on the site or at factory or workshop or at other place(s) manufactured or at any places where these are laying or from which these are being obtained and the contractor shall give facilities as may be required for such inspection and examination.

15.3. In case of any class of work for which there is no such specification supplied by the owner as is mentioned in the tender documents, such work shall be carried out in accordance with Indian Standard Specifications and if the Indian Standard Specifications do not cover the same the work should be carried out as per standard Engineering practice subject to the approval of the Engineer-in-Charge/Site-in- Charge.

15.4. Should the work be suspended by reason of rain, strike, lockouts or other cause the contractor shall take all precautions necessary for the protection of the work and at his own expense shall make good any damages arising from any of these causes.

15.5 The contractor shall cover up and protect from injury from any cause all new work also for supplying all temporary doors, protection to windows and any other requisite protection for the whole of the works executed whether by himself or special tradesmen or sub- contractors and any damage caused must be made good by the contractors at his own expense.

15.6 If the contractor has quoted the items under the deemed exports, then it will be the responsibility of the contractor to get all the benefits under deemed exports from the Government. The Owner's responsibility shall only be limited to the issuance of required

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certificates. The quotation will be unconditional and phrases like “subject to availability of deemed exports benefit” etc. will not find place in it.

15. Integrity Pact : Effective 1st September, 2007, all tenders and contracts shall comply with the requirements of the Integrity Pact (IP) if the value of such tenders or contracts is r 1crore & above. Failure to sign the Integrity Pact shall lead to outright rejection of bid.

16. Grievances of parties participating or intend to participate in the tender shall be addressed in writing to the officer designate of the Grievance Redressal Cell where the tenders have to be submitted within the stipulated period. Detailed mechanism of Grievance Redressal is available on the BGL website

17. The guidelines for Holiday Listing as adopted and available on BGL website shall be applicable to all tenders floated and all Purchase Orders/Contracts placed by BGL.

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Section V: Special Conditions of Contract (SCC)

Note for Bidders: Following Special Conditions of Contract (SCC) shall apply for this procurement. These Special Conditions shall modify/ substitute/ supplement the corresponding (GCC / GTC) clauses as indicated below. Whenever there is any conflict between the provision in the GCC/ GTC and that in the SCC, the provision contained in the SCC shall prevail.

Special Terms and Conditions – Works Contracts

GCC Clause No.	Topic	To be Read as
GTC 1.7	Order of Precedence	The Order of Precedence of documents shall be as follows with document at level 1 having the highest precedence: - 1. Contract Agreement 2. Detailed SOR attached with Tender document 3. Detailed Letter of Acceptance along with its enclosures 4. Letter of Award / Fax of Acceptance 5. Job Specifications (specific to particular job only) 6. Drawings 7. TIS 8. NIT 9. Special Conditions of Contract / Purchase 10. Technical Specifications 11. AITB 12. Instructions to Bidders 13. General Conditions of Contract 14. Other Documents Any amendment / change order issued after signing of formal contract shall take precedence over respective clauses of the formal contract and its annexures.

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GTC 3.5	Escalation in tender rates	No change in the referred clause.
GTC 4a	Earnest Money Deposit	No change in the referred clause.
GTC 4b	Security Deposits	N As defined in AITB against ITB clause 13.2.4
GTC 5b	Commencement of Work	No change in the referred clause.
GTC 5g	Inspection of Works	No change in the referred clause.
GTC 5n	Defect Liability Period	No change in the referred clause.
GTC 6e	Insurance and Labour	The clause 6.e of General Terms and Conditions of Contract shall apply along with the following: Bidder shall carry out and maintain any and all Statutory Insurance(s) Requirements required under Indian laws and regulations, including Workmen Compensation Act/ Employee State Insurance/ Third Party Liabilities etc. and Insurances for their personnel engaged in performance of the work at Contractor's own cost. Irrespective of work acceptance, the responsibility to maintain adequate insurance coverage at all times during the period of Contract shall be that of Contractor alone. Contactor's failure in this regard shall not relieve him of any of his responsibilities and obligations under the contract. Contractor shall provide the Owner with a copy of all insurance policies and documents taken out by him in pursuance of the Contract. Such copies of documents shall be submitted to the Owner immediately upon the Contractor having taken such insurance coverage. Contractor shall also inform the Owner at least 60 (Sixty) days in advance regarding the expiry, cancellation and/or changes in any of such documents and ensure revalidation/renewal etc, as may be necessary well in time.

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GTC 7c	Retention Money	No change in the referred clause.
GTC 7d	Statutory Levies, Taxes and Duties	No change in the referred clause.
GTC 10	Price Reduction / Liquidated Damages Clause	**Liquidated Damages Clause** In case contractor fails to complete the work within the contract period as defined in Contract then unless such failure is due to force majeure as defined in Bid document, there will be reduction in contract price @ 0.5% for each week of delay or part thereof subject to maximum of 5% of contract price.
GTC 6a2	EMPLOYMENT LIABILITY OWARDS WORKERS EMPLOYED BY THE CONTRACTOR	In case of labour unrest/labour dispute arising out of non-implementation of any law, the responsibility shall solely lie with the CONTRACTOR and he shall remove/resolve the same satisfactorily at his cost and risk.
GTC 6a2	EMPLOYMENT LIABILITY OWARDS WORKERS EMPLOYED BY THE CONTRACTOR	The CONTRACTOR shall at all times take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or amongst his staff and labour and to preserve peace and protection of persons and properly in the neighbourhood of the Works against such conduct
GTC 7 E 1	CONSTRUCTION EQUIPMENT, TOOLS & TACKLES	CONTRACTOR shall be solely responsible for making available for executing the WORK, all requisite CONSTRUCTION EQUIPMENTS, Special Aids, Barges, Cranes and the like, all Tools, Tackles and Testing Equipment and Appliances, including Customs of such equipment etc. as required. In case of Customs of the same the rates applicable for levying of Custom Duty on such Equipment, Tools, & Tackles and the duty drawback applicable thereon shall be ascertained by the CONTRACTOR from the concerned authorities of Government of India. It shall be clearly understood that OWNER shall not in any way be responsible for arranging to obtain Custom Clearance and/or payment of any duties and/or duty draw backs etc. for such equipment's so imported by the CONTRACTOR and the CONTRACTOR shall be fully responsible for all taxes, duties and documentation with regard to the same.

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GTC 7e & 7f	CEMENT & STEEL	In partial modification to Clause. 7.e and 7.f (GTC-WORK CONTRACT), unless until specified explicitly in the tender, supply of cement and steel shall be arranged by Contractor

		and the cost of the same shall be deemed to be included in the quoted rates
		Appendix to SCC
1	**SCOPE OF WORK / SUPPLY**	The scope of work covered in this Contract will be as described in particular job specifications, Technical specifications, Standard Specifications, Schedule of Rates etc. The scope of supply covered in this Contract will be as described in Particular Job Specifications, Technical Specifications, Standard Specifications, Schedule of Rates etc. It is however, explicitly understood that scope described is not limiting, in so far as the responsibilities of the contractor are concerned and shall include, inter alia, carrying out any and all works and providing any and all facilities as are required to complete the works in all respect. Materials to be supplied by the Owner on free issue basis, if any, under this Contract will be as described in tender document.

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2	**OTHER REQUIREMENT**	For specific requirements, Contractor shall refer to the Technical Specification. Status of all clearances required for the works shall be provided to the Successful Bidder or Contractor, should there be any other requirement for execution of works the same shall be obtained by the Contractor at its own cost and statutory payments shall be reimbursed by Owner based on documentary evidence. Contractor shall, at his own responsibility and cost, supply & provide water, power and cement and other utilities for the entire job in the quantities and at the times required for performance of work under the contract. The contract price shall be deemed to include the costs towards the same. The owner/consultant shall not supply water, power, cement and other utilities. Contractor shall obtain transport permit for the access roads and other permits required for the execution of the works conforming to all the requirements of the Governing authorities. Contractor shall, if required by him, for the entire duration of the execution of the work make available near the site, land for construction of Contractor's office, Warehouse, Workshops

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		and for any purpose in connection with providing infrastructure required for the execution of the Contract. The Contractor shall at his own cost construct all temporary buildings and provide suitable water supply and sanitary arrangement as required. On completion of the work undertaken by the Contractor, he shall remove all temporary works erected by him and have the site cleared as directed by Engineer-in-Charge. If the Contractor shall fail to comply with these requirements, the Engineer-in-Charge may at the expense of the Contractor remove such surplus and rubbish materials and dispose off the same as he deems fit and get the site cleared as aforesaid, and the Contractor shall forthwith pay the amount of all expenses so incurred and shall have no claims in respect of any such surplus material disposed of as aforesaid. The CONTRACTOR shall not be permitted to enter on (other than for inspection purpose) or Take possession of site until instructed to do so by Owner / Consultant in writing. The portions of the site to be occupied by the CONTRACTOR shall be defined and/or marked on the site plan failing which these shall be indicated by Owner / Consultant at site and the operations beyond the areas, in respect of any land permitted by the Owner for the use of the CONTRACTOR for the purpose of or in connection with the Contract, the same shall be subject to the following and such other terms and condition as may be imposed by Owner. Such use or occupations shall not confer any right of tenancy of the land to the CONTRACTOR. The contractor shall submit fortnightly report covering all major activities indicating schedule / actual progress, near-misses, slippages & its reasons and catch up plan. The CONTRACTOR shall have no right to put up any construction of its own of any nature or type at the Site except temporary constructions for storage of equipment's for the work under the Contract or as a resting place for the laborer (workmen) employed by it for the work provided that it obtains the requisite previous permission in writing from Owner /Consultant. Owner may refuse such permission in its absolute discretion or grant conditional permission, as it may deem appropriate. Such construction will be erected at the CONTRACTOR's own

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		cost. The CONTRACTOR shall at its own cost demolish all such constructions and remove the debris thereof. As also all its materials and equipment's and clean and level the site thereof before handing over the completed work to the Owner. The CONTRACTOR shall provide if necessary or if required for the site all temporary access thereof and shall alter adapt and maintain the same as required from time to time and shall take up and clear them away as and when no longer required and as and when ordered by Owner/ Consultant and make good all damages done at /to the site. The CONTRACTOR shall note that the final bill will not be certified for payment till the action as above is completed by the CONTRACTOR to the entire satisfaction of Owner / Consultant. All drawings, tracings, photo prints and writing (except letter) shall be the sole property of Owner and must be returned to them on completion of work. The drawings maintained on the site are to be carefully mounted on boards of appropriate size. They are to be protected from ravages from termites, ants, silverfish and other insects. The completion of the work may require working in the monsoon also. The CONTRACTOR must maintain labour force as may be required for the job and plan and execute the construction and erection according to the prescribed schedule. No extra rate will be considered for such work in monsoon. The time schedule includes monsoon window period also. Hence request for time extension due to monsoon shall not ordinarily be entertained by Owner. During the execution of the work CONTRACTOR shall check its work with drawings. The CONTRACTOR shall be responsible for all the errors in this connection and shall have to rectify all defects and / or error at its own cost failing which BGL reserves the rights to get the same rectified at the risk and cost of the CONTRACTOR. During inclement weather the CONTRACTOR shall suspend concreting and plastering for such time as Owner/ Consultant may direct and shall protect from injury all works in the course of erection.

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		Should the work be suspended by reason of rain, strike, lockouts or other cause the CONTRACTOR shall take all precautions necessary for the protection of the work at its own expense shall make good any damages arising from any such cause. All rubbish including muck and water, as it accumulates from time to time during the progress of the work shall be cleared through proper drainage arrangement so as not to hamper the progress of various other site works in progress. The CONTRACTOR shall provide suitable pillar with flat tops and build the same in concrete for temporary benchmarks. All the pegs for setting out the works and fixing the necessary levels required for the execution thereof shall if desired by Owner/ Consultant likewise be built in masonry at such places and in such manner as the Owner may determine. The CONTRACTOR shall cover up and protect from injury due to any cause to all new work and any other requisite protection for the whole of the works executed whether by itself or special tradesman or sub- CONTRACTORs and any damage caused must be made good by the CONTRACTORs at its own expense. Cutting of trees shall not be permitted except in the case that tree is falling on the line of ROU/ROW. In such circumstances, details of such tree being cut shall be prepared and forest/ municipal authorities be informed, and necessary approval be obtained by contractor.
3	**BID PRICES**	Price must be furnished in the Price Schedule format available online in e-tender portal of BGL. Quoted prices must be net of discount, if any. Conditional discounts, if offered by a bidder, shall not be considered for evaluation. Unless otherwise agreed to in the terms of the Work / Purchase Order, the price shall be firm and not subject to escalation for any reason whatsoever till the execution of entire order, even though it might be necessary for the order execution to take longer than the delivery period specified in the order. Price shall be exclusive of GST (CGST, SGST, IGST as applicable), Customs Duty and applicable cess, which are leviable by law on

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		sale of finished goods to Corporation. The nature and extent of such levies shall be shown separately. Quoted prices shall be inclusive of all testing and inspection requirements (including stage wise and final inspection by Owner/ Owner's Consultant for which no extra charges shall be paid) as specified in the bid document. It shall be contractor's sole responsibility to co-ordinate with all the stakeholders including vendors and expedite the equipment / package delivery to meet the project schedule. The Contractor's qualified QC engineer shall be present for all the Inspection activities along with Consultant / Owner at sub-vendors workshop / site. On award of contract, the bidder / contractor shall submit the detailed Inspection Categorization plan for all the packages / equipment's in the tendered works for Consultant / Owner's approval. In case the material gets rejected / does not fulfil acceptance criteria as per technical requirements then it shall be sole responsibility of the contractor to carry out rectification or arrange for replacement of part or full equipment / package as required, without any time and cost implication to the Owner / Consultant. Also in such an event, bidder shall be responsible for carrying out the re-inspections from consultant appointed TPIA at their own cost. Bidder's quoted prices shall be firm & fixed till the completion of the works in all respects and no escalation in prices on any other account shall be admissible to the contractor. The quoted prices shall be deemed to include entire scope of work and all obligations and responsibilities to be carried out/ executed by the Bidder as per terms of bid document. The quoted base price shall be inclusive of Mandatory Spares, Pre-Commissioning & Commissioning Spares, and Special Tools & Tackles for Complete items as per technical specifications. It shall be the responsibility of the Bidder to duly enquire of their own and comply with all applicable laws, rules, regulations, orders and formalities applicable to GST, Customs Duty, Countervailing Duty etc. on the manufacture, sale and/or supply

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		of any material / services to Owner / Consultant. The Bidder shall keep the Owner / Consultant indemnified from and against any and all claims, demands, prosecutions, penalties, damages, demurrages and/or other levies whatsoever made or levied by any Court, Tribunal or the Customs or other Authorities with respect to any alleged breach, evasion or infraction of such duties, taxes, charges or levies or any breach or infraction of such laws, rules, regulations, orders or formalities concerning the same and from the consequence thereof. Price quoted by the bidder, shall remain Firm & Fixed until complete execution of the Work / Purchase Order and shall not be subject to any variation, except statutory variation in taxes, duties & levies pursuant to relevant provisions in Special Terms and Conditions of Contract. The Bidder's quoted price shall also remain Firm and Fixed on account of Foreign Exchange (FE) Variation, unless otherwise any specific provision is indicated in IFB document. The bidder shall quote the prices after careful analysis of cost involved for the performance of complete work considering all parts of the IFB documents. In case, any activity though specifically not covered but is required to complete the work as per scope of work, scope of supply, specifications, standards, drawings, GTC, STC or any other part of IFB Document, the prices quoted shall deemed to be inclusive of cost incurred for such activity(ies). Bidder to note and consider the following: a) Suppliers/Contractors shall arrange Road Permits/Waybills by themselves and comply with the statutory laws of the concerned state. b) In case as per state laws the issuance of Road Permit/Waybill is to be arranged by the buyer, BGL will arrange to issue Road Permit/Waybill. In case of imposition of any Tax the same shall be discharged by the buyer and the same will be adjusted against the payments due to vendors against their bills. Bidders shall quote their prices in Indian Rupees and only indicate the following in their offer:

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		Site work Prices, if applicable as per the scope of work mentioned in tender documents, shall be exclusive of Prevailing GST. All necessary taxes & duties and registration, if required, for carrying out the site activities shall be done by the bidder and cost towards the same shall be included in quoted site work prices. GST Tax, payable extra on Site Work Services, as applicable. The entire work covered under this contract shall be treated as **"Works Contract".**
4	**TIME OF COMPLETION**	The work shall be executed strictly as per time Schedule mentioned elsewhere in the Bidding document. The period of completion given includes the time required for mobilization as well as testing, rectifications, if any, retesting and completion in all respects to the entire satisfaction of the Engineer-in-Charge. The work for each part shall commence concurrently. The Engineer-in-Charge and Contractor will prepare a joint program of execution of work. This program will take into account the time of completion mentioned above. Monthly/ weekly construction program will be drawn up by Engineer-in-Charge jointly with the Contractor based on availability of work fronts and the joint construction programs as per the above clause. The Contractor shall scrupulously adhere to these targets / programme by deploying adequate personnel, construction tools & tackles and it shall also supply itself all materials within its scope of supply in good time to achieve the targets set out in the weekly and monthly programme. In all matters concerning the extent of targets set out in the weekly and achievements, the decision of the Engineer-in-Charge shall be final and binding on the Contractor. If the Contractor fails to achieve the targeted progress schedule of each month as mentioned in the IFB, the Owner at its option, may terminate the Contract as Contractor's default and get the work completed from other sources at Contractor's risk, consequence and cost. Contractor shall give every day report on category wise labour and equipment deployed along with the progress of work done

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		on previous day in the proforma prescribed by the Engineer-inCharge. The Contractor shall submit fortnightly report covering all major activities indicating schedule /actual progress, slippages & its reasons and catch up plan.
5	**COMPENSATION FOR IDLE TIME**	The Owner shall make every reasonable effort to have free issue materials and right - of - use (ROU) available so as not to delay laying activities. No Idle time claim shall be entertained under any circumstances
6	**WORK ON SUNDAYS, HOLIDAYS AND DURING NIGHT HOURS:**	Contractor will be allowed to work on Sundays, holidays and during night hours only after obtaining prior written approval of Engineer-in-charge / Owner, but in no case at any extra cost or charges to the Owner for such work subject, however, to the statutory restrictions, if any, in respect thereof.
7	**PROGRESS REPORTS:**	All reports, progress charts etc. as required by Site Engineer or by the Owner shall be kept available at bidder's site office. The same shall be submitted to Site Engineer or the Owner as and when required without any charge to either the Site Engineer or Owner.
8	**LABOUR AT SITE:**	No labour shall be allowed to stay at site. The bidder shall obtain prior permission of the Owner for the watchman who will be required to stay at the site. The bidder shall arrange to provide due facilities to his labour at site. He will keep his temporary office, shed, etc. reasonably clean at all times
9	**LABOUR RELATIONS**	The following shall be appended as relevant clause of GTC-Works Contract. In case of labour unrest/labour dispute arising out of non-implementation of any law, the responsibility shall solely lie with the CONTRACTOR, and he shall remove/resolve the same satisfactorily at his cost and risk. The following shall be appended as sub clause no. 6.a.3 to clause no. 6.a of GTC-Works Contract.

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		The CONTRACTOR shall at all times take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or amongst his staff and labour and to preserve peace and protection of persons and properly in the neighbourhood of the Works against such conduct.
10	**SITE FACILITIES:**	**Power Supply.** Contractor shall arrange at his own cost power supply distribution for the site. All works by the Contractor will be done as per Indian Electricity Act & Rules framed there under and passed by the Engineer-in –charge. The temporary lines will be removed forthwith, after completion of the work or if there is any hindrance caused to other work due to the alignment of these lines, the Contractor will re-route or remove the temporary lines at his own cost. The Contract Price shall be deemed to include all costs towards all above. **Water Supply.** The water required for construction and drinking shall be arranged by the Contractor at his own cost. The Contract Price shall be deemed to include all costs towards all above. Contractor shall be provided with some area within the site premises for Site Office / Fabrication Yard / Warehouse. Any additional area if required by Contractor for execution of the works shall be arranged by them at their own cost preferably at a location in close proximity to site. On completion of the relevant works undertaken by the Contractor, it shall remove all temporary works erected by it and have the site cleared as directed by Engineer-in-Charge. If the Contractor shall fail to comply with these requirements, the Engineer-in-Charge may at the expense of the Contractor remove such surplus and rubbish materials and dispose off the same as he deems fit and get the site cleared as aforesaid, and the Contractor shall forthwith pay the amount of all expenses so incurred and shall have no claims in respect of any such surplus material disposed of as aforesaid. Besides providing site facilities as per law of land, site camps with all related amenities shall be provided in line with the requirements of all Regulations/Acts and the Statutory

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		Authorities along with the following facilities at all work places where workmen are deployed / engaged by contractor: i) Arrangement for First Aid. ii) Arrangement for clean & potable drinking water & Tea, etc. iii) A creche where 10 or more women workers are having children below the age of 6 years. iv) Any other facility/utility as may be required under the Contract as per the existing legislation. v) Rest rooms / toilets for site staff / labour. vi) Proper Rest Facility with drinking water during lunch period.
11	**COMPLIANCE WITH LAWS:**	The Contractor shall abide by all applicable rules, regulations, statutes, laws, as amended from time to time governing the performance of works in India, including but not limited to the following: a. Indian Explosives Act, 1984. b. The Motor Vehicles Act, 1988. c. The Factories Act 1949. d. The Petroleum Act, 2002. e. Workman's Compensation Act 1923. f. Static/Mobile Pressure Vessel Act, g. Indian Electricity Act, h. Indian Boiler Act, 1923. i. Water (Prevention & Control Pollution) Act, 1974. j. Water (Prevention & Control of Pollution) Cess Act-1977. k. The Air (Prevention & Control of Pollution) Act-1981. l. The Radiation Protection Rules-1971 m. The Indian Forest Act-1927. n. The Environment [Protection] Act 1986. o. The Environment (Protection) Rules-1986.

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		p. The Hazardous Wastes (Management & Handling) Rules-1989. q. The Manufacture, Storage & import of Hazardous Chemicals Rules-1989. r. Wildlife Act 1972 and Wildlife [Protection] Act 2006. s. Contract Labour (Regulation & Abolition) Act 1970 & the centre rules1971 framed there under t. The Central Motor Vehicle Rule-1989. u. Payment of Wages Act 1936. v. Minimum Wages Act 1948. w. Employer's Liability Act 1938. x. Apprentices Act 1961. y. Industrial Disputes Act 1947. z. Merchant Maritime Act1920 aa. Building and other Construction workers Act 1996 bb. Employees' State Insurance Act 1948 cc. Employees' Provident Fund and Miscellaneous Provisions Act, 1952 dd. Any other Statute, Act, Law as may be applicable.
12	**PROVIDENT FUND**	The Contractor shall strictly comply with the provisions of Employees Provident Fund Act and register themselves with RPFC before commencing work. The Contractor shall deposit Employees and Employers contributions to the RPFC every month. The Contractor shall furnish along with each running bill, the challan/ receipt for the payment made to the RPFC for the preceding months.
13	**CONSTRUCTION EQUIPMENT, TOOLS & TACKLES**	Contractor shall be solely responsible for making available for executing the work, all requisite equipment, special aids, crane, tools, tackles and testing equipment and appliances suitable and required for the entire

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		job including the stations works for installation of both free issue material and contractor bought out items. Such equipment etc. shall have applicable safety/fitness certificates as applicable under Government Rules/Laws and shall be subject to examination and approval by Owner for the same being in first class operating condition. Any discrepancies pointed out by Owner shall be immediately got rectified, repaired or the equipment replaced altogether, by Contractor. Owner shall not in any way be responsible for providing any such equipment machinery, tools and tackles etc. The Contractor shall without prejudice to his overall responsibility to execute and complete the work as per specifications and time schedule, progressively arrange and deploy adequate equipment's and tools and tackles as per construction plan approved by Owner at construction site and augment the same as decided by the Engineer-in-Charge depending on the exigencies of the work so as to suit the construction schedule, without any additional cost to Owner. 16.3 Total Stations, Theodolite for survey, Dumpy levels, plump bobs, prismatic compass, chain, steel and metallic tape as a minimum and all other surveying instruments found necessary for the works at all the stations shall be provided by the CONTRACTOR for the due performance of their contracts as instructed by Owner/ Consultant. Owner/ Consultant. will use any or all measure instruments or tools belonging to the CONTRACTOR as and when he chooses for checking the completed works as well as the work in progress. All scaffolding and ladders that may be necessary for taking measurements at site will be provided by the CONTRACTOR. Contractor shall provide minimum requirement of equipment's / Machinery as per Annexure 1 of STC.
14	**CHANGE ORDERS**	A change order will be initiated in case: The Owner directs the Contractor to include any addition to the scope of work not covered under this contract or deletes any part of the scope of the work under the contract. Contractor requests to delete any part of the work which will not adversely affect the operational

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		capabilities of the project and if agreed by the Owner and for which cost and time benefits shall be passed on to the Owner. Any changes required by the Owner before giving their approval to detailed procedure or any other document relating to material procurement, layout plans etc for complying with the requirements of bidding document shall not be construed to be a change in the scope of work under the contract. Any change order as above comprising an alteration which involves a change in the cost of the works (which sort of alteration is hereinafter called a "Variation") shall be the subject of an amendment to the contract by way of an increase or decrease in the contract price and adjustment of the Construction Schedule if any. If the contract provides applicable rates for the valuation of the variation in question the contract price shall be increased or decreased in accordance with those rates. If the parties agree that the contract does not contain applicable rates then the parties shall negotiate a revision of the contract price which shall represent the change in cost of the works caused by the variations. Any change order must be duly approved by the Owner in writing. If there is a difference of opinion between Contractor and Owner whether a particular work constitutes a change order or not, the matter shall be handled in accordance with the procedures as defined below. Within 10 (Ten) working days of receiving the comments from the Owner on the documents submitted by the Contractor for approval, the Contractor's response in writing stating which item(s) is/are potential change (s), if applicable, will be submitted to the Owner. **Procedure** During execution of work if the Contractor observes that any new requirements which is not specific or intended in the bidding document has been indicated by Owner, they shall discuss the matter with Owner's representatives.

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		In case such requirement arises from the side of the Contractor they would also discuss the matter with Owner's Representative. In either of the two cases above, the representatives of both the parties shall discuss the project requirement and mutually decide whether the project requirement constitutes a change order. If it is mutually agreed that the project requirement/Inquiry constitutes a "Change Order" then a joint memorandum will be prepared to confirm a "Change Order" and basic ideas of necessary agreed modifications. Contractor will study the work required in accordance with the Joint memorandum and assess subsequent schedule and cost effect if any. The results of this study would be discussed mutually to enable Owner to give a final decision whether Contractor should proceed with the Change Order or not, in the best interest of the Project. If Owner's representative accepts the change order in writing, then Contractor shall proceed with the work stipulated in the Change order. Time worked by all workmen employed and a statement showing the description and quantity of all materials and plant utilised for extra work shall be submitted to Owner. The Owner's representative shall sign and return to the Contractor the statement, as agreed. At the end of each month the Contractor shall deliver to the Owner's representative a priced statement of the labour, materials and plant used. Whenever any dispute arises as to cost allocation between the Contractor and the Owner, the voucher shall nevertheless be signed by the Owner as a record of time worked and materials used. List and vouchers so signed will be the subject of negotiations between the Owner and the Contractor regarding their costs allocation. In case, mutual agreement as above that is whether Project Requirement constitutes a Change order or not, is not reached, then Contractor, in the interest of the project, shall take up the implementation of the work, if advised in writing to do so by Owner's representative pending settlement between the two

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		parties to the effect whether the Project Requirement constitutes a change order or not as per the terms and conditions of Contract Documents. The time and cost effect in such a case shall be mutually verified for the purpose of record. Should it be established that the said work constitutes a Change Order, the same shall be compensated taking into account the records kept and in accordance with the contract. Should the amount of extra work/ change order, if any, which the Contractor may be required to perform under instructions from the Owner, fairly entitle the Contractor to extensions of time beyond the scheduled completion date for completion of either the whole of the works or for such extra work only, the Owner and the Contractor shall mutually discuss and decide the extension of time, if any to be granted to the Contractor. Contractor should bring into notice of Owner/Owner representative if any quantity exceeds from the quantity mentioned in SOR and take approval before further execution of any such quantity, failing to which contractor is not liable for any extra claim for the same and no change order will be issued in this regard.
15	**CONSTRUCTION EQUIPMENT AND ORGANIZATION**	**CONSTRUCTION EQUIPMENT** The CONTRACTOR shall without prejudice to his overall responsibility to execute and complete the work as per specifications and time schedule deploy construction equipment and tools & tackles and augment the same as decided by the Engineer-in- Charge depending on the site requirement & exigencies of the work so as to complete all works within the contracted time schedule and without any additional cost to OWNER. No construction equipment shall be supplied by the OWNER. CONTRACTOR to ensure deployment of suitable equipment and take all safety precautions during execution of work. CONTRACTOR shall be solely responsible for making available for executing the WORK, all requisite CONSTRUCTION EQUIPMENTS, Special Aids, Barges, Cranes and the like, all Tools, Tackles and Testing Equipment and Appliances, including

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		imports of such equipment etc. as required. In case of import of the same the rates applicable for levying of Custom Duty on such Equipment, Tools, & Tackles and the duty drawback applicable thereon shall be ascertained by the CONTRACTOR from the concerned authorities of Government of India. It shall be clearly understood that OWNER shall not in any way be responsible for arranging to obtain Custom Clearance and/or payment of any duties and/or duty draw backs etc. for such equipment's so imported by the CONTRACTOR and the CONTRACTOR shall be fully responsible for all taxes, duties and documentation with regard to the same. Tenderer in his own interest may contact, for any clarifications in the matter, concerned agencies/Dept./Ministries of Govt. of India. All clarifications so obtained, and interpretations thereof shall be solely the responsibility of the CONTRACTOR. **Schedule of Labor Rates** Hiring / Recovery Rate for Deployment of Manpower attached as mentioned in clause no. 38 below shall be used for analysing rates for recovery for non- deployment of manpower. **SITE ORGANISATION** Subject to the provisions in the contract document and without prejudice to CONTRACTOR's liabilities and responsibilities to provide adequate qualified skilled, semiskilled and unskilled personnel on the work, CONTRACTOR shall deploy supervisory personnel as mentioned in tender documents and augment the same as decided by the Engineer-in-Charge depending upon the site requirement & the exigencies of work so as to complete all works within the contracted time schedule and without any additional cost to OWNER. Qualification and experience of Key Supervisory Personnel to be deployed for this work shall be as mentioned in Special Terms and Conditions.
16	**MEASUREMENT OF WORK**	Payments will be based on the actual measurements jointly taken by the Engineer-in-

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		Charge/Owner's representative and the Contractor. All payments will be made on the basis of actual measurements only
17	**PRICE REDUCTION FOR DELAY IN DELIVERY / LIQUIDATED DAMAGE**	In partial modifications of the General terms and conditions of Works contract, in the event of delay beyond the Contractual progressive delivery dates for reasons not attributable to Owner and not constituting conditions of force majeure, it will be at Owner's discretion, without prejudice to his other rights under the contract, to accept delayed delivery at the prices reduced as per the following: Time allowed for carrying out the work as mentioned in bidding document shall be strictly adhered to by the Contractor. Work shall be carried out with all the diligence throughout the stipulated period of the contract. Value/Quantum of completed job as on the date of Contractual Delivery Date (CDD) shall be recorded jointly by the Contractor, Consultant/Owner. The price reduction for slippage shall be equal to 0.5% per week of delay or part thereof and on the undelivered portion of the contract price as on CDD. Total Price reduction shall be subject to ceiling of 5% of the undelivered portion of the contract price. Second Crop/additional compensations to be paid to landowners due to fault of vendor will be recovered from the vendor.
18	**STATUTORY APPROVALS**	The approval from any authority required as per statutory rules and regulations of Central/State Government/Local Bodies shall be the contractor's responsibility unless otherwise specified in the bid document. The application on behalf of the Owner for submission to relevant authorities along with copies of required certificates complete in all respects shall be prepared and submitted by the Contractor well ahead of time so that the actual construction/ commissioning of the work is not delayed for want of the approval/inspection by concerned authorities. The Contractor shall arrange the inspection of the works by the authorities and necessary coordination and liaison work in this

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		respect shall be the responsibility of the contractor. However statutory fees paid, if any, for all inspections and approvals to such authorities shall be reimbursed at actual by the Owner to the contractor on production of documentary evidence. Any change/ addition required to be made to meet the requirements of the statutory authorities shall be carried out by the contractor without additional cost to Owner. The inspection and acceptance of the work by statutory authorities shall however, not absolve the contractor from any of his responsibilities under this contract.
19	**TESTS AND INSPECTION**	The Contractor shall carry out various tests as enumerated in the technical specifications of the bidding document and the technical documents that will be furnished to him during the performance of the work. All the tests either on the field or at outside laboratories concerning the execution of the work and supply of materials by the Contractor shall be carried out by Contractor at his own cost. The work is subject to inspection at all times by the BGL/TE. The contractor shall carry out all instructions given during inspection and shall ensure that the work is being carried out according to the technical specifications of bid document, the technical documents and the relevant codes of practice will be furnished to him during the performance of the work. The Contractor shall provide for purposes of inspection access ladders, lighting and necessary instruments at his own cost. Any work not conforming to execution drawings, specifications or codes shall be rejected forthwith and the Contractor shall carryout the rectifications at his own cost. All results of inspection and tests will be recorded in the inspection reports, proforma of which will be approved by the Engineer-in-Charge. These reports shall form part of the completion documents. For materials supplied by Owner, Contractor shall carryout the tests, if required by the Engineer-in- Charge, and the Owner

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		shall reimburse the cost of such tests at actual to the Contractor on production of documentary evidence. Statutory fees paid to IBR authorities and for repeat tests and inspection due to failures, repairs etc. such reasons attributable to the Contractor shall be borne by the Contractor. Inspection and acceptance of work shall not relieve the Contractor from any of his responsibilities under this Contract.
20	**INSPECTION OF SUPPLY ITEMS/ MATERIALS**	All inspection and tests on bought out items/ materials shall be made as per the specifications forming part of this contract. Various stages of inspection and testing (for ingredients/ execution quality/ execution workmanship/ Post execution) shall be identified after receipt of Quality Assurance Program from the Contractor/Manufacturer. Inspection calls shall be given for associations of Owner/ Consultant's representative as per mutually agreed program in prescribed proforma with 15 days margin, giving details of equipment and attaching relevant test certificates and internal inspection report of the Contractor. All drawings, General Arrangement and other contract drawings, specifications, catalogues etc. pertaining to equipment offered for inspection shall be got approved from Owner/Consultant and copies shall be made available to Owner/Consultant beforehand for undertaking inspection. The Contractor shall ensure full and free access to the inspection engineer of Owner/Consultant at the Contractor's or their sub-contractor's premises at any time during contract period to facilitate him to carry out inspection and testing assignments. The Contractor/sub-contractor shall provide all instruments, tools, necessary testing and other inspection facilities to inspection engineer of Owner/Consultant free of cost for carrying out inspection. Where facilities for testing do not exist in the Contractor's/sub-contractor's laboratories, samples and test pieces shall be drawn by the Contractor/Subcontractor in presence of Inspection Engineer of Owner/Consultant and duly sealed by the later and sent for testing in NABL approved Test House or

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		any other testing laboratories approved by the Inspection Engineer at the Contractor's cost. It is sole responsibility of Contractor to ensure facilitation of Inspection for all the bought-out items & timely completion of the delivery of such items to site locations without leading to impact the construction schedule. Any changes / re-inspection required to be carried out due to non-compliance to the technical requirements will be sole responsibility of the contractor. Contractor shall perform these actions without any time & cost implications to Owner / Consultant.
21	**TEST CERTIFICATES**	Bidder shall be required to submit recent test certificates for the material being used in works from the recognized laboratories. These certificates should indicate all properties of the materials as required in relevant IS Standards or International Standards. Contractor shall also submit the test certificate with every batch of material supplied which will be approved by Engineer-in-Charge. In case any test is to be carried out, the same shall be got done at the discretion of the Owner/Consultant in the approved laboratory at the cost of contractor. No secured advance will be given for the materials not having test Certificates.
22	**FINAL INSPECTION**	After completion of all tests as per specification the whole work will be subject to a final inspection to ensure that job has been completed as per requirement. If any defects noticed in the work attributable to Contractor, the Contractor at his own cost shall attend and rectify these defects, as and when the owner brings them to his notice. The Owner/Consultant shall have the right to have these defects rectified at the risk and cost of the contractor if he fails to attend to these defects immediately.
23	**HEALTH SAFETY AND ENVIRONMENT (HSE) MANAGEMENT**	The Contractor, during entire duration of the Contract, shall adhere to HSE requirement as per HSE MANAGMENENT Specifications provided in Tender Documents. The contractor shall engage qualified and experienced HSE Engineer at each location. The qualification and experience of

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		such personnel shall not be less than what specified in Tender Documents
24	**COMPUTERIZED CONTRACTORS BILLING SYSTEM**	Without prejudice to stipulation in Terms and Conditions of Works Contract, the Contractor should follow the printed / typed billing system. The bills will be prepared by the Contractor on their own PCs as per the standard formats and codification scheme proposed by Owner/Consultant. The Contractor will be provided with data entry format to capture the relevant billing data for subsequent processing. Contractor will submit these data to Owner/Consultant in an electronic media along with the hard copy of the bill, necessary enclosures and documents. The Contractor will also ensure the correctness and consistency of data so entered with the hard copy of the bill submitted for payment. Owner/Consultant will utilize these data for processing and verification of the Contractor's bill and payment.
25	**INSURANCE FOR FREE ISSUE MATERIAL**	Not Applicable for this tender.
26	**MAKE OF MATERIAL**	The materials required to be supplied by the Bidder under this Contract shall be procured only from Owner / Consultant approved vendors. Where the makes of materials are not indicated in the IFB, Bidder shall furnish the details (Past track record / credentials) of proposed makes and shall obtain prior approval of Owner / Consultant. Bidder shall not procure any item from vendors not approved by Consultant/ Owner. Bidder is also required to ensure that equipment qualification criteria, specified elsewhere in the bid document, are also simultaneously met. Bidder shall make an independent assessment of capability of all the vendors for timely deliveries of material / equipment. Any delays in deliveries by vendor(s) shall not be a cause of Schedule and cost implication. Non-acceptance of a particular proposed Makes /vendor due to any reasons whatsoever shall not be a cause of Schedule and cost implication to the Owner.

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		At any stage of the project, if it comes to the notice of Owner/ Consultant that Vendor has procured material / equipment, intentionally or unintentionally whatsoever, from an unapproved vendor and/or items not falling in approved range of vendor(s), the same shall be rejected forthwith and Vendor shall be liable to replace such material /plant / machinery without any Schedule and cost implication to the Owner. It is understood that should the name of Vendor be changed due to change in their Company or Corporate shareholding, Owner may accept such Vendors under its new name with prior approval. Any such approval shall however, not absolve the Vendor from any of his obligations under the contract; neither shall any such approval signify nominations or instruction to use such a vendor. All approved vendors are deemed to have been freely chosen by the VENDOR at his own risk.
27	**SETTLEMENT OF DISPUTE BETWEEN TWO PSUS**	In the event of any disputes or difference relating to the interpretation and application of the provisions of the contracts, such disputes or differences shall be referred by either party to the Arbitration in the Department of Public Enterprises nominated by the Secretary to the Govt. of India in charge of the Board of Public Enterprises, Govt. of India. The Arbitration and Conciliation of shall not be applicable to such arbitration. The award of the Arbitrator shall be binding upon the parties to the dispute, provided, however, any party aggrieved by such award may make a further reference for setting aside or revision of the award to the Law Secretary, Ministry of Law and Justice, Government of India. Upon such reference the dispute shall be decided by the Law Secretary cc the Special Additional Secretary when so authorized by the Law Secretary whose decision shall bind the parties finally and conclusively. The parties to the dispute will share equally the cost of arbitration as intimated by the Arbitrator. Since this is a Domestic tender hence Conciliation clause is applicable in place of Arbitration.
28	**ADDITIONAL WORKS/ EXTRA WORKS**	Owner reserves their right to execute any additional works/ extra works, during the execution of work, either by themselves or by appointing any other agency even though such works are incidental to and necessary for the completion

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		of works awarded to the Contractor. In the event of such decisions taken by Owner, Contractor is required to extend necessary cooperation, and act as per the instructions of Engineer-in-Charge. No extra time/cost compensation will be made by Owner/Consultant.
29	**GUARANTEE**	Contractor needs to replace/repair or reinstall free of cost any material/equipment supplied by him in case it fails to operate due to defective materials or workmanship as per requirements of this specification within Twelve (12) months from the date of issue of completion certificate and/or the date of Owner taking over the work, whichever is earlier, in line to General Terms and Condition of Work Contract thereby acceptance of the entire system by Owner. Contractor shall replace at his own cost if any item found defective or missing before handing over the system to Owner. The decision of Engineer-in-Charge/Owner shall be final and binding in this regard. The guarantee for such rectified/replaced item shall be for a period of 12 months from completion of such rectification/replacement.
30	**LIMITATION OF LIABILITIES**	The final payment by the Owner in pursuance of the contract terms shall not mean release of the Contractor from all his liabilities under the contract. The Contractor will be liable and committed under this contract to fulfil all his liabilities and responsibilities, till such time the Owner releases Contract Performance Guarantee. Contractor's over all liability towards execution of the Contract will not exceed 100% (One hundred Percent) of the total Contract Price without prejudice to any other rights Owner may have as per terms & conditions of the Contract. Provided, this cap on liability of the Contractor shall not apply in case of loss or damage arising out of (i) negligence of the Contractor or any person engaged by the Contractor and or (ii) infringement of any intellectual property by Contractor or any person engaged by the Contractor and or (iii) statutory liability.
31	**GOVERNMENT OF INDIA NOT LIABLE**	It is expressly understood and agreed by and between Bidder and M/s BHAGYANAGAR GAS LIMITED is entering into

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		this agreement solely on its own behalf and not on behalf of any other person or entity. In particular, it is expressly understood and agreed that the Government of India is not a party to this agreement and has no liabilities, obligations or rights hereunder. It is expressly understood and agreed that M/s BHAGYANAGAR GAS LIMITED is an independent legal entity with power and authority to enter into contracts solely on its own behalf under the applicable Laws of India and general principles of Contract Law. The Bidder expressly agrees, acknowledges and understands that M/s BHAGYANAGAR GAS LIMITEDisnot an agent, representative or delegate of the Government of India. It is further understood and agreed that the Government of India is not and shall not be liable for any acts, omissions, commissions, breaches or other wrongs arising out of the contract. Accordingly, Bidder hereby expressly waives, releases and foregoes any and all actions or claims, including cross claims, impleader claims or counter claims against the Government of India arising out of this contract and covenants not to sue to Government of India as to any manner, claim, cause of action or thing whatsoever arising of or under this agreement.
32	**ISSUE OF OWNER SUPPLIED MATERIAL**	Not Applicable for this tender.
33	**LOCATION OF DUMPYARD / WAREHOUSE / STORAGE YARD**	Not Applicable for this tender.
34	**QUALITY ASSURANCE/ QUALITY CONTROL**	Bidder shall include in his offer the Quality Assurance Program containing the overall quality management and procedures, which is required to be adhered to during the execution of contract. After the award of the contract detailed quality assurance program shall be prepared by the contractor for the execution of contract for various works, which will be mutually discussed and agreed to. The Contractor shall establish document and maintain an effective quality assurance system outlined in recognized codes.

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		Quality Assurance System plans/procedures of the Contractor shall be furnished in the form of a QA manual. This document should cover details of the personnel responsible for the Quality Assurance, plans or procedures to be followed for quality control in respect of Design, Engineering, Procurement, Supply, Installation, Testing and Commissioning. The quality assurance system should indicate organizational approach for quality control and quality assurance of the construction activities, at all stages of work at site as well as at manufacturer's works and dispatch of materials. The Owner/Consultant or their representative shall reserve the right to inspect/witness, review any or all stages of work at shop/site as deemed necessary for quality assurance. The contractor has to ensure the deployment of quality Assurance and Quality Control Engineer(s) depending upon the quantum of work. This QA/QC group shall be fully responsible to carry out the work as per standards and all code requirements. In case Engineer-in-charge feels that contractor's QA/QC Engineer(s) are incompetent or insufficient, contractor has to deploy other experienced Engineer(s) as per site requirement and to the full satisfaction of Engineer-In-Charge. In case contractor fails to follow the instructions of Engineer-in-charge with respect to above clauses, next payment due to him shall not be released unless and until he complies with the instructions to the full satisfaction of Engineer-in-charge. The Contractor shall adhere to the quality assurance system as provided in tender documents. Contractor shall provide all information and along with the consultant maintain C.T.E Registers. 38.9 The contractor shall engage a full time Quality Assurance/QC Engineer for each location as defined in tender document. Contractor shall use stage wise Checklist to ensure that all the construction activities are carried out complying with Specifications, Codes & Standards, Typical formats of Checklist are as per Technical Specifications. These are attached separately with this Tender.

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35	**MOBILIZATION ADVANCE**	NOT APPLICABLE FOR THIS TENDER
36	**DISTINCTION BETWEEN FOUNDATION AND SUPERSTRUCTURE**	To distinguish between work in foundations and superstructures, the following criteria shall apply: For all Equipment pedestals, pipe racks, other foundation and R.C.C. Structures, work done up to 300 mm level above finished grade level will be taken as work in foundations and work above this level will be treated as work in superstructures and payments would be made accordingly. For Buildings only, all works upto level corresponding to finished floor level shall be treated as `Work in foundation' and all works above the finished floor level shall be treated as "Work in superstructure". Irrespective of what has been stated above, all pavements, R.C.C. Retaining wall, all pipe sleepers and any similar item would be taken as work done in foundations irrespective of locations, nomenclature and levels given anywhere. Where not specifically pointed out all works in Cellars/ sumps, Tank Pads, Cable trenches, or such similar item would be taken as work in foundation.
37	**SITE CLEANING**	The Contractor shall clean and keep clean the work site from time to time to the satisfaction of the Engineer- in-Charge for easy access to work site and to ensure safe passage, movement and working. If the work involves dismantling of any existing structure in whole or in part, care shall be taken to limit the dismantling up to the exact point and/or lines as directed by the Engineer-in-Charge and any damage caused to the existing structure beyond the said line or point shall be repaired and restored to the original condition at the Contractor's cost and risks to the satisfaction of the Engineer-in-Charge, whose decision shall be final and binding upon the Contractor. The Contractor shall be the custodian of the dismantled materials till the Engineer-in-Charge takes charge thereof. The Contractor shall dispose of the unserviceable materials, debris etc. to any area as decided by the Engineer-in-Charge.

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		The Contractor shall sort out, clear and stack the serviceable materials obtained from the dismantling/renewal at places as directed by the Engineer-in-Charge. No extra payment shall be paid on the account of site cleaning.
38	**SITE ORGANISATION**	Subject to the provisions in the contract document and without prejudice to Contractor's liabilities and responsibilities to provide adequate qualified skilled, semi-skilled and unskilled personnel on the work and augment the same as workout basis earned value method and decided by the Engineer-in-Charge depending upon the site requirement & the exigencies of work so as to complete all works within the contracted time schedule and without any additional cost to OWNER. In case of any failure to augment resources as above Owner/Consultant reserve the right to deploy and deduct cost of such deployment from contractor's bills. 42.2 Contractor shall mobilize the key personnel as detailed below. Contractor shall mobilize work force as per agreed schedule duly approved by Owner/ Consultant

Sr. No.	Category	Nos. of Key Personnel (Minimum)	Qualifications	Experience
1.	Construction Manager	1	Degree / Diploma in Civil Engineering	At least 5 years of experience for Degree holder or 7 years for Diploma holder in construction of relevant field.
2.	QA / QC Engineer	1	Degree / Diploma in Mechanical / Metallurgy Engineering with ASNT	At least 3 years of experience for Degree holder or 5 years for Diploma holder in in Welding / Quality / NDT management in

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					Level-II in RT/UT	construction of relevant field.
		3.	Lead Planning / Billing Engineer	1	Degree / Diploma in Engineering/ Project Management	At least 3 years of experience for Degree holder or 5 years for Diploma holder in executing projects in construction of pipelines in relevant field.
		4.	Safety Officer	1	Diploma in Industrial safety	At least Diploma in Industrial Safety with minimum 3 years relevant Experience in Construction Safety.

NOTE:

1. The details of minimum manpower required to be mobilized by the execution contractor to

complete the work within schedule is given above and is not exhaustive. Contractor is required to augment the above list with additional numbers/categories of workmen as required and directed by Engineer-In charge to complete the work within the completion time schedule and quoted price.

2. The Manpower as identified above should have required qualification and adequate relevant experience.

3. Contractor shall mobilize Construction Manager, QA/QC Engineer, Planning/ Billing Engineer and Safety Officer who will be the permanent employees of the Contractor and shall be available for the entire duration of job unless approved otherwise by BGL.

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		4. Contractor shall mobilize the required manpower as per agreed schedule (month-wise) duly approved by BGL. 5. Contractor shall submit bio-data of mandatory Key Supervisory Personnel meeting the requirement as above along with bid document. Contractor shall maintain record of actual mobilization of key personnel and work force and Joint record of mobilization will be maintained and offered to Owner/ Consultant for verification month-wise. In case of early mobilization or additional mobilization of manpower as compared to required manpower (based on approved schedule) to meet the schedule requirement, contractor shall not be entitled for any extra claim. Key personnel and manpower may be demobilized by the contractor on completion of work at site after written clearance of Engineer-in-charge. Price adjustment due to delayed mobilization or shortfall in mobilization of manpower shall be as below. a) The Key Supervisory Personnel as mentioned above shall be mobilized within 15 days of written instructions for mobilization given during Kick- off-meeting or by Engineer-in-charge based on front availability at site. In case of delay in mobilization or shortfall in Key personnel manpower, penal recovery shall be levied from 16th day onwards as per the recovery rates specified below till the date of mobilization of Key Supervisory personnel at site. b) All personnel of the contractor entering on work premises shall be properly and neatly dressed and shall wear uniform badges while working on premises of the Purchaser including work sites. c) In case Contract fails to depute required manpower, recovery will be made on contractor invoice at the following rate.

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		<table><tr><th>Sr. No.</th><th>Category</th><th>Rate Per Day of Normal Hours (In Rs.)</th></tr><tr><td>1.</td><td>Construction Manager</td><td>2,500</td></tr><tr><td>2.</td><td>QA / QC Engineer</td><td>2000</td></tr><tr><td>3.</td><td>Lead Planning / Billing Engineer</td><td>2000</td></tr><tr><td>4.</td><td>Safety Officer</td><td>2000</td></tr></table>
39	**COMPLETION DOCUMENTS**	Notwithstanding the provisions contained in standard specification, upon completion of work, the Contractor shall complete all of the related drawings and documents to the "AS BUILT" stage (including all vendor / sub-vendor drawings for bought out items), all Free-Issue-Material (FIM) documents and provide the Owner/Consultant, the following: i. One complete bound set of all original documents as mentioned but not limited to documents listed elsewhere in the bid document. ii. Three complete bound sets of documents as mentioned at (i) above, in original size and in 3 (three) pen drive. iii. Three complete bound sets of Contractor's specification including design calculations. iv. Three copies of Daily Progress Reports v. Three sets of all raw data collected / generated for and during execution of the entire job as specified in documents requirement. vi. Three sets of Closure report. **Completion Documents** The following documents shall be submitted in soft copy and hard binder by the Contractor in 3 (Three) sets, as a part of completion documents: i. Welding Procedure Qualification Report. ii. Welder Qualification Report. iii. Radiographic Procedure Qualification. iv. Radiographic Report along with radiographs (Radiographs only with the original).

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		v. Batch Test Certificate from manufacturers for electrodes. vi. Pre-testing & final Hydrostatic and other test results & reports. vii. Electronic Geometry Pigging results & reports as specified in technical document. vii. Pre-commissioning/ Commissioning checklist. ix. All other requirements as specified in the respective specifications. x. Approved Construction Drawing & As built drawings. xi. Any other drawing/document/report specified elsewhere in the bidding document xii. No Claim / No Dues certificate by the contractor. xiii. Copies of deviation statement and order of extension of time, if granted. xiv. Copies of all documents related to statutory requirement i.e. Labour License, CAR Policy, Open Transit Policy, WCP, EPF, ESI Challans etc. xv. Any other contractual documents required on completion. xvi. Soft Copy of Pipe Book and Alignment Drawing, Isometric Drawing and other relevant documents. xvii. Test Certificate, Warrantee/Guarantee certificates and copies of Purchase Order with Prices blank from manufacturers for all supply material. xviii. All other requirements as specified in the respective specifications. xix. One set of reproducible on polyester film of construction drawing showing therein the execution of the work duly approved by the Engineer-in-Charge. Note: The Contractor shall be eligible to apply for issue of completion certificate after submission of completion documents as mentioned above.

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40	**COORDINATION WITH OTHER AGENCIES**	Work shall be carried out in such a manner that the work of other agencies operating at the site is not hampered due to any action of the Contractor. Proper coordination with other agencies will be Contractor's responsibility. In case of any dispute, the decision of Engineer- in-Charge shall be final and binding on the Contractor.
41	**UNDERGROUND AND OVERHEAD STRUCTURES**	The information to possible extent regarding existing structures/ overhead lines, existing pipelines and utilities shall be informed to Contractor. Over and above Contractor may encounter other structures/ pipelines/ OFC etc., the Contractor is required to collect such information's on his own before commencing the work. The Contractor shall execute the work in such a manner that the said structures, utilities, pipelines etc. are not disturbed or damaged, and shall indemnify and keep indemnified the Owner from and against any destruction thereof or damages thereto.
42	**EXECUTION OF ELECTRICAL WORKS**	The Contractor shall engage an approved electrical agency for execution of electrical works so required for execution of the works under this Contract, holding valid electrical Contractor license. In case Contractor himself executes electrical works then he shall arrange valid electrical Contractor license before start of electrical works at site.
43	**RESPONSIBILITY OF CONTRACTOR**	It shall be the responsibility of the Contractor to obtain the approval for any revision and/or modifications decided by the Contractor from the Owner/ Engineer-in-charge before implementation. Also, such revisions and/or modifications if accepted/approved by the Owner/Engineer-in-charge shall be carried out at no extra cost to the Owner. Any changes required during and/or after approval for detailed construction drawings due to functional requirements or for efficient running of system keeping the basic parameters unchanged and which has not been indicated by the Contractor in the data/drawings furnished along with the offer will be carried out by the Contractor at no extra cost to the Owner. All expenses towards mobilization at site and de-mobilization including bringing in equipment, clearing the site etc. shall be deemed to be included in the prices quoted and no separate payments on account of such expenses shall be entertained.

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		It shall be entirely the Contractor's responsibility to provide, operate and maintain all necessary construction equipment, scaffoldings and safety gadgets, cranes and other lifting tackles, tools and appliances to perform the work in a workman like and efficient manner and complete all the jobs as per time schedules. Preparing approaches and working areas for the movement and operation of the cranes, levelling the areas for assembly and erection shall also be the responsibility of the Contractor. The Contractor shall acquaint himself with access availability, facilities such as railway siding, local labour etc. to provide suitable allowances in his quotation. The Contractor may have to build temporary access roads to aid his own work, which shall also be taken care while quoting for the work. The procurement and supply in sequence and at the appropriate time of all materials and consumables shall be entirely the Contractor's responsibility and his rates for execution of work will be inclusive of supply of all these items. Bidder shall note that any delays due to Sub-Vendor / Third Party appointed by contractor in Project execution & completion shall be sole responsibility of the contractor.
44	**GENERAL GUIDELINES DURING AND BEFORE ERECTION**	Contractor shall be responsible for organizing the lifting of the equipment in the proper sequence, that orderly progress of the work is ensured and access routes for erecting the other equipment's are kept open. Orientation of all foundation, elevations, lengths and disposition of anchor bolts and diameter of holes in the supports saddles shall be checked by contractor, well in advance. Minor rectifications including chipping of foundations as the case may be, shall be carried out at no extra cost by the contractor after obtaining prior approval of the Engineer-in-Charge. The Contractor shall also be provided with the necessary structural drawings and piping layouts etc., wherever required for reference. During the structural member need to be dismantled, to facilitate the equipment erection, same shall be done by the contractor after ensuring proper stability of main structure with prior permission of Engineer-in-Charge. All such dismantled members shall be put

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		in position back after the completion of equipment erection to satisfaction of Engineer-in-Charge. During the performance of the work the Contractor at his own cost, shall keep structures, materials and equipment adequately braced by guys, struts or otherwise approved means which shall be supplied and installed by the Contractor as required till the installation work is satisfactorily completed. Such guys, shoring, bracing, strutting, planking supports etc. shall not interfere with the work of other agencies and shall not damage or cause distortion to other works executed by him or other agencies. Manufacturer's recommendations and detailed specifications for the installation of the various equipment and machines will be passed on to the contractor to the extent available during the performance of work. The requirements stipulated in these clauses shall be fulfilled by the Contractor. Various tolerances required as marked on the drawings and as per specifications and instructions of the Engineer-in-Charge, shall be maintained. Verticality shall be maintained. Verticality shall be verified with the Theodolite.
45	**ERECTION OF EQUIPMENTS**	Any erection which may be required, shall be carried out by Cranes of suitable capacity. Erection by derrick shall not be permissible. The contractor shall arrange the crane of suitable capacity required for erection and include cost for same in respective items without any liability on the part of Employer/Consultant. Bidder shall submit the indicative erection scheme for compressor/equipment and shall undertake the erection only after obtaining approval of erection scheme by Engineer-in-charge. Grouting of equipment's, anchor bolts, pockets and under base plates shall be carried out as per technical specifications.
46	**REPAIR OF PIPE DEFECTS**	Immediately prior to aligning pipe for welding, the bevelled ends of each joint of pipe and the area immediately adjacent thereto (at least 25mm from the edge on the inside and outside of the pipe) shall be thoroughly cleaned of paint, rust, mill scale, dirty or other foreign matter by use of power drive

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		wire buffing wheels, disc sanders, or by other methods approved by Employer/Consultant. This shall be done at no extra cost to Employer/Consultant. All damaged ends of pipe that are bent, cut or otherwise mutilated to such an extent that in the opinion of the Employer/Consultant, faulty alignment or unacceptable welding would result, shall be repaired or cut-off and re-bevelled to the correct angle with a bevelling machine of a type approved by Employer/Consultant. No compensation shall be allowed by reason of such recutting or bevelling, except when required because of the original bevel being damaged before the pipe is "taken over" by Contractor. Dents in bevels with a depth of less than 1 mm shall be removed by Contractor during cleaning and grinding, ahead of the welding in the field. Contractor shall re-bevel dented bevel ends with a depth between 1 and 3 mm. Dents over 3mm depth shall be repaired by cutting and re-bevelling
47	**MECHANISED CONSTRUCTION**	Contractor shall without prejudice to his overall responsibility to execute and complete the work as per specifications and time schedule adopt as far as practicable, mechanized construction techniques for major site activities. Contractor agrees that he will deploy the required numbers and types of the plant & machinery applicable for different activities in consultation with the Engineer-in-charge during execution of works. Contractor further agrees that Contract price is inclusive of all the associated costs, which he may incur for actual mobilization, required in respect of use of mechanized construction techniques and that the Owner/Consultant in this regard shall not entertain any claim whatsoever in this regard.
48	**CHECKING OF LEVELS**	The Contractor shall be responsible for checking levels, orientation plan of all foundations, foundation bolts, etc., well in advance of taking up the actual erection work and bring to the notice of Engineer-in-Charge discrepancies, if any. In case of minor variations in levels etc. the Contractor shall carry out the necessary rectifications to the foundations within his quoted price.

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		The Contractor shall also be responsible for checking with templates, wherever necessary, the disposition of foundation bolts with the corresponding bases of structure and shall effect rectifications, as directed, within his quoted rate.
49	**REGISTRATION OF THE CONTRACT WITH STATUTORY AUTHORITIES**	Before submission of their first invoice for Running payment, the Contractor shall register themselves and the contract at their own cost with the Reserve Bank of India, Income Tax, Sales Tax and such other statutory authorities, as may be required under the governing rules and regulations in India. The Contract Price shall be deemed to include all costs towards the same. The copies of all the related documents to all such registrations shall be submitted by the Contractor to Owner for their records and reference when-ever required during the tenure of the contract period
50	**AUDITS OF CONTRACT**	The project is subject to inspection by various audit/vigilance agencies of government of India/bgl., if any inspection of works is carried by such agencies, CONTRACTOR shall extend his full cooperation to these agencies in examining records, works etc. On inspection by such agencies, if it is pointed out that CONTRACTOR has not carried out work according to guidelines laid down in the tender document, immediate rectifications shall be taken up at no extra cost; and also if any recoveries against some items are pointed out therein, the same shall be recovered from CONTRACTOR's RA bills/final bill. The items under dispute shall not be paid in full till the job is completed to satisfaction of the inspection agency.
51	**SUBSEQUENT LEGISLATION**	All duties, taxes (on works Order/ trade tax/ turnover tax/etc. as applicable), fees, charges, expenses, etc. (except where otherwise expressly provided in the Order) as may be levied/ imposed in consequence of execution of the works or in relation there to or in connection therewith as per the Acts, Laws, Rules, Regulations in force shall be to contractor's account
52	**SINGLE POINT RESPONSIBILITY**	The entire work as per scope of work covered under this Order shall be awarded on Overall Lowest Cost Basis (L1) on single point responsibility basis.

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53	**WORK FRONT**	The work involved under this Order may include such works as have to be taken up and completed after other agencies have completed their jobs. The CONTRACTOR will be required and bound to take up and when the fronts are available for the same and no claim of any sort whatsoever shall be admissible to the CONTRACTOR on this account.
54	**TEMPORARY WORKS**	All Temporary and ancillary works including enabling works connected with the work shall be responsibility of the Contractor and the price quoted by them shall be deemed to have included the cost of such works which shall be removed by the contractor at his cost, immediately after completion of his work.
55	**DEFECTS AFTER TAKING OVER OR TERMINATION OF WORK CONTRACT BY OWNER**	The Contractor shall remain responsible and liable to make good all losses or damages that may occur/appear to the work carried out under this Contract within a period of 12 months from date of issue of the Completion Certificate and/or the date of Owner taking over the work, whichever is earlier. The Contractor shall issue a Bank Guarantee to the Owner in the sum of 10% of the work entrusted in the Contract, from any Scheduled bank (other than Co- operative Bank) acceptable to the Owner and if however, the Contractor fails to furnish such a Bank Guarantee the Owner shall have right to retain the Security Deposit and Retention Money to cover the 10% of the Guarantee amount under this clause and to return/refund the same after the expiry of the period of 12 months without any interest thereon.
56	**GRIEVANCE REDRESSAL MECHANISM**	There is a grievance redressal mechanism in BGL for vendors participating in the tender, the details of which are available on BGL's website www.bglgas.com
57	**ROYALTY**	All royalties etc., as may be required for any entry permits, including right of way etc., to be arranged by Contractor shall be deemed to have been included in the quoted prices. Owner will not be able to obtain exemption from payment of royalty charges. Bidder's quoted rates shall include the royalty on different applicable items as per the prevailing State Government rates. Any increase in prevailing rate of royalty shall be borne by the Contractor at no extra cost to Owner.

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		Documentary evidence to be furnished by Contractor along with the bills.
58	**EXCAVATION BY BLASTING**	Not applicable for this tender.
59	**BREACH OF CONTRACT**	In case of separate orders issued for various Parts or locations / Schedule(s) of the works in respect of Composite Works for MS, The Contractor shall be responsible for execution of all orders to the entire satisfaction of the Owner and breach in one order shall constitute as breach in the other order and accordingly appropriate action shall be taken as per stipulations of the order.
60	**CONTRACTOR'S STANDARD CONDITIONS**	Contractor's standard conditions if any shall not be applicable to the Contract.
61	**PATENTS, INFRINGEMENT & INDEMNITY**	Contractor shall protect and fully indemnify Owner from any claims for infringement of patents, copyright, trademark or the like. Contractor shall also protect and fully indemnify Owner from any claims from Contractor's workmen/employees, their heirs, dependents, representatives etc. Or from any other persons/persons or bodies/companies etc. for any act of commission or omission while executing the Contract. Contractor shall be responsible for compliance with requirements under the laws and shall protect and indemnify completely Owner from any claims/penalties arising out of any infringements.
62	**IMPORT LICENCE**	Contractor shall arrange import of all materials required for permanent incorporation in the works in respect of Composite Works for MS as well as construction equipment as per the guidelines laid down by the Relevant Authorities. Owner/Consultant shall not provide import license.
63	**WITHHOLDING, ACCOUNTING AND TAX REQUIREMENTS**	Contractor agrees for withholding from wages and salaries of its agents, servants or employees all sums, required to be withheld by the laws of the Republic of India or any other agency having jurisdiction over the area where Contractor is conducting operations, and to pay the same promptly and directly when due to the proper authority. Contractor further agrees to comply with all accounting and reporting

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		requirements of any Nation having jurisdiction over the subject matter hereof and to conform to such laws and regulations and to pay the cost of such compliance. If requested, Contractor will furnish the evidence of payment of applicable taxes, in the country(ies) of the Contractor's and his sub-contractor(s) and expatriate employees.
64	**INTELLECTUAL PROPERTY**	Neither Owner/Consultant nor Contractor nor their personnel, agents nor any sub-contractor shall divulge to anyone (other than persons designated by the party disclosing the information) any information designated in writing as confidential and obtained from the disclosing party during the course of execution of the works so long as and to the extent that the information has not become part of the public domain. This obligation does not apply to information furnished or made known to the recipient of the information without restriction as to its use by third parties or which is demonstrated to be in recipient's possession at the time of disclosure by the disclosing party. Upon completion of the works or in the event of termination pursuant to the provisions of the Contract, Contractor shall immediately return to Owner/Consultant all drawings, plans, specifications and other documents supplied to the Contractor by or on behalf of Owner/Consultant or prepared by the Contractor solely for the purpose of the performance of the works, including all copies made thereof by the Contractor.
65	**DRAWINGS AND DOCUMENTS**	The drawings accompanying the bid document (if any) are of indicative nature and issued for bidding purpose only. Purpose of these drawing is to enable the Bidder to make an offer in line with the requirements of the Owner. However no extra claim whatsoever, shall be entertained for variation in the "Approved for Construction" and "Tender drawings" regarding any changes/units. Construction shall be as per drawings/specifications issued/approved by the Engineer-in-Charge during the course of execution of work. Detailed construction drawings (wherever required) on the basis of which actual execution of work is to proceed will be prepared by the Contractor. The drawings and documents to be submitted by the Contractor to Owner after award of the LOA as per the requirements enlisted in the IFB shall be for Owner's review,

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		information and record. The Contractor shall ensure that drawings and documents submitted to Owner are accompanied by relevant calculations, data as required and essential for review of the document/ drawings. All documents and drawings including those of Contractors' sub-vendor's manufacturer's etc. shall be submitted to Owner after having been fully vetted in detail, approved and co- opted by the Contractor & shall bear Contractor seal/ certifications to this effect. All documents/drawings & submissions made to Owner without compliance to this requirement will not be acceptable and the delay & liability owing to this shall be to the Contractor's account. The Contractor shall, upon request of the Owner, submit all drawing and documents as envisaged herein to the Consultant. The Consultant shall review the drawings/ documents within 15 days from the date of submission provided the same are accompanied by relevant calculations, data as required and essential for review. Upon review of the submitted documents, Consultant may give their comments and ask for redesign/ resubmission after necessary rectifications/ modifications and the time frame of 15 days will be applicable for the same. The review of documents and drawings by Owner/Consultant shall not absolve Contractor from its responsibility to meet the requirements of specifications, drawings etc. and liabilities for mistakes and deviations. Upon receiving the comments on the drawing/documents reviewed by Owner/Consultant, Contractor shall incorporate the comments as required and ensure compliance. Copies of all detailed working drawing relating to the works shall be kept at the Contractors' office at the site and shall be made available to the Engineer-in-charge/ Owner/Consultant at any time during execution of the Contract. However no extra claim what so ever shall be entertained for any variation in the "approved/issued for construction drawings" and "tender drawings "regarding any changes/units unless otherwise agreed. The Contractor shall rectify any inaccuracies, errors and or non-compliance of requirements envisaged in the Contract. Any delay occurring for reasons attributable to such

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		inaccuracies, error and or non-compliance shall not construe a reason for delay/ extension.
66	**HOUSE KEEPING**	It is the responsibility of the Contractor to maintain general cleanliness and proper housekeeping at work site. Contractor shall organize disposal of excavated earth /garbage/ rubbish/ scrape, electrode butts etc. on day to day basis to identified disposal areas/safe areas as per Owner / Consultant. The CONTRACTOR shall dispose off the unserviceable materials, debris etc. to the earmarked area within / outside the work site as decided by the Owner / Consultant. No extra payment shall be paid on this account. Serviceable materials shall be stored in designate area separately after obtaining acknowledgement of duly authorized officer of Owner.
67	**PROTECTION OF EXISTING FACILITIES**	Contractor shall obtain all safety clearance (viz. excavation, hot/cold work permit). Contractor shall obtain plans and full details of all existing and planned underground services from Owner / Consultant and shall follow these plans closely at all times during the performance of work. Contractor shall be responsible for location and protection of all underground lines and structures at its own cost. Despite all precautions, should any damage to any structure / utility etc. at Site occur, the Contractor shall contact the Owner / Consultant / authority concerned and Contractor shall forthwith carry out repair at its expenses under the direction and to the satisfaction of Owner / Consultant and Owner / Consultant/concerned authority. Contractor shall take all precautions to ensure that no damage is caused to the existing pipelines, cables etc., at Site during construction. Existing structures, existing compound wall, tiling and other items damaged / disturbed during construction shall be repaired and restored to their original condition by Contractor after completion of relevant works to the complete satisfaction of Owner. If required, CONTRACTOR shall in consultation with Owner and Consultant and the concerned authorities, take adequate measures for strengthening the existing electric poles, cast

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		iron pipes, sewer lines, GI pipelines telephone poles etc. in the proximity of proposed City Gate Station. CONTRACTOR shall take adequate protective measures to prevent damage to these facilities during execution of above said work. Contractor shall have to adopt such method of construction as will be suitable for working at Site using the limited space available and without causing any damage to Site. Contractor shall be deemed to have taken cognizance of all such constraints, etc. while working at Site and Contractor shall not be entitled to claim any extra at a later stage. All the monuments, articles of value of antiquity and structure or other remains of geological or archaeological discovered on the site of works shall be declared to be the property of the Owner during the entire course of execution of work. Site Contractor shall take reasonable precautions to prevent these workmen or any other persons from removing or damaging any such articles or thing and shall immediately inform the Owner / Engineer-in-charge and thereafter hand them over immediately back to Owner in their existing condition, as per the instructions of Owner / Engineer-in-charge, at no extra cost to Owner.
68	**CONSTRUCTION**	RULES AND REGULATIONS CONTRACTOR shall observe in addition to Codes specified in respective specification, all Applicable Laws and shall be responsible for any extra costs arising from non-adherence with the same. PROCEDURES Contractor shall prepare and submit all the plans, procedures and documents to Consultant / Owner as specified in the Contract. CONSTRUCTION EXECUTION PLAN Contractor shall submit Construction Execution Plan to Consultant / Owner for review and approval while providing the Project Execution Strategy. The Construction Execution Plan shall detail the execution methodology of the Contractor

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		during execution of City Gate Station covering the following aspects as minimum: Contractor's Construction Execution Plan shall include: Contractor's man-power and its deployment schedule on monthly basis. Other plans of Contractor and procedures to be submitted at least 04 weeks prior to start of respective activity at site include the following as minimum: Temporary facilities, etc. Scaffolding Plan Heavy Transport & Heavy Lifting Plan (Rigging Plan) Pre-Fabrication Plan Hydro-test Plan Other activity plans (eg. Piping, equipment and steel structure erection plan etc) Monsoon Counter measures and preparation. Emergency Evacuation Procedure Storm Management Plan.
69	**WORKING HOURS**	Normal working Hours shall be from 09:00 am to 05:30 pm. However, the same may be extended by Owner/Consultant on request and need basis. However, working hours for work within the work site shall be governed by the work permits issued by Owner. Depending upon the requirement, Works Time Schedule / drawing programmes and the target set to complete the relevant work in time, the works may have to continue beyond normal working hours to the extent of round the clock also, for which no extra claim shall be entertained.
70	**HYDROSTATIC TESTING**	The Bidder as per the technical specification along with its Tender taking into account the Completion Period shall furnish the detailed procedure proposed for the hydrostatic testing. The necessary piping, pumps etc. shall be provided by the Contractor. The final disposal of water after testing shall be

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		Contractor's responsibility and should be in such a way that neither the traffic movement even pedestrians nor the standing crop in nearby fields gets affected. Suitable drains shall be provided for this purpose as directed by the Engineer-in-Charge within the Contract Price. The Contractor shall propose and obtain approval of Engineer-in-Charge based on drawings, availability of water for hydro testing and keeping in view other exigencies, if any before starting hydro testing work. The Contractor will carry out the hydrostatic test for approved number of test section including preparation for test and tie-ins, without any time and cost implication on this account to Owner/Consultant. Any increase or decrease in number of test sections will not have any cost implication to Owner / Consultant.
71	**PROJECT PLANNING, SCHEDULING AND MONITORING SYSTEM**	The following schedules/documents/reports shall be prepared and submitted by the Contractor for review/approval at various stages of the Contract. Work Time Schedule at the time of submitting the Tender and Project Schedule after the Award of Contract a) Works Time Schedule The Works Time Schedule submitted by the Bidder for the execution of work (including mobilization period) shall be developed keeping in mind the Completion Period and the provisions of the IFB. The Contractor is required to submit a Works Time Schedule in Primavera. The Works Time Schedule shall cover all aspects like sub-ordering, manufacturing and delivery, indicated in the Tender Documents. The Owner interface activities shall be clearly identified with their latest required dates. Owner reserves the right to disqualify the Bidder if the above Works Time Schedule submitted by the Bidder is not in line with the overall requirement of the Project. b) Scheduling & Monitoring System The Bidders should describe their system of scheduling and monitoring the works in respect of execution of Composite

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		Works for MS, the extent of computerization, level of detailing, tracing methodology etc. with the name of computer package and sample outputs. c) Overall Project Schedule The Contractor shall submit within 1 week of LOA, a sufficiently detailed overall intended 'Project Schedule' in the activity network form, clearly indicating the major milestones, interrelationship/ interdependence between various activities together with analysis of critical path and floats. The intended 'Project Schedule' will be reviewed and approved by Engineer- in-Charge and the comments if any shall be incorporated in the network before issuing the same for implementation. The network thus finalized shall be referred as the 'Project Schedule' and form part of the Contract and the same shall not be revised without the prior permission from Engineer-in- Charge during the entire period of Contract. d) Progress Measurement Methodology The Contractor is required to submit within 1 week of award of LOA, the methodology of progress measurement of sub-ordering, manufacturing/ delivery, sub- contracting construction and commissioning works and the basis of computation of overall services/physical progress informed. Owner reserves the right to modify the methodology in part or in full. e) Functional Schedules The Contractor should prepare detailed functional schedules in line with network for functional monitoring and control and submit scheduled progress covers for each function viz. ordering, delivery and construction.
72	**Project Review Meetings**	The Contractor shall present the programme and status at various review meetings as required. **Weekly Review Meeting** Level of Participation Agenda

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		Contractor's / Consultant's construction Manager & Job Engineers. a. Weekly programme v/s actual achieved in the past week & programme for next week. b. Remedial Actions and hold up analysis. c. Client query/ approval. d. Status of HSE adherence / compliance Venue: Site Office **Monthly Review Meeting** Level of Participation Agenda Senior Officers of Owner/Consultant and Contractors. Progress Status/ Statistics a. Completion Outlook b. Major hold ups/slippages c. Assistance required d. Critical issues e. Client query/ approval f. Status of HSE adherence / compliance **Progress Reporting Proforma** A. **Monthly Progress Report** This report shall be submitted by the Contractor to Owner/Contractor on a monthly basis within 10 (ten) calendar days from cutoff date, as agreed upon covering overall scenarios of the Composite Works for MS. The report shall include, but not limited to the following: Brief Introduction of the work. a. Activities executed/ achievements during the month. b. Schedule versus actual percentage progress and progress curves for Detail Engg. Sub- ordering, manufacturing/delivery,

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		sub-contracting, construction, commissioning and overall and quantum wise status & orders against schedule. c. Area of concern/ problem/ hold-ups, impacts and action plans. d. Resources deployment status. e. Annexures giving status summary for drawings, MRs, deliveries, sub-contracting and construction. f. Procurement status for items to be supplied by Contractor. B. Weekly Reports The report will be prepared and submitted by the Contractor to Owner/Consultant on weekly basis and will cover following items: a. Activities programmed and completed during the week. b. Resource deployed men and machines. c. Quantities achieved against target in construction d. Record of man-days lost. e. Construction percentage progress schedule and actual. C. Daily Reports a. Activity programme for the day b. Progress of the previous day and commutative progress. c. Manpower & machinery deployed. D. Any other additional reports/ information as may be required by Engineer In Charge **Progress Reports** Contractor shall make every effort to keep the Owner adequately informed as to the progress of the works in respect of execution of work throughout the duration of the Contract. Contractor shall keep the Owner informed well in advance of the relevant Project Schedule so as to enable the Owner to arrange for requisite inspection to be carried out in such a manner as to minimize interference with progress of works. It

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		is imperative that close coordination be maintained with the Owner during all phases of Composite Works for MS. By the 10th (tenth) of each month, Contractor shall furnish the Owner a detailed report covering the progress as of the last day of the previous month. These reports will indicate actual and scheduled percentage of completion of construction as well as general comments of interest or the progress of various phases of execution of the work. The frequency of progress reporting by the Contractor shall be weekly. Once a week, Contractor shall submit a summary of the works accomplished during the preceding week in form of percentage completion of the various phases to the Owner. Progress reports shall be supplied by Contractor with documents such as chart, networks, photographs, test certificate etc. Such progress reports shall be in the form and size as may be required by the Owner and shall be submitted in at least 3 (three) copies. Contractor shall prepare daily progress report (DPR) in the desired format and submit it to Engineering-In-Charge along with schedule of next day to Engineer-In-Charge.
73	**PIPES FOR WELDING QUALIFICATION**	For the purpose of qualification of welding procedure, operators, Contractor may use the same pipes issued by Employer/Consultant. However, accounting of such pipes shall be done within the unaccountable wastage and scraps limit as defined in bidding document. The bare pipes for the purpose as above shall be issued within two week from the date of FOI/FOA. The contractor shall bear all cost towards lifting, carting from issue point to work site/Contractor's store, custody, handling, insurance and levies etc. and return of surplus/scrap materials to employer designated storage point. No separate payment shall be made for such expenditure.
74	**SPARES**	Contractor shall procure and supply all spare parts required during commissioning of the various items / materials supplied by him as enumerated in the Bidding Document. The quoted lumpsum prices shall be deemed to have been inclusive of all such provision of commissioning spares, required till

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		commissioning of such items. Contractor shall make available all the commissioning spares required at site at least 4 (four) weeks before start of commissioning. However, listed spares not used during commissioning shall be handed over to Employer at their designated place. Contractor shall also supply commissioning spares not listed but required during commissioning within the contracted price. In addition to above, special tools & tackles required, if any, for operation & maintenance shall also be supplied by the Contractor and the quoted prices shall be deemed to have been inclusive of all such provisions.
75	**STORAGE FACILITIES**	The Contractor shall store all materials / instruments required for calibration and testing of the instruments in suitable condition / environment conducive for the same at its own cost. The Contractor shall provide these facilities within the quoted rate.
76	**WORK PERMIT**	When Contractor is working at Site, Contractor shall note that Contractor would be required to obtain applicable hot work/ cold work permits on daily basis from the competent authority. Contractor shall also comply with all the conditions on the work permit / entry permits at no extra cost to Owner. Contractor shall be required to obtain police verification for obtaining work/entry permits to work inside the work site for all the employees and workers employed for the various works. The Contractor shall provide identity cards to all its staff/workmen who will be working inside the Site/Premises, The ID cards will have to be produced by the Contractors' workmen as and when demanded by the Owner's representatives or security personnel at Site/ Premises. Action where there is no specification: In case of any class of work for which there is no specification mentioned, the same shall be carried out in accordance with the latest edition of Indian Standard Specifications subject to the approval of the Owner. Typographical or Clerical Errors

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		Owner clarifications regarding partially omitted particulars or typographical or clerical errors shall be final and binding on the Contractor.
77	**BUILDING AND OTHER CONSTRUCTION WORKER'S ACT**	In order to govern welfare and working conditions of labourers engaged in construction activities, the Building and other Construction Workers' (Regulation of Employment and Conditions of Service "RE&CS") Act, 1996 came into force. RE&CS Act'1996 is applicable in respect of building and other construction work. Wherever applicable, The Contractor shall strictly comply with the following provisions pertaining to RE &CS Act'1996. a. The Contractor shall be registered with the concerned authorities under the Building and Other Construction Workers' (RE&CS) Act, 1996 or in case of non-registration; the CONTRACTOR shall obtain registration within one month of the award of LOA. b. The CONTRACTOR shall be responsible to comply with all provisions of the Building and Other Construction Workers' (RE&CS) Act, 1996, the Building and Other Construction Workers' Welfare Cess Act, 1996, the Building and other Construction Workers' (RE&CS) Rules, 1998 and the Building and Other Construction Workers Welfare Cess Rules, 1998. c. Cess as per the prevailing rate, shall be deducted at source from bills of the Contractor by the Engineer-In-Charge of the Contract and remitted to the "Secretary, Building and Other Construction Workers Welfare Board" of the concerned State. The Contractor shall be responsible to submit final assessment return of the cess amount to the assessing officer after adjusting the cess deducted at source. Before starting of work, the Contractor shall obtain a license from concerned authorities under the Contract Labour (Abolition and Regulation) Act, 1970, and furnish a copy of the same to the Engineer-in-Charge. Every worker engaged by the Contractor should be enrolled under the following scheme(s): i. Pradhan Mantri Jeevan Jyoti Bima Yojna (PMJJBY)

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		ii. Pradhan Mantri Suraksha Bima Yojna (PMSBY) Under the two schemes, applicable annual premium amount (presently Rs. 342/- per person) shall be considered by the prospective bidder while submitting the price bid. Proof of payment towards the above two scheme shall be submitted by the Contactor to EIC for verification of the same from time to time.
78	**BUILDING AND OTHER CONSTRUCTION WORKERS (BOCW) WELFARE CESS**	82.4.1 BOCW, if applicable, shall be paid extra at actual against the documentary proof of submission against payment of BOCW to relevant tax authorities. Notwithstanding the foregoing, Owner shall not bear any liability in respect of: a) Personal taxes on the personnel deployed by the Contractors, his sub-contractors and Agents, etc. b) The Corporate taxes in respect of Contractor and his Sub-contractors and other Agents, Indian or foreign based.”
79	**GOVT. ACTS/ REGULATIONS**	Any reference to the specific statutes/regulations in the IFB is only indicative, and it is entirely for the Bidder to ascertain the Applicable Laws.
80	**SUBSTITUTION, WRONG SUPPLIES AND SHORT SUPPLIES**	Unauthorized substitution or materials delivered in error, other than those mentioned in the Contract, or material of sub-standard quality or supplied in excess quantity (unless authorized by the buyer), shall be rejected and the rejected goods if any shall be returned to Contractor at Contractor 's cost and risk.
81	**CEMENT & STEEL**	In partial modification to Clause. 7.e and 7.f of (GTC-WORK CONTRACT), unless until specified explicitly in the IFB, supply of cement and steel shall be arranged by Contractor and the cost of the same shall be deemed to be included in the quoted rates.
82	**QUANTITY VARIATION FOR SUPPLY & WORKS**	Owner reserves the right, at the time of execution of Contract, to increase or decrease the quantity of goods for all items as specified in the IFB up to +/- 25% without any change in the unit prices (as well as lump sum prices, if any) and other terms and conditions. Bidder’s quoted rates shall be valid for such quantity variation.

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83	**RECOVERY OF FAILURE OF ITEMS FOR SUPPLY**	In case the items supplied by the Contractor fails during fabrication and or erection due to manufacturing defect the Contractor shall become liable to replace the items without any additional cost to Owner and in a timely manner so as not to deviate from the Completion Period. The Contractor shall bear the landed cost for replacing the defective items, including all costs incurred up to delivery thereof at site, all duties, freight, insurance, labour, material, charges for cutting, removing, replacement, engineering and construction supervision charges of consultant, and relaying of defective part(s), including cost of incidental activities.
84	**JURISDICTION**	The courts at Mumbai (India) shall have exclusive jurisdiction over all Disputes arising under or in connection with the CONTRACT.
85	**INTEGRITY PACT**	Integrity Pact: All tenders and contracts shall comply with the requirements of the Integrity Pact (IP) if the value of such tenders or contracts exceed Rs.1 crore. Failure to sign the Integrity Pact shall lead to outright rejection of bid. The successful tenderer shall execute Integrity Pact with Owner as per the enclosed Draft Integrity Pact Agreement. Hard copy of the same duly filled signed, stamped by authorized person and witnessed to be forwarded along with EMD in physical condition so as to be received at Tractebel Office prior to bid due date and time.
86	**EPMC CONSULTANT**	Notwithstanding anything contained elsewhere, Bidder acknowledges that the EPMC Consultant has been engaged by Owner for procurement assistance, tendering, evaluation of tenders and recommendation for placement of orders including expediting and inspection, and accordingly, the Bidder /Contractor shall be required to function in close co-ordination with the Consultant.
87	**PENALTIES**	BGL shall have right to levy following penalties on the Contractor and deduct applicable amount from the Contractor's Running Bills: 87.1 In case proper barricading, as per technical specification and instruction of EIC is not provided, the work shall be immediately suspended till such time proper barricading, as

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		per the technical specification is provided and penalty will be levied as per SCC clause "PENALTIES" 87.3. 87.2 In case required numbers of safety equipment like Safety Harness belts, helmets, fluorescent jackets etc as per the Technical Specifications and Special conditions of the contract of the tender, could not be provided by the contractor during execution, work shall be suspended, and penalty will be levied as per SCC clause "PENALTIES" 87.3. 87.3 Either of the case as in clause "PENALTIES" 87.1 & 87.2 above shall attract penalty of **INR 1000.00** per instance. Any subsequent instance shall attract penalty of **INR 5000.00** per instance with a notice to contractor. Subsequent non-compliance within 5 days shall lead to a deduction of up-to 1% from RA bill at the discretion of the EIC and may also lead to blacklisting of the contractor for future jobs. 87.4 In case of complete compliance of HSE norms throughout the contract period the contractor shall be issued a letter of appreciation by the Owner on recommendation by the consultant. 87.5 In case required numbers of equipment, Tools & Tackles, shuttering, vibrators, cubes auto level etc. as per the scope of work & Technical Specifications, could not be provided by the contractor at the time of need, a notice shall be issued to the contractor by Engineer- In charge and **INR 1000/-per day** shall be levied as penalty till such time the equipment, Tools & Tackles are made available for completion of the work. 87.6 Failure to submit weekly & monthly reports by 10th of every month, a penalty of **INR 500/- per instance per day** shall be levied till the time report is submitted to the Engineer-in Charge. 87.7 Failure to adhere to the timelines of project as mutually decided before start of project by Engineer In Charge and contractor, shall invite a penalty of **INR 5000 per week** (provided the delay is attributable to the contractor) unless such failure is due to force majeure. The deduction will be made in RA bills. In case of delay beyond the validity of

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		purchase order, penalty of ½% per week shall be levied subjected to a maximum of 5% of total purchase order value. 87.8 In case the contractor does not mobilize the required machines at site and fails to start the work within one week from the intimation received from Engineer-In charge adhering BGL safety standards. Owner at its sole discretion may get it executed from an alternate agency at the risk and cost of the contractor shall be borne by contractor. Also, an administrative charge @ 15% over and above the actual cost incurred shall be levied from contractor's bill. In case, no work is done, penalties will be deducted from CPBG. 87.9 Delay in submission of test reports within 7 days of intimation by Engineer in-charge shall invite a penalty of INR1000 per instance. 87.10 In case of installation of contractor's supplied material without inspection and prior approval EIC/sited in charge, **INR 5000/- per instance** shall be levied from the running bills. 87.11 For non-execution / poor quality of restoration work till completion of the work in respective area, a penalty of INR 5000/- per week or part thereof shall be imposed on contractor till satisfactory execution & acceptance by EIC following submission of NOC from respective Local Authority/statutory bodies. In addition to this, in case of any penalty imposed by statutory Authority / third party to Owner for non-execution/ poor quality of restoration, the same penalty shall be recovered from underground utilities. 87.12 In case of non- compliance of statutory provisions penalty will be imposed by the owner as detailed below: a) Contractor's failure to submit RPFC/ ESI challans of previous month along with the bills during the validity of the contract, Owner shall deduct 5% (Five percent) of payable amount from the contractor's running bill and retain the same as a deposit. Such retained amount shall be refunded to contractor on production of RPFC challan/ receipt. In case of non-submission of challans for a particular month, a penalty of INR 5000 /- shall be imposed for that particular month.

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		b) Delay of more than 21 days from the date of PO / LOI in obtaining / submitting WC cover or taken for shorter duration will result into penalty of **INR 5000/- per week** or part thereof. c) Delay of more than 21 days from the date of PO / LOI in obtaining / submitting the required insurance policies as specified in the tender document will result into a penalty **of INR 5000/- per week** or part thereof. d) The contractor must obtain labour licence at the start of work at allotted site. Delay of more than 30 days from the date of PO / LOI in submitting the labour licence shall attract a penalty of **INR 5000/- per week** or part thereof. 87.13 In case contractors sub-let his part or whole work, contractor shall be liable for a penalty of **INR 5000.00 per instance** on issuance of site memo. Any subsequent instance shall attract penalty of **INR 10,000.00** with a notice to contractor to remove the sub-contractor within 15 days. Subsequent non-compliance within 15 days shall lead to a deduction of penalty up to 1% of total executed work value from RA bill at the discretion of the EIC / Owner / Consultant and may also lead to blacklisting of the contractor for future jobs as per owner policy. The owner / Consultant may terminate the contract and the remaining work shall be carried out at the risk and cost of the contractor.
88	**SAFETY CODE**	The Contractor shall at his own expenses arrange for the Safety provisions as may be necessary for the execution of the work or as required by the Engineer-in-Charge in respect of all labours directly or indirectly employed for performance of the works and shall provide all facilities in connections therewith. In case the contractor fails to make arrangements and provide necessary facilities as aforesaid, the Owner shall be entitled but not bound to do so and recover the cost thereof from the Contractor. From the commencement to the completion of the works, the contractor shall take full responsibility for the care thereof and of all the temporary works (defined as meaning all temporary works of every kind required in or for the execution, completion or maintenance of the works). In case damage, loss or injury shall happen to the works or to any part thereof or to temporary works due to any cause whatsoever the contractor

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		shall repair at his (Contractor's) own cost and make good the same so that at the time of completion, the works shall be in good order and condition and in conformity in every respect with the requirement of the contract and Engineer-in Charge's instructions. In respect of all labour, directly or indirectly employed in the work for the performance of the Contractor's part of this agreement, the contractor shall at his own expense arrange for all the safety provisions as per relevant Safety Codes of C.P.W.D, Bureau of Indian Standards, the Electricity Act/I.E. Rules. The Mines Act and such other Acts as applicable. The Contractor shall observe and abide by all fire and safety regulations prescribed by the local government and/or the Owner. Before starting construction work, the Contractor shall consult the Owner's Safety Engineer or Engineer-in-Charge/Site-in-Charge and must make good to the satisfaction of the Owner any loss or damage due to fire to any portion of the work done or to be done under this agreement or to any of the Owner's existing property. The Contractor will be fully responsible for complying with all relevant provisions of the Contract Labour Act and shall pay rates of Wages and observe hours of work/conditions of employment according to the provisions under the applicable Law and rules in force from time to time. The Contractor will be fully responsible for complying with the provision including documentation and submission of reports on the above to the concerned authorities and does hereby indemnify the Owner from any such lapse for which the Government may take action against them.
89	**CLOSING OF PO**	Contractor to close the work order within Three (03 months, once the value is consumed or validity is expired (including time extensions for completion of scope of work, if required). In case contractor fails to close the work order within this period, Owner/PMC will short close the work order as per data available on the record. OWNER reserves the right to adjust any pending liability of the closed work order /contract from the any other running work order /contract.

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25. COORDINATION WITH OTHER AGENCIES
26. SETTLEMENT OF DISPUTE BETWEEN TWO PSU'S
27. ROYALTY
28. SITE FACILITIES FOR WORKMEN
29. ARBITRATION
30. PROJECT PLANNING, SCHEDULING AND MONITORING SYSTEM
31. CHECKING OF LEVELS
32. STORAGE FACILITIES
33. ABNORMALLY HIGH RATED ITEMS (AHR ITEMS)
34. BANK GUARANTEES
35. CENVAT BENEFITS
36. COMPUTERIZED BILLS
37. ORDER PLACEMENT OF BOUGHT OUT ITEMS
38. REQUIREMENTS FOR CONTRACTOR AT SITE
39. COMPLIANCE WITH LAWS
40. NOTES TO SCHEDULE OF RATES

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41. INSURANCE
42. PRICE REDUCTION SCHEDULE
43. DIRECT PAYMENTS TO SUB-VENDORS/ SUPPORTING AGENCIES OF MAIN CONTRACTOR
44. SUB-LETTING OF WORKS
45. BONUS FOR EARLY COMPLETION
46. PRADHAN MANTRI SURAKSHA BIMA YOJANA (PMSBY) AND PRADHAN MANTRI JEEVAN JYOTI BIMA YOJANA (PMJJBY)
47. FORCE MAJEURE (FOR COVID-19)

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1. GENERAL

1.0 Special conditions of contract (SCC) shall be read in conjunction with the General Conditions of Contract (GCC). Schedule of rates, specifications of work, drawings and any other document forming part of this contract wherever the context so requires.

1.1 Notwithstanding the sub-division of the document into these separate sections and volumes, every part of each with and into the contract so far as it may be practicable to do so.

1.2 Where any portion of the GCC is repugnant to or at variance with any provisions of the special conditions of contract, then unless a different intention appears, the provision(s) of the special conditions of contract shall be deemed to override the provision(s) of GCC only to the extent that such repugnancies of variations in the special conditions of contract are not possible of being reconciled with the provisions of GCC.

1.3 Wherever it is stated in this Bidding Document that such and such a supply is to be effected or such and such a work is to be carried out, it shall be understood that the same shall be effected/carried out by the contractor at his own cost, unless a different intention is specifically and expressly stated herein or otherwise explicit from the context. Contract value (also referred to as Contract price) shall be deemed to have included such cost.

1.4 The materials, design and workmanship shall satisfy the applicable relevant Indian Standards, the job specifications stipulate requirements in addition to those contained in the standard codes and specifications, these additional requirements shall also be satisfied. In the absence of any Standard/ Specifications/codes of practice for detailed specifications covering any part of the work covered in this Bidding on the contractor.

1.6 In partial modification to Clause No.21.0 of GCC-Works the following shall apply:

In case of contradiction between Indian or other applicable Standards, General Conditions of Contract, Special Conditions of Contract, Specifications, drawings, Schedule of Rates, the following shall prevail in order of precedence:

i) Letter of acceptance alongwith statement of Agreed variations. ii) Fax / Letter of Intent / Fax of Acceptance
iii) Schedule of Rates as enclosures to letter of acceptance
iv) Particular Job Specifications
v) Drawings
vi) Technical / Material Specifications
vii) Special Conditions of Contract
viii) General Conditions of Contract
ix) Indian Standards
x) Other Applicable Standards

1.7 It will be contractor's responsibility to bring to the notice of Engineer-in-charge

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any irreconcilable conflict in the contract documents before starting the work(s) of making the supply with reference which the conflict exists.

In the absence of any specifications covering any material, design of work(s) in the same shall be performed / supplies / executed in accordance with Standards Engineering Practice as per the instructions / directions of the Engineer-in-charge, which will be binding on the Contractor.

1.8 The requirements of any statutory body and authority like Indian boiler regulation, Tariff Advisory Committee, Chief controller of Explosives, etc, shall govern where these are more stringent than the requirements specified above.

1.9 Owner's representative means authorized representative of Owner (i.e. M/s BHAGYANAGAR GAS LTD.) and / or Consultant (i.e. M/s LEPL).

2.0 THE WORK

2.1 Scope of work

The scope of work covered in this Contract will be as described in Annexure- 1 to SCC at Particular job specifications, Standard Specifications, Schedule of Rates etc.

2.2 Scope of Supply

The scope of supply covered in this Contract will be as described in Annexure-2 to SCC Particular Job Specifications, Standard Specifications, Schedule of Rates etc.

2.3 Time schedule

2.3.1 The work shall be executed strictly as per time schedule given in Annexure-3 to SCC. The period of completion given includes the time required for mobilization as well as testing, rectifications, if any, retesting, demobilization and completion in all respects to the satisfaction of the Engineer-in-Charge.

2.3.2 A joint program of execution of work will be prepared by the Engineer-in- Charge and Contractor. This program will take into account the time of completion mentioned in 2.3.1 above.

2.3.3 Monthly/Weekly execution program will be drawn up by the Engineer-in- Charge jointly with the Contractor based on availability of materials, work fronts and the joint program of execution as referred to above. The contractor shall scrupulously adhere to the Targets/Programs by deploying adequate personnel, Construction Equipment, Tools and Tackles and also by timely

supply of required materials coming within his scope of supply as per Contract. In all matters concerning the extent of target set out in the weekly/monthly program and the degree of achievement, the decision of the Engineer-in-Charge will be final and binding on the Contractor.

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2.3.4 Contractor shall give every day category-wise labour and equipment deployment report alongwith the progress of work done on previous day in the proforma prescribed by the Engineer-in-Charge.

2.4 Measurement of Works

In addition to the provisions of Clause 88.1 of the General Conditions of Contract and associated provisions thereof, the provisions of Annexure – 4 to SCC shall apply.

2.5 Terms of Payment

Terms of Payment will be as specified in Annexure – 5 to SCC.

2.6 Temporary Works

All temporary works, ancillary works, enabling works, including dewatering of surface and subsoil water, temporary drains at the work site, preparing approaches to working areas, wherever required, for execution of the work, shall be the responsibility of Contractor.

2.7 Temporary Fencing

The Contractor shall, at his own costs and expenses, erect and maintain in good condition temporary fences and gates along the boundaries of the site assigned to him wherever required as per instruction of Engineer-in-charge. Wherever trenching is being done specially at crossing site near habitation and public movement. The contractor shall provide barricading as per sketch enclosed and provide proper night light as per requirement and to the satisfaction of EIC. The Contractor shall, except when authorized by the Engineer-in-Charge, confine his men, materials and plant etc. within the site of which he is given possession. The Contractor shall not use any part of the site for purpose not connected with the works unless prior written permission or consent of the Owner/Engineer-in-Charge has been obtained. Access to site shall be made only through the approved gateways. The Contractor shall maintain sufficient watchmen at site to the satisfaction of the Owner/Engineer- in-Charge.

2.8 Contractor's Temporary Structure

The Contractor may, at his own costs and expenses and subject to the approval of the Engineer-in-Charge and statutory authorities, construct offices, stores, workshop and remove the same as per the orders of the Engineer-in-Charge on completion of the contract. Whenever required the Contractor shall furnish such details of his temporary works as may be called for by the Owner/Engineer-in-Charge as to their safety and efficiency. The Owner/Engineer-in-Charge may direct those temporary works which he considers unsafe or, inefficient be removed and replaced in a satisfactory manner. The Contractor shall immediately follow Owner/Engineer-in-Charge's direction/instruction, on maintenance of all the equipments and he shall ensure that they are suitable for the work and is maintained in such a manner as to ensure their efficient working. The Owner/Engineer-in-Charge, may if they deem fit, direct the Contractor to remove from site any

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equipment which are not efficient and/or prejudicial to the quality of work to be replaced by equipment to their satisfaction. The Contractor shall immediately follow Owner/Engineer-in-Charge's direction/instruction.

2.9 Statutory Approvals

2.9.1 All associated activities required for obtaining necessary clearances, permissions, approvals, all licenses from all concerned authorities in respect of pipeline crossing & all related works shall be the responsibility of the Contractor and the cost of the same shall be deemed to have been included in the quoted prices.

The approval from any authority required as per statutory rules and regulations of Central/State Government shall be the Contractor's responsibility unless otherwise specified in the Bidding Document. The application on behalf of the Owner for submission to relevant authorities along with copies of required certificate complete in all respects shall be prepared and submitted by the Contractor well ahead of time so that the actual construction of the work is into delayed for want of the approval/inspection by concerned authorities. The inspection of the works by the authorities shall be arranged by the Contractor and necessary coordination and liaison work in this respect shall be the responsibility of the Contractor. However statutory fees paid, if any, for all inspections and approvals by such authorities shall be reimbursed at actual by the Owner to the Contractor on production of documentary evidence.

Any change/addition required to be made to meet the requirements of the statutory authorities shall be carried out by the Contractor free of charge. The inspection and acceptance of the work by statutory authorities shall however, not absolve the Contract from any of his responsibilities under this Contract.

2.10 Quality Assurance

2.10.1 Bidder shall include in his offer the quality assurance programme containing the overall quality management and procedures, which is required to be adhered to during the execution of contract. After the award of contract detailed quality assurance program shall be prepared by the contractor for the execution of Contract for various works, which will be mutually discussed and agreed to.

2.10.2 The Contractor shall establish document and maintain an effective quality assurance system as outlined in recognized codes.

2.10.3 Quality Assurance System plans/procedures of the Contractor shall be furnished in the in the form of QA manual. This document should cover details of the personnel responsible for the quality assurance, plans or procedures to be followed for quality control in respect of Design, Engineering, Procurement, Supply, Installation, Testing and Commissioning.

The quality assurance system should indicate organizational approach for quality control and quality assurance of the construction activities, at all stages of work at site as well as at manufacturer's works and dispatch of materials.

2.10.4 The Employer/ consultant / Consultant or their representative shall reserve the right

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to inspect/witness, review any or all stages of work at shop/site as deemed necessary for quality assurance without any extra cost to Employer.

2.10.5 The Contractor has to ensure the deployment of quality Assurance and Quality Control Engineer(s) depending upon the quantum of work. This QA /QC group shall be fully responsible to carryout the work as per standards and all code requirements. In case Engineer- in-charge feels that contractor's QA/QC Engineer (s) are incompetent or insufficient, contractor has to deploy other experienced Engineer(s) as per site requirement and to the full satisfaction of engineer-in- charge.

2.10.6 In case contractor fails to follow the instructions of Engineer –in-charge with respect to above clauses, next payment due to him shall not be released unless until he complies with the instructions to the full satisfaction of Engineer –in –charge.

2.10.7 The contractor shall adhere to the quality assurance system as per LEPL specification enclosed in the bidding document as Annexure-6.

2.11 Notice and Licenses

The Contractor shall at his costs and expenses give to the Municipal or Panchayat, Police and other authorities all notices etc., that may be required in law to be given and obtain all necessary permissions and licenses etc., for temporary obstructions, enclosures and pay all fees, taxes charges etc. which may be leviable by such authorities for that purpose. The Contractor shall make good any damage to the adjoining property whether public or private.

2.12 Working Hours

Depending upon the requirements, time schedule/ drawn up programs and the target set to complete the job in time the works may have to continue beyond normal working hours to the extent of round the clock and on holidays also for which no extra claim shall be entertained.

2.13 Responsibility of Contractor

Preparing approaches and working area for the movement and operation or the cranes, leveling the area for assembly and erection shall also be the responsibility of the Contractor. The Contractor shall acquaint himself with access availability, facilities such as railway siding, local labour etc.

The procurement and supply in sequence and at the appropriate time of all materials and consumables covered under Contractor's scope of supply shall be entirely the Contractor's responsibility. Contractor shall not use any of the equipment or materials issued to him by Owner for temporary works, manufacturing erection aids etc. Misuse of materials will be seriously viewed and deduction at penal rates will be made from the Contractors bill for such quantities that are misused.

Contract Price is deemed to be inclusive of all expenses towards above responsibilities.

2.14 Additional Works/Extra Works

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Owner reserve their right to execute any additional works/ extra works, during the execution of Work, either by themselves or by appointing any other agency, even though such works are incidental to and necessary for the completion of works awarded to the Contractor. In the event of such decisions taken by Owner, Contractor is required to extend necessary cooperation and act as per the instructions of Engineer-in-Charge

2.15 Compensation for Idle Time

The owner shall make every reasonable effort to have the materials and working front available so as not to delay laying activities. No idle time claim shall be entertained under any circumstances.

2.17 Power and Water Connection

The Purchaser/Consultant will not provide any power and water during construction period. Contractor shall apply and obtain necessary power and water during connection from relevant authority and will pay its usage charge or arrange the same from the other sources.

3.0 CONSTRUCTION

OWNER reserves the right to inspect all phases of Contractor's operations to ensure conformity to the SPECIFICATIONS. Owner will have Engineers, Inspectors or other duly authorized representatives, made known to the Contractor present during progress of the WORK and such representatives shall have free access to the WORK at all times. The presence or absence of an Owner's representative does not relieve the Contractor of the responsibility for quality control in all phases of the WORK. In the event that any of the WORK being done by the Contractor or any Sub-Contractor is found by
Owner's representatives to be unsatisfactory or not in accordance with the DRAWINGS, procedures and SPECIFICATIONS, the Contractor shall, upon verbal notice of such, revise the work in a manner to conform to the relevant DRAWINGS, procedures and SPECIFICATIONS.

3.1 Rules and Regulations

ontractor shall observe in addition to Codes specified in respective specification, all national and local laws, ordinances, rules and regulations and requirements pertaining to the work and shall be responsible for extra costs arising from violations of the same.

3.2 Procedures

Various procedures and method statements to be adopted by Contractor during the construction as required in the respective specifications shall be submitted to Engineer-in-Charge in due time for approval. No construction activity shall commence unless approved by Engineer-in-Charge in writing.

3.3 Security

If the work being in protected area, entry into the work area shall be restricted and

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governed by issue of photo gate passes by the Security/CISF. The Contractor shall arrange to obtain through the Engineer-in-Charge, well in advance, all necessary entry permits/gate pass for his staff and labour and entry and exit of his men and materials shall be subject to vigorous check by the security staff. The Contractor shall not be eligible for any claim or extension of time whatsoever on this account. Also for domestic installation works, contractor shall provide Identity cards to their employees/ workers to work inside the society / house premises.

3.4 Drawings and Documents

3.4.1 The drawings accompanying the bid document (if any) are of indicative nature and issued for bidding purpose only. Purpose of these drawing is to enable the bidder to make an offer in line with the requirements of the Employer/Consultant. However no extra claim whatsoever, shall be entertained for variation in the "Approved for Construction" and "Bid document drawings" regarding any changes/units. Construction shall be as per drawings/specifications issued/approved by the Engineer-in-Charge during the course of execution of work. Detailed construction drawings (wherever required) on the basis of which actual execution of work is to proceed will be prepared by the contractor.

3.4.2 The drawings and documents to be submitted by the Contractor to Employer/Consultant after award of the work as per the requirements enlisted in the bidding document shall be for Employer/Consultant's review, information and record. The Contractor shall ensure that drawings and documents submitted to Employer/Consultant are accompanied by relevant calculations, data as required and essential for review of the document/ drawings. LEPL shall review the drawings/ documents within two weeks from the date of submission provided the same are accompanied by relevant calculations, data as required and essential for review.

manufacturer's etc. shall be submitted to Employer/Consultant after having been fully vetted in detail, approved and co-opted by the Contractor & shall bear Contractor seal/ certifications to this effect. All documents/drawings & submissions made to Employer/Consultant without compliance to this requirement will not be acceptable and the delay & liability owing to this shall be to the Contractor's account.

3.4.4 The review of documents and drawings by Employer/Consultant shall not absolve Contractor from his responsibility to meet the requirements of specifications, drawings etc. and liabilities for mistakes and deviations. Upon receiving the comments on the drawing/documents reviewed by Employer/Consultant, Contractor shall incorporate the comments as required and ensure their compliance.

3.4.5 Copies of all detailed working drawing relating to the works shall be kept at the contractors' office at the site and shall be made available to the Engineer- in-charge/ Employer/Consultant at any time during execution of the contract. However no extra claim what so ever shall be entertained for any variation in the "approved/issued for construction drawings" and "tender drawings" regarding any changes/units unless otherwise agreed.

3.4.6 The Contractor shall rectify any inaccuracies, errors and non-compliance to contractual requirements. Any delay occurring on this shall not construe a reason for

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delay/ extension.

3.5 DELETED.

3.6 Construction Equipment & Mechanization of Construction Activities

Contractor shall, without prejudice to his overall responsibility to execute and complete the Work as per specifications and time schedule, adopt as far as practicable, mechanized construction techniques for major site activities. However, Contractor agrees that he will deploy the required numbers and types of the part & machinery applicable for different activities in consultation with the Engineer-In-Charge during execution of works.

The Contractor shall mechanize the construction activities to the maximum extent by deploying all necessary construction equipment/machinery in adequate numbers and capacities.

Wherever Structural/Piping works are included in the scope, the Contractor's responsibilities shall include establishing and maintaining of a proper fabrication workshop with transportation facilities to site to carryout fabrication of steel structures, piping specials etc., preparing approaches working areas for the movement/operation of cranes and leveling the areas for assembly/erection to ensure effective mechanization on the works. The
Contractor shall acquaint himself with availability of access, facilities such as railway siding, local labour etc. and the Contractor may have to build temporary access roads to aid his work and the quoted and agreed rates shall be deemed to include the same. It may be noted that all fabrication work shall be carried out in fully mechanized workshops to reduce site fabrication to minimum.

Contractor shall also ensure use of computer software for at least the following:

(i) Billing
(ii) Planning & Scheduling
(iii) Progress Reporting
(iv) Material Control & Warehousing
(v) Safety Records
(vi) Resource Deployment (vii) Communication

Contractor further agrees that Contract price is inclusive of all the associated costs) which he may incur for actual mobilization, required in respect of use of mechanized construction techniques and that the Owner/Consultant in this regard shall entertain no claim whatsoever.

3.7 Site Organization

The Contractor shall provide all necessary superintendence during the design and execution of the Works and as long thereafter as the Engineer-in-Charge may consider necessary for the proper fulfilling of the Contractor's obligations under the Contract. Such superintendence shall be given by sufficient persons having adequate knowledge of the operations to be carried out including the methods and

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techniques required the hazards likely to be encountered and methods of preventing accident for the satisfactory and safe execution of the Work. The workmen deployed, by the Contractor should also possess the necessary license etc., if required under any law, rules and regulations.

Subject to the provisions in the Contract Document and without prejudice to Contractor's liabilities and responsibilities to provide adequate qualified and skilled personnel on the Work, Contractor shall augment the same as decided by the Engineer-in-Charge depending on the exigencies of Work.

3.7.1 SUPERVISION

All construction work will be carried out as per direction of EIC, and this will be the primary point of contact between the Contractor and BHAGYANAGAR GAS LTD. on site. All work will be issued and sanctioned through the EIC and site control exercised by site engineers. The Contractor shall ensure that technical quality standards are maintained, that construction is carried out cost effectively and that a good customer and public image is maintained for BHAGYANAGAR GAS LTD.

The Contractor will appoint his own supervisors of minimum number instructed by EIC. These personnel will be responsible to the SE for monitoring construction standards and for ensuring that all detailed technical requirements are met on each and every job which is undertaken. The Contractor's supervisor(s) will have day to day liaison with the SE, and will provide the SE with technical reports and audits, and other management information as is required on work progress and construction quality standards.

The Contractor's supervisor shall have mobile telephones or pagers to ensure that they can be contacted at all times. The Contractor will also nominate one person who can be contacted if necessary out of hours, for the duration of the works. The Contractor's supervisor will have access to transport at all times to allow them to visit sites and attend meetings with BHAGYANAGAR GAS LTD.as is required. The normal day to day issue of work instructions, communication between BHAGYANAGAR GAS LTD.and the Contractor's supervisor and the SE. No deviation from the approved technical specification / issued construction drawings shall be undertaken without written approval of EIC.

3.8 Health Safety and Environment (HSE) Management

After the award of the contract, detailed Health, Safety and Environment (HSE) program to be followed for execution of contract under various divisions of works will be mutually discussed and agreed between Contractor, Client & PMC.

The Contractor shall establish document and maintain an effective Health, Safety and Environment (HSE) management system.

In case contractor fails to follow the instructions of Engineer-in-charge with respect to above clauses, next payment due to him shall not be released unless until he

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complies with the instructions to the full satisfaction of Engineer-in-charge.

The Contractor shall adhere to the Health, Safety and Environment (HSE) management system as per BHAGYANAGAR GAS LTD.Specification and General Conditions of Contract.

It will be the Contractor's responsibility to acquaint his site staff and operatives of all current safety legislation, statutory requirements and BHAGYANAGAR GAS LTD.'s safety standards. In addition, and before any work takes place all the Contractor's operatives shall be given training in site safety by the trained person under supervision of BHAGYANAGAR GAS LTD. If the Contractor wishes to start any new operatives on site, he must first inform the SE, who will arrange for such training to be arranged.

3.9 General Guidelines During and Before Erection

3.9.1 The Contractor shall be responsible for organizing the lifting of the structural element, equipment in the proper sequence, that orderly progress of the work is ensured and access routes for erecting the other structures/ equipments are kept open.

3.9.2 During the performance of the work the Contractor at his own cost, shall keep structures, materials and equipment adequately braced by guys, struts or otherwise approved means which shall be Supplied and installed by the Contractor as required till the installation work is satisfactorily completed.

Such guys, shoring, bracing, strutting, planking supports etc. shall not interfere with the work of other agencies and shall not damage or cause distortion to other works executed by him or other agencies.

3.9.3 Manufacturer's recommendations and detailed specifications for the installation of the various equipment and machines shall be fulfilled by the Contractor.

3.9.4 Various tolerances required as marked on the drawings and as per specifications and instructions of the Engineer-in-Charge, shall be maintained.

Verticality shall be maintained. Verticality shall be verified with the Theodolite/advanced instruments,

3.10 Construction Photographs

The Owner desires to have two sets of monthly progress reports with photographs showing the progress of construction. Before utilizing any photograph for publicity, the Contractor shall obtain prior approval of the Owner.

3.11 Schedule of Labour

Schedule of Labour Rates attached as Annexure-9 to SCC shall be used for analysing rates for extra items.

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Schedule of equipment rates attached as Annexure-9 to SCC shall be used for analysing rates for extra items.

3.11.1. Construction Equipment

Minimum construction equipment to be deployed is enclosed as Annexure-8 to SCC. However, Any other equipment required for completion of pipeline laying work but not specifically mentioned here, shall be deployed by contractor without any additional cost. The list of equipments mentioned in Annexure-8 is the minimum to be deployed by contractor and contractor shall ensure the availability at site of listed equipments in good working condition.

3.12 Specific Requirements

Specific requirements spelt out in various technical parts of the Bidding Document shall be followed by Contractor.

3.13 SITE CLEANING

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

3.13.2 Working site should be always kept cleaned up to the entire satisfactions of the Engineer-in-charge.

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

3.14 SURVEY OF WORK

Before the WORK or any part thereof are begun, the Contractor's agent and the Engineer-in-Charge's representative shall together survey the SITE and decide the tentative route considering all obstructions on which the pipeline is to be laid and on which measurements of the WORK are to be based. Such particulars shall be plotted by the BIDDER and trial pits started thereon.

The Contractor shall be entirely responsible for the correctness of every part of the WORK and shall rectify any errors or imperfections therein. Such rectifications shall be carried out by the Contractor at his own cost, when instructions are issued to this effect by the Engineer-in-Charge or his representative.

WORK shall be suspended for such times as necessary for checking lines and levels on any part of the WORK.

The Contractor shall at his own expense provide all assistance, which the Engineer-in-Charge may require for checking the setting out to WORKS.

Before commencement of any activity, Contractor's quality control set up duly approved by company must be available at site.

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4.0 TESTS, INSPECTION AND COMPLETION

4.1 Tests and Inspection of Material under Contractor's Scope

Inspection and test prior to shipment of material and at final acceptance shall be as specified in Technical Specification. However, without prejudice to the provision of Technical Specification following shall hold good.

The Owner/Consultant or its representative shall have the right to inspect ad or to test the material to conform their conformity to the specification.

If any inspected or tested material fail to conform the specification , the Owner/Consultant may reject them and the contractor shall either replace the rejected materials or make all the alteration necessary to meet the specification , free of cost to the purchaser/consultant.

The Purchaser / Consultant's right to inspect , test and where ever necessary reject the material after the material's arrival in the purchaser / consultant site shall in no way be limited to or waived by reason of the material having previously been inspected , tested and passed by the purchaser/ Consultant or their representative prior to the material shipment from the material supplier.

4.2 Tests and Inspection during execution

The Contractor shall carry out the various tests as enumerated in the technical specifications of this Bidding Document and technical documents that will be furnished to him during the performance of the work at no extra cost to the Owner.

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

The work is subject to inspection at all times by the Engineer-in-Charge. The Contractor shall follow all instructions given during inspection and shall ensure that the work is being carried out according to the technical specifications of this Bidding Document, the technical documents that will be furnished to him during performance of work and the relevant codes of practice.

The Contractor shall provide for purposes of inspection access ladders, lighting equipment for testing, necessary instruments etc. at his own cost, low voltage lighting equipment for tray fixing and inspection work.

Compressed air for carrying out works shall be arranged by the Contractor at his own cost.

For material supplied by Owner, Contractor shall carryout the tests, if required by the Engineer-in-Charge, and the cost of such tests shall be reimbursed by the Owner at actual to the Contractor on production of documentary evidence.

Contractor shall inspect carefully all equipment before receiving them from Owner

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for installation purposes. Any damage or defect noticed shall be brought to the notice of Engineer-in- Charge immediately.

All results of inspection and tests will be recorded in the inspection reports, proforma of which will be approved by the Engineer-in-Charge. These reports shall form part of the completion documents. Any work not conforming to execution drawings, specifications or codes shall be rejected and the Contractor shall carryout the rectifications at his own cost.

Inspection and acceptance of the work shall not relieve the Contractor from any of his responsibilities under this Contract.

4.3 Final Inspection during execution

After completion of all tests as per specification the whole work will be subject to a final inspection to ensure that job has been completed as per requirement. If any defect is noticed, the Contractor will be notified by the Engineer-in-Charge and he shall make good the defects at his own cost and risk with utmost speed. If, however, the Contractor fails to attend to these defects within a reasonable time (time period shall be fixed by the Engineer- in-Charge) then Engineer-in-Charge may have defects rectified at Contractor's cost.

When these works are carried out at the risk and cost of the Contractor, the Engineer-in-charge would recover the actual cost incurred towards labour, supervisions and material, consumables or otherwise, plus 100% towards overheadsfrom any pending bill of the Contractor or the security deposit.

4.3 Documentation

4.3.1 As - Built Drawings

Notwithstanding the provisions contained in standard specifications, upon completion of commissioning, the BIDDER shall complete all of the related approved drawings along with bill of materials to the "AS BUILT" stage provide to a scale of 1:200 and submit to BHAGYANAGAR GAS LTD., the following:

a) One complete set in reduced size (279 mm x 432 mm).
b) One complete set of Soft Copy in CD of all original drawings.
c) Four complete sets of approved prints in A2 / A3 sizes.

4.3.2 Completion Document

The following documents shall be submitted in hard binder by the BIDDER in FOUR sets, as a part of completion documents: -

a) Copies of the Inspection reports, Laying Graphs, HDD Profiles (IF ANY) and valve pit drawings (IF ANY).

b) Pre testing, final Hydrostatic / pneumatic and other Test results and reports.

c) Consumption statements of PE / GI certified by Owner's Site Engineer.

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d) Material Reconciliation, stores issue & return statements

e) All other requirements as specified in the respective specifications.

f) Completion Certificate issued by Owner's Site Engineer.

g) No claim certificate by the BIDDER.

h) Completion certificate for embedded and covered up works wherever applicable.

i) Recovery statement, if any.

j) Deviation statement.

k) Statement for reconciliation of all the payments and recoveries made in the progress bills.

l) Copies of deviation statement and order of extension of time, if granted.

m) Any other contractual documents required on completion.

4.4 Statement of Final Bills-Issue of No Demand Certificate

The final bill of Contractor shall be accompanied by no-demand certificate from the following departments of the Owner:

i) Administration & Personnel Department regarding vacation of land, housing accommodation, recovery of tents etc.

ii) Fire and Safety Officer and CISF.

The Contractor shall obtain such no-demand certificates from the concerned authorities and furnish the same to the Engineer-in-Charge.

4.5 Issue and Reconciliation of Material

Refer Annexure-7 to SCC for details.

4.8 GOVERNMENT OF INDIA NOT LIABLE

It is expressly understood and agreed by and between the Contractor and the Employer that the Employer is entering into this agreement solely on its own behalf and not on behalf of any other person or entity. In particular, it is expressly understood and agreed that the Government of India is not a party to this agreement and has no liabilities, obligations or rights there under. It is expressly understood and agreed that the Employer is an independent legal entity with power and authority to enter into contract, solely in its own behalf under the applicable laws of India and general principal of Contract Law. The Contractor expressly agrees, acknowledges

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and understands that the Employer is not an agent, representative or delegate of Govt. of India. It is further understood and agreed that the Govt. of India is not and shall not be liable for any acts, omissions, commissions, breaches or other wrongs arising out of the contract. Accordingly, contractor hereby expressly waives, releases and foregoes any and all actions or claims, including cross claims, impleader claims or counter claims against the Govt. of India arising out of this contract and covenants not to sue to Govt. of India as to any manner, claim, cause of action or thing whatsoever arising of or under this agreement.

5.0 REGISTRATION OF THE CONTRACT WITH STATUTORY AUTHORITIES (FOR FOREIGN BIDDER if applicable)

5.1 Within 30 days of execution of the Contract agreement, the Contractor shall register themselves and the Contract at their own cost with the Reserve Bank of India, Income Tax, Sales Tax and such other statutory authorities, as may be required under the rules and regulations governing in India. The Contract Price shall be deemed to include all costs towards the same. A copy of all documents related to all such registration shall be submitted to Employer for record.

6.0 LIMITATION OF LIABILITY

6.1 The final payment by the Employer in pursuance of the Contract terms shall not mean release of the Contractor from all of his liabilities under the Contract. The Contractor shall be liable and committed under this contract to fulfil all his liabilities and responsibilities, till the time of release of contract performance guarantee by the Employer.

6.2 Notwithstanding anything contrary contained herein, the aggregate total liability of Contractor under the Contract or otherwise shall be limited to 100% of Contract value. However, neither party shall be liable to the other party for any indirect and consequential damages, loss of profit or loss of production.

7.0 Void

8.0 DELETED

9.0 DELETED

10. DELETED

11. DELETED

12.0 DELETED

13.0 VOID

14.0 DELETED

15 ISSUE OF CERTIFICATE- PERTAINING TO IMPORT

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BHAGYANAGAR GAS LTD.shall not provide any kind of certificate.

16.0 IMPORT LICENCE

16.1 Contractor shall arrange import of all materials required for permanent incorporation in the works as well as construction equipment as per the guidelines laid down by the Government of India. Employer shall not provide import license.

17.0 DELETED

18.0 INTELLECTUAL PROPERTY

18.1 Neither Employer nor Contractor nor their personnel, agents nor any sub- contractor shall divulge to any one (other than persons designated by the party disclosing the information) any information designated in writing as confidential and obtained from the disclosing party during the course of execution of the works so long as and to the extent that the information has not become part of the public domain. This obligation does not apply to information furnished or made known to the recipient of the information without restriction as to its use by third parties or which was in recipient's possession at the time of disclosure by the disclosing party. Upon completion of the works or in the event of termination pursuant to the provisions of the contract, Contractor shall immediately return to Employer/Consultant all drawings, plans, specifications and other documents supplied to the Contractor by or on behalf of Employer/Consultant or prepared by the Contractor solely for the purpose of the performance of the works, including all copies made thereof by the Contractor.

19.0 FIRM PRICE

19.1 The quoted prices shall be firm and shall not subjected to price escalation till the work is completed in all respects.

20.0 WORKS CONTRACT

20.1 The work covered under this contract shall be treated as "Works Contract".

21.0 PROVIDENT FUND ACT

21.1 The Contractor shall strictly comply with the provisions of Employees Provident Fund Act and register themselves with RPFC before commencing work. The Contractor shall deposit Employees and Employers contributions to the RPFC every month. The Contractor shall furnish along with each running bill, the challan/ receipt for the payment made to the RPFC for the preceding months.

22.0 DELETED

23.0 TERMS OF PAYMENT

23.1 Basis and terms of payment for making “On Account Payment” shall be as set out in

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Annexure-5 to SCC.

24.0 DELETED

25.0 COORDINATION WITH OTHER AGENCIES

25.1 Work shall be carried out in such a manner that the work of other agencies operating at the site is not hampered due to any action of the Contractor. Proper coordination with other agencies will be Contractor's responsibility. In case of any dispute, the decision of Engineer-in-Charge shall be final and binding on the Contractor.

26.0 DELETED

27.0 ROYALTY

27.1 Contractor's quoted rate should include the royalty on different applicable items as per the prevailing Government rates. In case, Employer is able to obtain the exemption of Royalty from the State Government, the contractor shall pass on the same to Employer for all the items involving Royalty.

28.0 THE FACILITIES FOR WORKMEN

28.1 Following facilities are to be ensured at all work places where workmen are deployed/engaged by Contractor & any other, as required by law at the time of execution.

Arrangement of first aid
Arrangement for clean drinking water.
Toilets
Canteen where tea & snacks are available
A crèche where 10 or more women workmen are having children below the age of 6 years.

29.0 DELETED

30.0 PROJECT PLANNING, SCHEDULING AND MONITORING SYSTEM

33.1 The Contractor shall follow the specifications with respect to Project Planning, Scheduling and Monitoring system as giving in Bidding Document.

31.0 CHECKING OF LEVELS

31.1 The Contractor shall be responsible for checking levels, orientation plan of all foundations, foundation bolts, etc., well in advance of taking up the actual erection work and bring to the notice of Engineer-in-Charge discrepancies, if any. In case of minor variations in levels etc. the Contractor shall carry out the necessary rectifications to the foundations within his quoted price.

31.2 The Contractor shall also be responsible for checking with templates, wherever

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necessary, the disposition of foundation bolts with the corresponding bases of structure and shall effect rectifications, as directed, within his quoted rate.

32.0 STORAGE FACILITIES

32.1 The Contractor shall maintain wherever required an air-conditioned room for the storage of the instruments as well as for calibration and testing of the instruments at his own cost. The contractor shall provide these facilities with in the quoted price.

33.0 ABNORMALLY HIGH RATED ITEMS (AHR ITEMS)

33.1 Clause No. 20.0 of GCC-Works is modified to the following extent:

33.2 "In items rate contract where the quoted rates for the items exceed 50% of the owners/ estimated rates, such items will be considered as Abnormally High Rates Items (AHR) and payment of AHR items beyond the SOR stipulated quantities shall be made at the least of the following rates:

i) Rates as per SOR, quoted by the Contractor.
ii) Rate of the item, which shall be derived as follows:

a) Based on rates of machine and labour as available from the contract (which includes contractor's supervision, profit, overheads and other expenses).

b) In case rates are not available in the contract, rates will be calculated based on prevailing market rates of machine, material and labour plus 15% to cover contractor's supervision profit, overhead & other expenses.

34.0 DELETED

35. DELETED

36. COMPUTERIZED BILLS

Contractor shall submit computerized bills with duly printed GST Registration no. etc.

37. ORDER PLACEMENT OF BOUGHT OUT ITEMS

The contractor is required to place firm order for all bought out items of adequate quantity (including 1st lot in those cases where items are required to be procured in more than one lot, if so stated in SOR/ SCC) within 30 days from the date of placement of order, failing which owner reserves the right to procure the same at the

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risk & cost of the contractor. However the contractor shall always take prior approval of owner and consultant for items required to be procured.

Further lots (for those cases where items are required to be procured in more than one lot, if so stated in SOR/ SCC) shall be procured after suitable period so as to ensure adequate availability of material at site through out the execution period).

38. REQUIREMENTS FOR CONTRACTOR AT SITE

38.1 Contractor shall establish site office in the respective areas with adequate facilities like tables, chairs, telephone, and computer with mailing facility etc. for effective communication and documentation.

38.2 Contractor shall provide as and when required a wagon(s) suitable for soil removal, for the delivery or reinstatement materials and for the transport of pipe to and from site.

38.3 Contractor shall supply transport for their technical staff and operatives to move from site to site, and to move tools and equipment from site to site, this vehicle will also be fitted with a tow bar suitable for the towing of a mobile air compressor or pipe trailer.

38.4 Contractor shall make appropriate arrangements to ensure that their supervisor(s) are adequately mobile and can attend sites or meeting with BGL/ LEPL & other authorities or customers as required, without any undue delay.

38.5 Contractors shall provide cell phones to their supervisors for day to day communication with BHAGYANAGAR Gas/ LEPL and site representatives of BGL/ LEPL.

38.6 The RCM/ site in-charge must be a permanent employee of the contractor having desired qualification and work experience, Any change in key persons working at site shall be informed to the Owner promptly.

38.7 Owner will not allow switching/ swapping of key personnel of any contractor working at site from one contractor to another during the continuity of the contract.

39. COMPLIANCE WITH LAWS

39.1 The Contractor shall abide by all applicable rules, regulations, statutes, laws governing the performance of works in India, including but not limited to the following:

i) Contract Labour (Regulation & Abolition) Act 1970 & the centre rules, 1971 framed there under. ii) Payment of Wages Act. iii) Minimum Wages Act. iv) Employer's Liability Act. v) Factory Act. vi) Apprentices Act. vii) Workman's Compensation Act. viii) Industrial Dispute Act. ix) Environment Protection Act. x) Wild life Act. xi)

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Maritime Act. xii) Any other Statute, Act, Law as may be applicable.
xiii) PNGRB Act.

40. NOTES TO SCHEDULE OF RATES (SOR)

i) The SOR items would be operatable as per job requirement.

ii) The quantities stated in SOR are tentative and may vary considerably on ± side depending upon site condition, methodology adopted as per site requirement. The payment will be made as per actual certified Measurement at site and as instructed by EIC.

iii) The scope as mentioned in the SOR is of indicative nature only and shall include all activities as detailed in the relevant clauses of the specifications attached and other relevant documents enclosed with tender.

iv) Any other materials & activities not mentioned/covered in SOR , but otherwise required for satisfactory completion/safety of work as defined in tender has to be supplied /done by contractor with in the specified schedule at no extra cost to owner.

v) Contractor shall be required to deploy adequate no. of plumbing teams to ensure domestic conversions expeditiously. In this regard, no. of independent teams shall be decided by Engineer-in-charge.

41.0 Insurance

All kind of Insurances including transit Insurance shall be borne & arranged by the bidder in line with clause no. 101 of GCC-Works. Price quoted in SOR shall be inclusive of this cost. Clause no. 16 of GCC-Goods, in this respect, shall stand superseded to this extent.

42.0 PRICE REDUCTION SCHEDULE

The Price reduction schedule shall be applicable as per clause no. 27 of GCC-Works. The Contract/order value shall exclude GST for the purpose of Price reduction schedule.

42.1. PRS is the reduction in the consideration/contract value for the goods/services covered under this contract. In case of delay in supply/ execution of the contract, the supplier/contractor/service provider should raise invoice for reduced value as per Price Reduction Schedule Clause (PRS clause). If the supplier/ contractor/ service provider has raised the· invoice for the full value, then the supplier/contractor/service provider should issue Credit Note towards the applicable PRS amount with applicable taxes

42.2. In such cases, if supplier/ contractor/ service provider fails to submit the invoice with

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reduced value or does not issue credit note as mentioned above, BHAGYANAGAR Gas will release the payment to supplier/ contractor/ service provider after giving the effect of the PRS clause with the corresponding reduction of taxes charged on vendor's invoice, to avoid delay in delivery/collection of material.

42.3 In case any financial implication arises on BHAGYANAGAR Gas due to issuance of invoice without reduction in price or non-issuance of Credit Note, the same shall be· to the account of supplier/ contractor/ service provider. BHAGYANAGAR Gas shall be entitled to deduct /setoff / recover such GST amount (CGST & SGST/UTGST or IGST) together with penalties and interest, if any, against any amounts paid or becomes payable by

BHAGYANAGAR Gas in future to the Supplier/Contractor under this contract or under any other contract.

43.0 DIRECT PAYMENTS TO SUB-VENDORS/ SUPPORTING AGENCIES OF MAIN CONTRACTOR

Normally, the payment is to be made to vendor/ contractor only as per provision of contract. During execution, in case of financial constraints, BGL may make direct payment to their sub-vendor/ supporting agencies as an exception from the amounts due to the vendors/ contractors from any of their bills under process upon certification by EIC subject to receipt of such request from the vendor/ contractor. Further, the request for direct payments to the sub-vendor/ sub-contractor shall be considered in performance evaluation of such vendor/ contractor.

44.0 SUB-LETTING OF WORKS

Pursuant to Clause No. 37 of GCC-Works:
The contractor shall not, save with previous consent in writing of the Engineer-in-charge, sublet, transfer or assign the contract or any part thereof or interest therein or benefit or advantage thereof in any manner whatsoever. Provided, nevertheless, that any such consent shall not relieve the contractor from any obligation, duty or responsibility under the contract.
However, subletting of WHOLE WORKS is prohibited. Vendor/ Contractor shall submit undertaking to this effect along with each invoice/ bill.

45.0 BONUS FOR EARLY COMPLETION

The Clause 27.3 of GCC-Works for Bonus for early completion shall not be applicable in this Contract.

46. PRADHAN MANTRI SURAKSHA BIMA YOJANA (PMSBY) AND PRADHAN MANTRI JEEVAN JYOTI BIMA YOJANA (PMJJBY)

Contractor shall ensure that all its personnel deployed under this contract have obtained additional insurance coverage under the Pradhan Mantri Suraksha Bima

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Yojana (PMSBY) and Pradhan Mantri Jeevan Jyoti Bima Yojana (PMJJBY) through the participating banks and submit the proof of such insurance coverage to the satisfaction of BGL. The cost of the insurance premium amount for both the above schemes shall be borne by the contractor giving evidence/proof to BGL in this respect and the Contractor shall suitably consider the same in their bid.

Both the schemes are to be regulated continuously on yearly basis and the same should be renewed on each successive relevant date in subsequent years.

47. FORCE MAJEURE (FOR COVID-19)

Shall be as per Government of India Guide lines.

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ANNEXURES TO SCC

C O N T E N T S

Annexure-1	:	Scope of Work
Annexure-2	:	Scope of Supply
Annexure-3	:	Time Schedule
Annexure-4	:	Measurement of Work
Annexure-5	:	Terms of Payment
Annexure-6	:	Quality Assurance
Annexure-7	:	Conditions for issue & reconciliation of material
Annexure-8	:	Construction equipment to be deployed
Annexure-9	:	Schedule of Labour Rate
Annexure-10	:	Schedule of Equipment Hourly Rental Rate

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SCOPE OF WORK

(ANNEXURE-1 TO SPECIAL CONDITIONS OF CONTRACT)

ANNEXURE-1 TO SCC

1.0 SCOPE OF WORK

Scope of work shall be as detailed in Particular Job Specification / Technical Vol II of II, Technical Specifications, Schedule of Rates & various other parts of this Bidding Document.

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SCOPE OF SUPPLY

(ANNEXURE-2 TO SPECIAL CONDITIONS OF CONTRACT)

ANNEXURE-2 TO SCC 1.0

SCOPE OF SUPPLY

1.1 Owner's Scope of Supply (Free Issue Item)

Owner's scope of supply shall be as specified in Particular Job Specification, Technical Specifications, Schedule of Rates & various other parts of the Bidding Document.

In order to speed up the project Free Issue Materials shall be issued to the Contractor from the designated store(s) of BHAGYANAGAR Gas Ltd. Contractor shall be responsible for lifting the free issue materials from Owner's storage point(s) and transporting the same to work site(s) at his own cost.

Conditions for Issue and Reconciliation of Materials shall be as per Document enclosed as Annexure-7 to Special Conditions of Contract.

1.2 Contractor's Scope of Supply

All materials except what is under Owner's scope of supply as mentioned in Clause No. 1.1 above, and required for successful completion of works in all respects shall be supplied by the Contractor and the cost of such supply shall be deemed to have been included in the quoted price without any additional liability on the part of Owner.

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TIME SCHEDULE

(ANNEXURE-3 TO SPECIAL CONDITIONS OF CONTRACT)

ANNEXURE-3 TO SCC

TIME SCHEDULE

Name of Work	Time of Completion	
CONSTRUCTION OF CNG MOTHER STATION AT MLV-13 INDRESHAM & KATEDHAN IN HYDERABAD OF BHAGYANAGAR GAS LIMITED (The time schedule is inclusive of mobilization period)	HYDERABAD	Contract validity period of 01 year from the date of LOI/FOA. However, the execution of works shall be completed within 06 months from the date of Intimation by the EIC. (FOA)

Note:

1) The time of completion shall be reckoned from the date of award of contract, which shall be the date of issue of letter/ Fax of Intent.

2) The time indicated is for completing all the works in all respects as per specifications, codes, drawings and instructions of Engineer-in-charge.

3) It should be noted that the period of construction given above includes preparation of drawings , procurement and supply of materials including their inspection & testing, mobilization at site, construction, laying, fabrication, erection inspection, testing, rectification (if any), pre-commissioning, commissioning and demobilization works etc. complete in all respects to the entire satisfaction of Owner/ Engineer-in- charge.

_____

(STAMP & SIGNATURE OF BIDDER)

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MEASUREMENT OF WORK

(ANNEXURE-4 TO SPECIAL CONDITIONS OF CONTRACT – TECHNICAL)

ANNEXURE-4 TO SCC

MEASUREMENT OF WORK

1.0 GENERAL

1.1 The mode of measurement shall be as mentioned in relevant standard specification incorporated in the Bidding Document. Any other mode of measurements not covered in above specifications shall be followed in accordance with relevant BIS codes/ Schedule of Rates/ Specifications etc. and/ or as decided by Engineer-in- charge.

1.2 Payment will be made on the basis of joint measurements taken by Contractor and certified by Engineer-in-charge. Measurement shall be based on "Approved for Construction" drawings, to be the extent that the work conforms to the drawings and details are adequate.

1.3 Wherever work is executed based on instructions of Engineer-in-charge or details are not adequate in the drawings, physical measurements shall be taken by Contractor in the presence of Engineer-in-charge.

1.4 Measurements of weights shall be in metric tonnes corrected to the nearest Kilogram. Linear measurements shall be in meters corrected to the nearest centimeters.

1.5 The weights mentioned in the drawing or shipping list shall be the basis for payment. If mountings for panels etc. are packed separately, their erection weights shall include all mountings.

1.6 Welds, bolts, nuts, washers etc. shall not be measured. Rates for structural steel work shall be deemed to include the same.

1.7 No other payment either for temporary works connected with this Contractor for any other item such as weld, shims, packing plates etc. shall be made. Such items shall be deemed to have been included for in the rates quoted.

1.8 Measurement will be made for various items under schedule of rates on the following basis as indicated in the unit column.

i)	Weight	:	MT or Kg
ii)	Length	:	M (Meter)
iii)	Number	:	No.
iv)	Volume	:	Cu.M
v)	Area	:	Sq.M

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TERMS OF PAYMENT

(ANNEXURE-5 TO SPECIAL CONDITIONS OF CONTRACT)

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ANNEXURE-5 TO SCC

1.0 TERMS OF PAYMENT

1.1 Advance

1.1.1 The Owner will not pay any advance in any circumstances.

1.2 The Payment terms shall be as follows:

The CONTRACTOR shall raise the RA bill on monthly basis and payment shall be made as per the following terms:

1.2.1 CIVIL / STRUCTURAL WORK

a) 80% payment shall be released on Pro-Rata basis against submission of RA bill with GST and other requisite document duly certified by Engineer-In-Charge.
b) 10% on completion of all the work and Certificate by Engineer-In -Charge
c) Balance 10% on contract closure and submission of all documents as per contract.

1.2.2 MECHANICAL/ ELECTRICAL WORKS

a) 80 % on Supply, fabrication, installation and testing with other requisite document duly certified by EngineerIn-Charge.

b) 10% on completion of all work and Certificate by Engineer-In -Charge

c) Balance 10% on contract closure and submission of all documents as per contract.

1.2.3 PAYMENT METHODOLOGY

a) The contractor shall raise GST invoices on monthly basis. Bidder shall enclose all relevant documents as per check list issued by BGL including during kick off meeting.

b) The payments to the Contractor will be released within a period of 15 days from the date of receipt of the complete invoice as per the terms and conditions of the Contract.

c) Employer will release payment through e-payments only as detailed in the Bidding Document.

d) Further break-up of Lump-sum Prices, if deemed necessary for any progressive payment of individual item may be mutually arrived at between Engineer-in-Charge and the Contractor.

e) All payments against running bills are advance against the work and shall not be taken as final acceptance of work / measurement carried out till the final bill.

1.2.4 PAYING AUTHORITY:
In charge- Finance BGL-
HO, Hyderabad.

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QUALITY ASSURANCE

(ANNEXURE-6 TO SPECIAL CONDITIONS OF CONTRACT)

(For details- Refer our Technical Specification enclosed in Vol.-II of tender document.)

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CONDITIONS FOR ISSUE AND RECONCILIATION OF MATERIAL

(ANNEXURE-7 TO SPECIAL CONDITIONS OF CONTRACT)

ANNEXURE-7 TO SCC

1.0 CONDITIONS FOR ISSUE OF MATERIALS

Whenever any material is issued by Owner, following conditions for issue of material in addition to other conditions specified in the contract shall be applicable.

1.1 Necessary indents will have to be raised by the Contractor as per procedure laid down by the Engineer-in-charge from time to time, when he requires the above material for incorporation in permanent works.

1.2 Materials will be issued only for permanent works and not for temporary works, enabling works etc. unless specifically approved by the Engineer-in-charge and the same shall not be taken into account for the purpose of materials reconciliation.

1.3 The contractor shall beer all other cost including lifting, carting from issue points to work site/ contractor's store, custody and handling etc. and return of surplus/ serviceable scrap materials to Owner's storage points to be designated by the Engineer-in-charge etc. No separate payment for such expenditure will be made.

1.4 No material shall be allowed to be taken outside the plant without a gate pass.

1.5 The contractor shall be responsible for proper storage, preservation and watch & ward of the materials.

1.6 Reconciliation of Owner supplied materials

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

Waste materials like part lengths of pipes and other partly used items are the property of BHAGYANAGAR GAS LTD. and must be returned to the store with the appreciate documentation so that they can be considered as part of the material reconciliation.

* In case supplied by Owner
Unaccountable wastage/ scrap shall be at actual as per site assessment subject to

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maximum as stated above.

The percentage allowance shall be accounted on the basis of final measurement book.

1.6.2 All unused, scrap materials and salvageable materials shall be the property of the Owner and shall be returned by the Contractor category-wise at his cost to the Owner's designated store yard(s). In case the Contractor fails to do so/ or exceeds the limits of allowances specified above for scrap/ serviceable materials, then recovery for such quantities not returned as well as returned in excess of permitted limit by the Contractor will be done at the penal rate i.e. 125% of landed cost at the time of final bill/ closing of contract by Engineer-in- charge shall be effected from the Contractor's bill(s) or from any other dues of the Contractor to the Owner. Contractor shall be responsible for the adjustment/ weighment/ measurement of the surplus materials to be returned to the store. Contractor shall also be responsible for suitable segregation of returned materials into separate stacks of serviceable and scrap materials.

1.6.3 Wherever certain material is covered under Contractor's scope of supply whether part or in full for any item of work covered under SOR, no allowance towards wastage/ scrap etc. shall be accounted for during execution stage.

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CONSTRUCTION EQUIPMENT TO BE DEPLOYED

(ANNEXURE-8 TO SPECIAL CONDITIONS OF CONTRACT)

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ANNEXURE-8 CONSTRUCTION

EQUIPMENT TO BE DEPLOYED

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Sl. No.	Description of Item	Minimum Qty. to be Deployed*for each city
i.	Electro-fusion machine with Bar Code and control box with leads	2
ii.	Moling Equipment	As and when required
iii.	PE Squeeze Tools for all diameter Pipes	2
iv.	Universal pipe scrapper 20mm, 32mm / hand scrappers for all diameters	4
v.	Tapping tools for PE service tees	2 sets of all size
vi.	PE pipe cutter/ Guillotine for all diameters	3
vii.	Gas detection equipment, wherever required	As and when required
viii.	Cable and pipe locator	As and when required
ix.	PE closure plugs/ test ends for 20mm / 32mm pipes	As required
x.	Towing heads	As required
xi.	Pipe alignment clamps, jointing of elbow, tee, top loading clamps for top tee	4
xii.	Pipe straightners, re-rounding tools of all pipe sizes	3
xiii.	Jumping Jack compactor	As and when required
xiv.	Roller for asphalting	As and when required
xv.	Water tanker	As and when required
xvi.	Hammer Drill	3
xvii.	Portable Power Generator a) 5 kVA b) 3 kVA	2 2
viii.	Piston Drill	2 Gangs
xix.	Conversion Kit	2 Gangs as required
xx.	Pneumatic Test Pumps	2
xxi.	Die sets for thread preparation	2 per gang
xxii.	Soldier Torch	2
xiii.	Cleaning pads	6
xiv.	Cleaning Brush	6
xxv.	Lacquer and thinner	As Required
xvi.	Safety Harness equipments with descent control	2

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xvii.	Calibrated Pressure Gauge (0-6 Bar)	6

Notes:

1. Any other equipment required for completion of pipeline laying work but not specifically mentioned hereinabove, shall be deployed by contractor without any additional cost to Owner. Contractor shall deploy above mentioned equipments in good working condition.

2. Mobilization shall be considered complete only after equipments having quantity specifically mentioned hereinabove (in the min. qty. to be deployed column), are made available at site in good working condition as verified by EIC.

*) Number of equipment indicated hereinabove is a minimum requirement, however for completion of job, if additional equipment is required, same shall be deployed by the contractor at site without any additional cost to Owner.

_____

(SIGNATURE OF BIDDER)

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SCHEDULE OF LABOUR RATES

(ANNEXURE-9TO SPECIAL CONDITIONS OF CONTRACT)

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ANNEXURE –9 to SCC

SCHEDULE OF LABOUR RATES
(FOR EXTRA WORKS)

Sl. No.	Classification Personnel	Rates in INR for 8 hours	Rate per Hour for OT, Sunday & Holiday
		Standard Time (Rs)	In Rs
1.	Engineer	1500/-	650
2.	Surveyor Foreman	1200/-	430
3.	Pipe Fitter	750/-	150
4.	Pipe Welder	750/-	150
5.	Gas Cutter	700/-	170
6.	Grinder	700/-	170
7.	Mason	520/-	120
8.	Plumber	500/-	120
9.	Carpenter	500/-	130
10.	Painter	500/-	120
11.	Electrician	600/-	150
12.	Cable Jointer	780/-	190
13.	Instrument Technician	1000/-	190
14.	Rigger	400/-	110
15.	Watchman/Helper	350/-	80
16.	Concrete Mixer Operator	350/-	80
17.	Heavy Machine Operator	700/-	170
18.	Fusion Operation/ Jointer	500	120
19.	Civil labour	450	60

(SIGNATURE OF BIDDER)

NOTES:-

Above rates are final and Tenderer is to sign only without deviation.

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EQUIPMENT HOURLY RENTAL RATES FOR EXTRA WORKS

(ANNEXURE-10 TO SPECIAL CONDITIONS OF CONTRACT)

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ANNEXURE-
10 TO SCC

EQUIPMENT HOURLY RENTAL RATES FOR EXTRA WORKS

SL. NO.	DESCRIPTION OF EQUIPMENT	HOURLY RENTAL RATES FOR EXTRA WORKS INCLUDING CONSUMABLES
1)	Excavator/ JCB	Rs. 1000/-
2)	Moling machine	Rs. 600/-
3)	3) Compressors 210 CFM	Rs. 1500/-
4)	Dewatering Pumps	Rs. 600/-
5)	Fusion Jointing Machine	Rs. 900/-
6)	Power generators (5KVA)	Rs. 250/-
7)	Gas cutting set with cylinders	Rs. 150/-
8)	Trucks (small)	Rs. 400/-
9)	Car/Jeep	Rs. 200/-
10)	Tripod with 5 Tons Chain Pulley Block	Rs. 300/-
11)	Tractor Compressor	Rs. 600/-

NOTES:-

1) Rates are final and Tenderer is to sign only without deviation.
2) In case of foreign bidder, Conversion rate applicable on one day prior to price bid Opening date published by the State Bank of India will be considered.
3) Rates are inclusive of operators / drivers as applicable
4) Rates are inclusive of contractor's overhead & profit
5) The recovery rate shall be the rates provided above plus 20%

_____

(SIGNATURE OF BIDDER)

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Section VI: Schedule of Requirements

Background of Services

1) **Background and Services; and impact on performance/ objectives;**

As per tender terms and conditions.

2) **Purpose and Service Outcomes Statement**

As per tender terms and conditions.

3) **Short Description and Scope of Services**

The scope involves Supply, Erection and Commissioning of Civil, Electrical, Instrumentation, Mechanical & Miscellaneous works for Mother Station (MS) for CNG & PNG facilities for CGD projects.

For detailed scope of work & specification, refer Technical Volume including Corrigendum (if any).

4) **Contract Duration / Contract Period**

As per tender terms and conditions

5) **Form of BOQ/ Contract**
SOR Type

6) **Deliverables/ Outcomes and Timelines(frequency) thereof:**

As per tender terms and conditions.

7) **Facilities and Utilities to be provided by the Employer to service provider at Site:**

As per tender terms and conditions.

8) **Institutional and organisational arrangement for Services**
As per tender terms and conditions.

9) **Statutory and contractual obligations to be complied with by the contractor**

As per tender terms and conditions.

10) **Insurances**

As per tender terms and conditions.

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Section VII: Performance Standards and Quality Assurance

Note for Bidders: Regarding this Schedule and its sub-schedules, Bidders shall submit the following forms, as relevant for the form of BOQ/ Contract, or if asked:

1) *Form 4: Performance Standards and Quality Assurance - Compliance*

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Technical Volume II of II				
Sl.No.	Description	Attached File	Set Value	Supporting Doc. Req'd
1	Technical Volume II of II		-	
2	Technical Volume II of II	Technical Volume II of II.pdf	-	

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TECHNICAL DOCUMENTATION

Technical Vol II of II, Rev. 0

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10	PTS	PTS – SS TUBES	**P.019141G 11077 M 137**	0	5	85
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COMPOSITE WORKS PACKAGE (CIVIL, MECHANICAL, INSTRUMENTATION AND ELECTRICAL WORKS) OF MOTHER STATIONS
P.019141 G11031 M003

INTRODUCTION

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2.0 SCOPE OF WORK 1

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1.0 INTRODUCTION

Bhagyanagar Gas Limited (BGL) (hereinafter referred as Owner), is executing the City Gas Distribution project in Hyderabad GA.

VCS has been appointed as Project Management Consultant (hereinafter referred as PMC), by BGL for providing Design, Engineering & PMC services for a mentioned project.

BGL is now inviting tenders on Competitive Bidding basis for the below works under the same tender-

a) Supply & installation, testing & commissioning for Mechanical piping & fittings Works, Civil works, instrumentation works and Electrical works of Mother Station under Hyderabad GA

b) Composite works (Mechanical, Civil, Electrical and instrumentation works). This part refers to Mechanical part i.e. Supply & installation, testing & commissioning of 'Laying, fitting of "SS Tubes, Carbon steel pipes & flanges above ground level" for 02 no. of Mother stations in GA of Hyderabad.

The present document covers the technical specifications for the enquiry.

2.0 BRIEF SCOPE OF WORK OF CONTRACTOR

FOR MOTHER STATION

The scope of work not limited to design, manufacture, supply, Inspection & testing at workshop, marking, packing, handling, and dispatch of Mechanical (SS, CS Piping system), as per P&ID's, Piping GAD, Plot Layout & specifications.

The scope of work is broadly divided into the following:

Procurement, manufacturing, inspection, testing, supply, storage & preservation

Project Management, Construction management, overall quality control including Document Management.

Construction, Installation, Erection and Testing

Pre-commissioning and Commissioning including supply of Manpower, Consumables, Non-sparking tools and tackles etc. Details of same shall be shared during execution.

Project Close Out

Supply, Installation, testing, and commissioning of Electrical Items:

Design, detailed engineering, Supply, installation, testing and commissioning of Electrical system comprising of the following.

(i) Electrical Distribution Boards (EDB, LT panel, Emergency DB) as per SLD

(ii) AC UPS shall be 2 nos. X 100% ratings Parallel redundant, 6 KVA, 230 V AC. 2 Nos. X 50 % Sealed maintenance free (Valve regulated lead acid VRLA) battery bank for 4-hour back-up time. UPS DB for the UPS loads.

(iii) Power, Control & Signal FRLS Cables.

(iv) Earthing, Lightning & Bonding System.

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(v) Air conditionings

(vi) Outdoor LED Lighting and Outdoor lighting DB flame proof and weatherproof.

(vii) Indoor LED Lighting and Indoor lighting DB

(viii) Solar Panel 6 KWp (1 No. x 100% ratings) with charger controller. 1 No. x 100 % Sealed maintenance free (Valve regulated lead acid VRLA) battery bank suitable for solar system. Battery Charger, 415V, 50hz, 10KW Appx. for Solar Battery Charging.

(ix) Structural Steel, Cable trays, pipe/conduit and its accessories for cabling and miscellaneous items etc

(x) 63 KVA 3-phase CPCB II compliant Gas Genset, Prime Rated, radiator cooled, 65 KVA Equivalent electric alternator, microprocessor based Controller, Silencer, Anti-Vibration mountings, exhaust flexible connector, Batteries with cables, Acoustic Enclosure and Pressure converter valve.

(xi) Other Miscellaneous items as per BOQ.

(xii) To facilitate the power supply connection from state electricity board.

***Note: Refer SOR for detailed scope of work.**

3.0 FREE ISSUE MATERIAL FOR (MOTHER STATION):

1. Cascades
2. Compressors
3. Dispenser
4. All CS Valves of size 4" and Above

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PIPELINE VALVES

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PIPELINE VALVES

INTRODUCTION

This Document (PTS - Particular Technical Specification for – PIPELINE VALVES) lists the Specification for Manufacturing of Ball Valves for City Gas Distribution Project in Hyderabad . Natural gas will be transported to residential, commercial, industrial (PNG) and automobile consumers (CNG) in the city.

The present specification can confirm, complete, or modify certain sections/paragraphs of said «General Technical Specification». The PTS will govern the requirements for all such sections.

AMMENDMENT TO GTS 70000/740/402

1. SCOPE

Add:

The present Particular Technical Specification relates to the manufacture of "Pipeline Ball Valves" (for above and underground) for City Gas Distribution Project for BHAGYANAGAR GAS LIMITED (BGL).

DEFINITIONS

Add:

Purchaser	shall mean Bhagyanagar Gas Limited,
GTS	means << General Technical Specification 70000/740/GTS/402 rev. 0 >> and all documents it refers to.
PTS	means the present <<Particular Technical specification P.019141 G11077 M005 >> and all its appendices, if any.
Manufacturer	means the Manufacturer of the valves as well as its sub-contractor(s).
Control Authority	Owner/Engineer or their Authorised Inspection Agency
Inspection Agency or Third-Party Inspection Agency (TPIA)	means the Inspection Agency to be appointed by the Manufacturer.
Engineer/ Owner's	the entity of the purchaser or the company nominated by the purchaser.

2. PRELIMINARY STATEMENT

Add:

- In case of conflict between the requirements in technical documents, the most stringent requirements shall apply.
- A valid copy of API 6D monogram/certificate shall be included in the offer.

Modify:

- For any control, test or examination required under the supervision of the Authorised Control authority (LOFC Intervention points included), the latter shall be informed in writing FIVE (5) working days in advance by the Manufacturer (Fifteen working days in case of supply of foreign origin) about place and

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time with a copy to the Purchaser/Engineer. Wages and travel expenditure of the Authorised Control Authority are at the Purchaser's expenses.

- As the manufacturing is to be carried out under LOFC concept, the Manufacturer shall send for approval a List of Operation in Manufacturing and Control (see annex 1) to the Authorised Control Authority and Purchaser/Engineer, TEN (10) working days before manufacturing. This list shall be in conformity with the annex 1 to this document. Before starting any manufacturing, the Manufacturer shall be in possession of this approved document, filled in with all intervention points.

3. DESIGN AND CONSTRUCTION

3.1 Design

3.1.1 Welding ends

Add:

The valve manufacturer shall supply all butt weld valves with a welded pups/Transition piece at both ends which shall be considered as an integral part of the valve & hence such as strength test, hydrostatic test & Leak test should be done with pup-piece/transition piece weld on valve.

The chemical composition of the steel of the Pup/Transition piece meets the following requirements.

Maximum limit of chemical elements which may be used in material under this Particular Technical Specification.

	%maximum
C	0.230
Mn	1.60
Si	0.50
P	0.030
S	0.025
Nb	0.080
V	0.120
Mo	0.250
Nt	0.0150

Alternate alloy elements may be used but they shall be discussed with the user prior to delivery of the material. This table is not intended to represent the composition of any heat of steel, but merely to record the maximum permissible amounts of one element. The combination of elements of any heat must conform to the carbon equivalent, computed like following:

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

and shall not exceed 0.43

For each heat the manufacturer shall analyse the following elements:

C, Mn, Si, P, S, Nb, V, Cr, Mo, Ni and Cu.

The intentional addition of elements other than those specified is not permitted unless agreed up by the purchaser.

In any case, for unintentional additions, the following limitations shall be respected:

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Cr ≤ 0.15%	Mo ≤ 0.05%	Cu ≤ 0.20%
Ni ≤ 0.30%	Co ≤ 0.01%	Al ≤ 0.07%

The content of N total (Nt) may be up to 0.0150% and must be guaranteed by the manufacturer. If the manufacturer cannot give any guaranty of N content, he shall analyse this element.

The total content for Nb + V will be limited to 0.150%.

In grades X42 through X60 for each reduction of 0.01% below the maximum carbon content, an increase of 0.05% manganese above the specified maximum is permissible, up to a maximum of 1.70%.

The choice and use of alloying elements made from high strength low alloy steels to give the tensile properties of API 5L Gr. X52 (in table hereafter), is of the responsibility of the manufacturer.

Symbol	Yield Strength (min.)		Tensile Strength (min.)		Elongation in 2 in.
	Ksi	Mpa	Ksi	Mpa	Min. percent
X52	52	360	66	460	20
X56	56	390	71	490	20

The ratio of effective yield strength to effective tensile strength of the steel shall not exceed 0.90 for material of SMYS 60000 psi.

If the butt-welding end of the valve has a thickness and/or a steel grade not equal to the connecting pipe, butt-welding ends shall be in accordance with any of the suggestive figures given in Appendix I of ASME B 31.8 or an appropriate combination selected by the valve manufacturers to ensure that availability of uniform pig passage without sacrificing pressure-temperature design requirement.

Thickness of Pup Piece shall be determined by the Vendor as per Code requirements. The pipe end of the Pup Piece shall match the Material, diameter and thickness of line pipe where the valve is required to be welded. Table below indicate the size, thickness, material of the line pipe for various sizes of Ball valves:

Size of Ball valve (NB)	Material of construction	Thickness
4''	API 5L Gr. X52, PSL 2	6.4 mm
8"	API 5L Gr. X52, PSL 2	6.4 mm
10"	API 5L Gr. X-56, PSL 2	6.4 mm
12"	API 5L Gr. X-56, PSL 2	6.4 mm

The Valve Manufacturers shall submit all necessary details regarding welding of BW end of valve with Line pipe along with calculation for provided thickness for approval of Owner/Owner's representative.

3.1.2 Design features

Double piston effect: when the pressure is applied to one side, let us say upstream" side, and when upstream ball seat is leaking, transfer pressure shall have a positive shut-off effect on the downstream seat (acting, for instance, on the back face of this seat) and thus reinforcing the global tightness of the valve. ***(Not applicable)***

3.1.3 Vent, sealant etc. shall be adequately supported on the stem and body using clamps.

4. MATERIALS

4.2 Pressure Retaining Parts

Modify clause no. 7.2.1 as below:

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Bodies, including end flanges and welding ends (other than for field welding), bonnet and covers of valves shall be made in material conforming to API 6D spec. (or another material specification accepted by the Purchaser/Engineer) and be furnished with certificates **EN 10204-3.2** stating the quality, the mechanical properties (yield strength, tensile strength, percent elongation, impact test value at the temperature specified under per Section 8.4.2) the chemical analysis, the manufacturing process and the marking (e.g. the heat number) of the steel. These certificates shall be added to the CMTR.

4.3 Bonnet, Cover and Body Bolting

Modify first paragraph as below:

Bonnet, flange cover and body bolting shall be in conformance to ASTM A320 Gr L7 or L7M or ASTM A193 grade B7 or B7M. Nuts shall conform to ASTM A194 Gr 7 or 7M or 2H. All bought out items shall be procured with certificates **EN 10204-3.1** including Valve actuator**.** These certificates shall be added to CMTR.

4.4 Sour Gas Service

Not Applicable

5. FABRICATION AND TEST

5.1 Welding Fabrication

Replace third point by:

The joints shall be furnished in accordance with the requirements of Section VIII of ASME Boiler and Pressure Vessel Code - Division 1 and Section IX.

Add:

Vendor shall provide detail instruction for carrying out welding; preheating etc and testing of weld joints between pipe and valves at site. Vendor shall depute his engineer for welding instruction at site

6. INSPECTION

6.1 Information

Add:

In case of supply from foreign origin, the Manufacturer shall inform the Control Authority min. fifteen (15) working days in advance of any intervention required by this specification and shall send a copy of it to the Purchaser/Engineer (by fax).

Add:

PACKING

Ball valves are to be suitably packed, crated (seaworthy crate in the case of foreign vendors) and handled properly to prevent damages or deteriorations during transportation by sea (in the case foreign vendors) and road to the designated ware houses (as detailed in the commercial volume of the tender) of the owner and unloading of the valves and storage prior to installation.

Vendors shall submit drawings and details of the proposed packing / crating method clearly indicating the following:

1. Secure bolting arrangement of the ball valve to the robust base of the crate for packing.
2. Lateral staying arrangement to prevent movement of the valve inside the crate resulting damage during transportation and handling.

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3. Also all extended parts such as drain and vent piping shall be securely supported to the valve body to prevent damage during transportation and also subsequent installation and use in operations.

7. PAINTING AND COATING

Following coating specification shall be followed:

Underground Valves:

The external coating for underground valves shall be made of solvent free PUR / min. 1000 microns thickness in two layers as per code DIN 30677-2 (Type DIN 30677/2-PUR-50).

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

Aboveground Valves:

The surface of the valve will be shot-blasted SA 2 1/2 (Swedish standard SIS 055900). Before painting, the valve shall be cleaned from grease and dirt. The painting shall be as per ISO12944-5-2007 (Table A-1) System No. A1.14 with durability C-5 (I) Very High Industrial.

The nature of the products shall be specified in the offer and shall guarantee a corrosion protection for a storage period in a shop for at least one year.

Painting in accordance with Purchaser/Engineer's specifications.

Painting and coating procedures shall be submitted for approval before manufacturing to the Control Authority and to the purchaser / engineer.

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(MECHANICAL WORKS)

PTS –LOADING, UNLOADING, TRANSPRTATION AND ERECTION OF MECHANICAL EQUIPMENT

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LOADING, UNLOADING, TRANSPORTATION & ERECTION OF MECHANICAL EQUIPMENTS

1.0 SCOPE OF WORK

1.1 Following Shall Constitute the Contractor's Scope of Work but Not Limited to as Given Herein

i) Receiving of material from stores.

ii) Loading of material/ equipment on a trailer / truck from BGL stores. Safe transportation to various sites.

iii) Unloading, placement and alignment on foundation -on ground or above ground + 4.5 m at roof top (cascade only).

iv) Transit Insurance of equipment from stores to site.

v) All equipment transported shall be securely boarded and transported without causing any damage to equipment. Any damage caused during loading, transportation & unloading shall be recoverable from the contractor.

vi) All the equipment shall be leak tested after erection as per instruction of engineering in charge and standard practice.

2.0 EQUIPMENT WEIGHT & SIZES

Sl. No.	Equipment	Size	Weight/ Unit Appx.
1.	Cascade 4500 L/3000L (water capacity)	5.5 M X 1.75M X 1.6M (H) approx.	6.0 T/9.0T

All excess, unutilized or defective materials and scrap shall be returned after duly accounting for, to the Owner's stores. Where materials are to be weighed before return, the Contractor shall be responsible for making necessary arrangements for weighing etc. The contractor shall not use scrapped or defective materials obtained during the course of construction for fabrication of temporary supports or other items without prior written permission of Engineer-in- Charge.

If the Contractor fails to return the surplus material aforesaid, the Owner will charge the Contractor for such un-returned material at penal rates, which will be deducted from whatever amount is due to the Contractor. In case any material issued by the Owner deteriorates during storage by the Contractor, new material will be issued to him if available at penal rates, but delay in procuring such materials will be at the Contractor's account only.

Contractor to arrange all equipment & tools such as cranes, winch, lifting hook etc and skilled & semiskilled manpower and consumables for erection of all the electro-mechanical equipment.

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PIPING FABRICATION AND ERECTION

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1.0 GENERAL

This specification covers general requirements of fabrication and erection of aboveground and trench piping systems at site. The specification covers the scope of work of Contractor, basis of work to be carried out by the Contractor and standards, specifications, and normal practice to be followed during fabrication and erection by the Contractor.

2.0 SCOPE

Scope of work of Contractor shall include the following:

2.1 Transportation of required piping materials, pipe support and all other necessary piping materials from OWNER/contractor's storage point to work site / shop including raising store requisitions for issue of materials in the prescribed format & maintaining an account of the materials received from Owner's stores.

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

a. Station Pipes (Below 4'' as per PMS)

b. Flanges (All sizes, types & Pressure ratings).

c. Fittings (All sizes, types, and schedule)

d. Valves (sizes 2" and below)

e. Gaskets (All sizes, types & Ratings)

f. Bolts, Nuts or M/C Bolts (All types)

g. Vent Cap (All Type and Size)

2.2 Shop & field fabrication and erection of piping in accordance with documents listed under Cl. 3.0 i.e 'BASIS OF WORK' including erection of all piping materials enumerated above.

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

2.4 **Fabrication**

2.4.1 Fabrication of piping materials like special radius bends, reducers, mitres etc.

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

2.4.3 Fabrication of swage nipples as and when required.

2.4.4 Fabrication of odd angle elbow like 60°, 30° or any other angle from 90/45° elbows as and when required.

2.4.5 Fabrication of flange, reducing flange, blind flange, spectacle blinds as and when required.

2.4.6 Fabrication of stub-in connection with or without reinforcement.

2.4.7 Grinding of edges of pipes, fittings, flanges etc. to match mating edges of uneven / different thickness wherever required.

2.5 Modifications like providing additional cleats, extension of stem of valve, locking arrangement of valves etc. as and when required.

2.6 Preparation of Isometrics, bill of materials, supporting details of all NON-IBR lines upto 2-1/2" within the unit battery limit and get subsequent approval from Engineer-in-Charge as and when called for.

2.7 Obtaining approval for drawings prepared by Contractor from statutory authority, if required.

2.8 Radiography, stress relieving, dye penetration, magnetic particle test etc. as required in specification.

2.9 Performing PMI using alloy analysers.

2.10 Casting of concrete pedestals and fabrication & erection of small structures for pipe supports including supply of necessary materials.

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2.11 Providing insert plates from concrete structures and repair of platform gratings around pipe openings.

2.12 Making material reconciliation statement and return of Owner's supplied left over materials to Owner's store.

2.13 Flushing and testing of all piping systems as per standard specification for inspection, flushing and testing of piping systems.

3.0 BASIS FOR WORK

3.1 The complete piping work shall be carried out in accordance with the following

3.1.1 "Approved for Construction" drawings and sketches issued by OWNER/PMC to the Contractor - Plans and/or Isometrics.

3.1.2 Approved Process licensor's standards and specifications.

3.1.3 Drawings, sketches and documents prepared by Contractor duly approved by Engineer-in-Charge/PMC (such as isometrics and offsite piping etc.)

3.1.4 Construction job procedures prepared by Contractor and approved by OWNER/PMC.

3.1.5 TEPL specifications/documents as below:

a. Process and Instrument Diagram.

b. Piping Materials Specification

c. Piping support standards.

d. Standard specification of NDT Requirement of Piping

e. Welding specification charts for piping classes.

f. Standard specification for Pressure Testing of Erected Piping System.

i. Welding specification for fabrication of piping

j. Any other specifications attached with Piping Material Specification or special condition of contract.

k. Procedure for storage, preservation, and positive identification of materials at Contractors works / stores.

3.1.6 Applicable codes, standards, and regulations

a.	ASME B 31.3	:	Process Piping
b.	PNGRB T4S	:	
c.	OISD - 226	:	Oil Industry Safety Directory for Natural Gas Transmission Pipeline and CGD Network
e.	OISD-GDN-192	:	Safety Practices During Construction
f.	OISD – 179	:	Oil Industry Safety Directory for Safety Requirements
g.	ASME Sec. VIII	:	Rules for Construction of Pressure Vessels.
h.	IBR Regulations		
i.	IS: 823	:	Code for procedure for Manual Metal Are Welding of Mild Steel (for structural steel).
		:	Code for Sour Services material requirements.

Note: All codes referred shall be latest edition.

3.2 Deviations

Where a deviation from the "Basis of Work" and approved job procedure described above is required or where the basis of work does not cover a particular situation, the matter shall be brought to the notice of

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Engineer - in - Charge and the work carried out only after obtaining written approval from Engineer – in – Charge in each case.

4.0 FABRICATION

4.1 Piping Material

Pipe, pipe fittings, flanges, valves, gaskets, studs bolts etc. used in a given piping system shall be strictly as per the "Piping Material Specification" for the "Pipe Class" specified for that system. To ensure the above requirement, all piping material supplied by the Contractor shall have proper identification marks as per relevant standards / TEPL's specifications. Contractor shall provide identification marks on left over pipe lengths wherever marked up pipe lengths have been fabricated / erected.

4.2 Fabrication

4.2.1 All fabrication shall be carried out in accordance with piping general arrangement drawings, including this specification and codes as specified in section 3.0.

4.2.2 CONTRACTOR shall be responsible for working to the exact dimensions as per the approved drawings.

4.2.3 Flange bolt holes shall generally straddle the established centre lines unless other orientation is required and as called out in approved drawings.

4.2.4 Threading shall be NPT as per ANSI B 1.20.1. Threading shall preferably be done after bending, forging or heat treatment operation. However, if it is not possible, precaution shall be taken to protect threading against deformation. Thread shall be clean cut with no burrs or stripping. Dies shall be new, sharp, and properly designed for piping material. Ends shall be reamed to remove burrs.

4.2.5 All threaded joints shall be aligned properly. The pipe entering unions shall be true to centrelines so as to avoid forcing of union coupling during make up. Damaged threads shall be cut from the end of run and the pipe shall be rethreaded.

4.2.6 Immediately before testing the piping, all threads of pipe and fittings shall be thoroughly cleared of cuttings, fuel oil or other foreign matter. The male threads shall be sealed with thread sealant and the piping made up sufficiently for the thread to seize. Sealant shall be Teflon tape.

4.2.7 Seal welding of threaded connections when specified shall include the first block valve, cover all threads. The joint shall be cleaned of all cutting oil and other foreign material and made up dry to full thread engagement. Instrument threaded connections which are frequently subjected to testing and maintenance shall not be seal welded.

4.2.8 All threaded connections shall be protected from rusting by applying greases or oil when in operating condition.

4.2.9 When socket weld fittings or valves are used, pipe shall be spaced approximately 1/16" to avoid bottoming which could result in excessive weld stress.

4.2.10 where the ends of the piping components being welded have an internal surface misalignment exceeding 1.6mm, the wall of the component extending internally shall be trimmed by machining so that the adjoining internal surface will approximately flush.

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

- Maximizing prefabrication, inspection and testing at fabrication shop with minimum field joints.
- Positive material identification, handling, storage & preservation.

4.3 Dimensional Tolerances

The Contractor shall be responsible for working to the dimensions shown on the approved 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

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extra pipe length of 100 mm over and above the dimensions indicated in the drawing may be left on one side of the pipe at each of the field welds. During erection, the pipe end with extra length at each field weld, shall be cut to obtain the actual dimension occurring at site. Isometrics, if supplied may have the field welds marked on them. However, it is the responsibility of the Contractor to provide adequate number of field welds. In any case no extra claims will be entertained from the Contractor on this account. Wherever errors / omissions occur in drawings and Bills of Materials it shall be the Contractor's responsibility to notify the Engineer-in-Charge prior to fabrication or erection.

4.4 Pipe Joints

The piping class of each line specifies the type of pipe joints to be adopted. In general, joining of lines 2" and above in process and utility piping shall be accomplished by butt welds. Joining of lines 1-1/2" and below shall be by socket welding / butt welding / threaded joints as specified in "Piping Material Specifications". However, in piping 1-1/2" and below where socket welding/ threaded joints are specified butt - welds may be used with the approval of Engineer- in-Charge for pipe to pipe joining in long runs of piping.

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

4.5 Butt Welded and Socket Welded Piping

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

4.6 Screwed Piping

In general, Galvanized piping shall have threads as per IS: 554 or ANSI B 1.20.1 NPT as required to match threads on fittings, valves etc. All other piping shall have threads as per ANSI B 1.20.1, tapered unless specified otherwise.

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

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

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

4.7 Flange Connections

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

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

4.8 Branch Connections

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

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

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

4.9 Bending

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

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Cold bends for lines 1-1/2" and below, with a bend radius of 5 times the nominal diameter shall be used as required in place of elbows wherever allowed by piping specifications. Bending of pipes 2" and above may be required in some cases.

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

4.10 Forging and forming

Forging and forming of small-bore fittings, like reducing nipples for piping 1-1/2" and below, shall be as per ASME B 31.3.

Mitre Bends and Fabricated Reducers not permitted.

4.11 Cutting and Trimming of Standard Fittings & Pipes

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

4.12 Galvanised Piping

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

4.13 Jacketed Piping

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

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

4.14 Shop Fabrication / Prefabrication

The purpose of shop fabrication or pre-fabrication is to minimise 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 a removable rust preventive. Care shall also be taken to avoid any physical damage to flange faces and threads.

4.15 Miscellaneous

4.15.1 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 Engineer-in-Charge.

4.15.2 Spun Concrete Lining

The work of inside spun concrete lining of pipes and specials of diameter 3" and above shall be done as per

Material specifications and special condition contract.

4.15.3 Fabrication of pipes from plate

Pipes shall be fabricated at site as and when required as per the specifications attached and the actual Piping

Material Specification.

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5.0 ERECTION

5.1 Cleaning of Piping before Erection

Before erection all prefabricated spool pieces, pipes, fittings etc. shall be cleaned inside and outside by suitable means. The cleaning process shall include removal of all foreign matter such as scale, sand, weld spatter chips etc. by wire brushes, cleaning tools etc. and blowing with compressed air/or flushing out with water. Special cleaning requirements for some services, if any shall be as specified in the piping material specification or isometric or line list.

5.2 Piping Routing

No deviations from the piping route indicated in drawings shall be permitted without the consent of Engineer-in-Charge.

Pipe to pipe, pipe to structure / 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 Engineer-in-Charge.

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

5.3 Slopes

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

5.4 Expansion Joints / Bellows

Installation of Expansion Joints/Bellows shall be as follows:

All Expansion joints / Bellows shall be installed in accordance with the specification and installation drawings, supplied to the Contractor.

Upon receipt, the Contractor shall remove the Expansion Joints/ Bellows from the case(s) and check for any damage occurred during transit.

The Contractor shall bring to the notice of the Engineer-in-Charge any damage done to the bellows / corrugations, hinges, tie-rods, flanges / weld ends etc.

Each Expansion Joint / Bellow shall be blown free of dust / foreign matter with compressed air or cleaned with a piece of cloth.

For handling and installation of Expansion Joints, great care shall be taken while aligning. An Expansion Joints shall never be slinged from bellows corrugations / external shrouds, tie / rods, angles.

An Expansion Joints / Bellow shall preferably be slinged from the end pipes / flanges or on the middle pipe.

Expansion Joints stop blocks shall be carefully removed after hydrostatic testing.

Angles welded to the flanges or weld ends shall be trimmed by saw as per manufacturer's instructions and the flanges or weld ends shall be ground smooth.

The pipe ends in which the Expansion Joint is to be installed shall be perfectly aligned or shall have specified lateral deflection as noted on the relevant drawings.

The pipe ends / flanges shall be spaced at a distance specified in the drawings.

The Expansion Joint shall be placed between the mating pipe ends / flanges and shall be tack welded/bolted. The mating pipes shall again be checked for correct alignment.

Butt-welding shall be carried out at each end of the expansion joint. For flanged

Expansion Joint, the mating flanges shall be bolted.

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After the Expansion Joint is installed, the Contractor shall ensure that the mating pipes and Expansion Joints are in correct alignment and that the pipes are well supported and guided.

The Expansion Joint shall not have any lateral deflection. The Contractor shall maintain parallelism of restraining rings or bellows convolutions.

Precautions

- For carrying out welding, earthling lead shall not be attached with the Expansion Joint.
- The Expansion bellow shall be protected from arc weld spot and welding spatter.
- Hydrostatic Testing of the system having Expansion Joint shall be performed with shipping lugs in

Position. These lugs shall be removed after testing and certification is over.

5.6 Flange Connections

While fitting up mating flanges, care shall be exercised to properly align the pipes and to check the flanges for trueness, so that faces of the flanges can be pulled together, without inducing any stresses in the pipes and the equipment nozzles. Extra care shall be taken for flange connections to pumps, turbines, compressors, cold boxes, air coolers etc. The flange connections to these equipments shall be checked for misalignment, excessive gap etc. after the final alignment of the equipment is over. The joint shall be made up after obtaining approval of Engineer-in-Charge.

Temporary protective covers shall be retained on all flange connections of pumps, turbines, compressors and other similar equipments, until the piping is finally connected, so as to avoid any foreign material from entering these equipments.

The assembly of a flange joint shall be done in such a way that the gasket between these flange faces is uniformly compressed. To achieve these bolts shall be tightened in a proper sequence. All bolts shall extend completely through their nuts but not more than 1/4".

Steel to C.I. flange joints shall be made up with extreme care, tightening the bolts uniformly after bringing flange flush with gaskets with accurate pattern and lateral alignment.

5.7 Vents and Drains

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

5.8 Valves

Valves shall be installed with spindle / actuator orientation / position as shown in the layout drawings. In case of any difficulty in doing this or if the spindle orientation / position is not shown in the drawings, the Engineer-in-Charge shall be consulted, and work done as per his instructions. Care shall be exercised to ensure that globe valves, check valves, and other uni- directional valves are installed with the "Flow direction arrow "on the valve body pointing in the correct direction. If the direction of the arrow is not marked on such valves, this shall be done in the presence of Engineer-in-Charge before installation.

Fabrication of stem extensions, locking arrangements and interlocking arrangements of valves

(If called for), shall be carried out as per drawings / instructions of Engineer-in-Charge.

5.9 Instruments

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

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

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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. Care shall be exercised, and adequate precautions taken to avoid damage and entry foreign matter into instruments during transportation, installation, testing etc.

5.10 Line Mounted Equipment / Items

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

5.11 Bolts and Nuts

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

5.12 Pipe Supports

Pipe supports are designed and located to effectively sustain the weight and thermal effects of the piping system and to prevent its vibrations. Location and design pipe support will be shown in drawing for lines 2" NB. However, any extra supports desired by Engineer-in-Charge shall also be installed.

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

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

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

- All restraints have been installed correctly.
- Clearances have been maintained as per support Drawings.
- Insulation does not restrict thermal expansion.
- All temporary tack welds provided during erection have been fully removed.
- All welded supports have been fully welded.

6.0 WELDING

Welding of pipelines shall be done as per applicable codes.

7.0 ERECTION

7.1 Pre-fabrication and Field Assembly

Extent of pre-fabrication shall be purely at the discretion of CONTRACTOR keeping in view the following: -

7.1.1 Field joint shall be decided by CONTRACTOR keeping in view the transportation of prefabricated pieces to site.

7.1.2 There can be some variations in the dimensions and leve appearing in the arrangement drawings and those actually occurring at site due to minor variations in the location of equipments, structures, cut out etc. Adequate field joints shall be provided, permitting assembly and erection of pipe work without major modification.

7.2 Supporting Location and design of pipe supports shown in approved drawings and support drawings shall be strictly followed.

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7.2.1 Supports shall be installed in such a way that they do not contribute to over stressing of a line.

7.2.2 Fabrication and erection of additional supporting elements and structural fixtures which in COMPANY's view are required for proper supporting of the system, shall be carried out by CONTRACTOR at no extra cost.

7.2.3 All temporary supports, elements required for alignment, erection and a ssembly shall be removed after completion of work.

7.3 Equipment hook-up

7.3.1 Prior to hook-up, the alignment and trueness of flange faces shall be checked to ensure that no undue stresses shall be induced in the system while hooking up.

8.0 INSPECTION

8.1 CONTRACTOR shall provide all facilities/ assistance to OWNER for proper execution of their inspection without any extra charge.

8.2 All piping work shall be subjected to inspection by OWNER/PMC at any time during fabrication. CONTRACTOR shall furnish to OWNER detailed work programme sufficiently in advance, in order to enable OWNER to arrange for inspection.

9.0 PROTECTIVE COATING

9.1 All above ground piping system shall be applied with protective coating in accordance with specification (as attached in the Tender document) for shop & field painting

10.0 FLUSHING

Completed piping systems shall be flushed by CONTRACTOR with fresh water, to clean the pipe of all dirt, debris, and foreign material. CONTRACTOR shall prepare a procedure for flushing of the system for approval of OWNER/PMC. Flushing shall not be commenced without approval of flushing procedure.

10.1 CONTRACTOR shall perform all activities like dismantling and reinstalling of all strainers, in line instruments etc. before and after completion of flushing.

10.2 Flushing shall be considered as complete only after inspection and approval by Engineer-in-charge.

10.3 Disposal of muck and flushing media shall be arranged by CONTRACTOR as directed by OWNER/PMC, in such a manner that it does not spoil the adjacent installation. CONTRACTOR shall obtain OWNER/PMC approval regarding the place and method to be adopted for disposal of debris.

10.4 Record of flushing giving following details shall be submitted by CONTRACTOR to OWNER/PMC for its approval and records:

a) Date of Flushing

b) Identification of line: flushed-line Number

11.0 HYDROSTATIC TESTING

11.1 Completed piping system as approved by OWNER/PMC shall be hydrostatically tested in the presence of OWNER/PMC. The general requirements of hydrostatic testing shall be in accordance with codes specified in section 2.0.

11.2 CONTRACTOR shall prepare hydrostatic test procedure based on specified codes. The hydrostatic test shall

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commence only after approval of procedure by OWNER/PMC.

11.3 Piping system shall be hydrostatically tested to a pressure corresponding to 1.5 times the design pressure.

11.4 Fresh water shall be used as test media. CONTRACTOR shall locate the source of water supply and arrange for transportation of water to test site. CONTRACTOR shall arrange at his own cost the water analysis and confirm that water is suitable for testing. In case any corrosion inhibitor is added, the same shall be done after approval of OWNER/PMC.

11.5 Lines repaired subsequent to hydrostatic test shall be retested using the same procedure as originally adopted. However, OWNER/PMC may waive such retest in case of minor repairs by taking precautionary measures to ensure sound construction.

11.6 All equipment and instruments used for hydrostatic test shall be approved by OWNER/PMC before start of tests.

11.7 Pressure gauges shall be installed online to measure test pressures. In case of longer lines two or more pressure gauges shall be installed as directed by Engineer-in-charge. One gauge shall be installed at the discharge of the pressurising pump. Pressure gauge used for hydrostatic testing shall be calibrated with dead weight tester in the presence of Engineer-in-charge. Range of pressure gauge shall generally be 1.5 times the test pressure.

11.8 Orifice plates and restriction orifices shall not be installed until hydrostatic testing is completed. Temporary gaskets shall be used during testing.

11.9 First block valve of pressure instruments shall be half open & plugged at the time of hydrostatic testing. Temperature connections shall be blanked off during testing.

11.10 All equipment in line instruments, relief valves shall be disconnected from piping system by means of blinds during testing. Control valves shall be replaced by spool pieces during testing.

11.11 High point vents and low point drain required for testing in addition to those marked in the drawings shall be provided by CONTRACTOR at his own cost.

11.12 All welded and screwed joints shall be kept clean for detecting leaks during testing.

11.13 Test pressure shall be maintained long enough to facilitate complete inspection of the system. Minimum duration of test shall be 6 hours unless otherwise specified. Pressurising equipment shall be isolated immediately after test pressure is attained.

11.14 After successful completion of hydrostatic testing, the piping system shall be dewatered. All lines shall be completely dried using compressed air. CONTRACTOR shall make his own arrangement for supply of compressed air. Drying of lines shall be considered complete on approval OWNER/PMC.

11.15 Test Records

The records in duplicate shall be prepared and submitted by CONTRACTOR as below:

a) Date of test
b) Identification of pipe tested - line number
c) Test pressure
d) Test results
e) Signature of CONTRACTOR
f) Approval signature by OWNER/ PMC.

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BHAGYANAGAR GAS LIMITED (BGL)

COMPOSITE WORKS PACKAGE (CIVIL, MECHANICAL, INSTRUMENTATION AND ELECTRICAL WORKS) OF MOTHER STATIONS IN HYDERABAD GA

STATION PIPE

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1.0 SCOPE

This Technical Specification covers the supply if applicable of line pipe used for Natural Gas transportation and distribution systems. It describes the general requirements, controls, tests, QA/QC examination and final acceptance criteria which need to be fulfilled.

2.0 INSTRUCTION

2.1 CONTRACTOR shall procure all the construction material from the vendor list mentioned in the tender documents.

2.2 Eventual interpretations and deviations to this specification by the Manufacturer shall be requested by writing in his offer with detailed justification and approved by the Owner before the eventual order to the Manufacturer. The latter is responsible and shall indemnify the Engineer-in-charge for any damage resulting from the non-respect of this obligation.

2.3 The specifications of the steel used by the material Manufacturer and all potential subcontractors will be described in the offer. After order, no change will be accepted except for justified "force majeure". In that case, the changes shall be supported by a technical file submitted to the Owner / Owner's representative for approval.

2.4 The Manufacturer shall provide a technical description of the manufacturing method that might influence the quality of the material.

2.5 When the order is placed, the Manufacturer shall promptly inform the Owner / Owner's representative about his subcontractor's names, addresses, phone numbers as well as sub-order numbers, extent and delivery terms. On this basis, the Manufacturer shall send a general planning including at least the raw material supply, the manufacturing stages testing, painting and packing/despatch. This planning shall be updated by the Manufacturer at least every month unless otherwise provided in the purchase order. A dispatcher/inspector delegated by the Owner / Owner's representative is entitled to follow, examine and verify the planning's relevance and effectiveness.

2.6 The Owner / Owner's representative keeps the right to audit the Manufacturers and subcontractor's manufacturing process and control methods. All costs form such an audit shall be borne by the Manufacturer except the wages and travel expenditures of the auditor(s) supported by the Owner / Owner's representative.

2.7 The manufacturing processes and the laboratories, in which destructive and non-destructive tests are carried out, shall be approved by the Owner / Owner's representative.

2.8 The Owner / Owner's representative shall have, at any time, free access to all parts of the Manufacturer's facilities and to those of all his subcontractors involved in the order manufacturing. All reasonable means shall be placed at the inspector(s)'s disposal to enable him to check that the product is being manufactured in accordance with this specification. All tests and inspections required in this specification shall be carried out, prior to shipment, in the Manufacturer's plant (or subcontractor's plant) and at the Manufacturer's expenses, unless otherwise provided in the order. The Owner / Owner's representative shall try not to interfere unnecessarily with other Manufacturer's works when running these tests and inspection.

2.9 A valid copy of the ISO 9001 certificate shall be included in the offer.

2.10 For any control, test or examination required under the supervision of the Third Party Inspection Agency the latter shall be informed in writing one (1) week in advance by the Manufacturer about place and time with a copy to the Owner / Owner's representative.

2.11 The Manufacturer shall send for approval a list of operation in manufacturing and control to the Third Party Inspection Agency and Owner / Owner's representative, one (1) week before manufacturing. This list shall be in conformity with the annex 1 to this document. Before starting any manufacturing, the Manufacturer shall be in possession of this approved document, filled in with all intervention points.

2.12 Material, even released by the TPIA and in which injurious defects are found after delivery, shall be rejected. The Manufacturer shall be notified, and the material replaced all costs involved, including wages and travel expenditure of the TPIA, Owner & Owner's representative shall be borne by the Manufacturer.

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2.13 An approval of documents can never be considered as an acceptance of deviations or relaxation to requirements. A deviation is only possible after specific request to the Owner/Owner's representative.

2.14 The Owner/Owner's representative may verify the control equipment of the Manufacturer, its calibration, and the points at which it is located. If during the production certain problem arises, the Owner/Owner's representative may demand supplementary tests.

3.0 GENERAL

3.1 This specification describes the pipe to be installed on transportation and distribution of natural gas.

3.2 This specification describes the examinations and upgrading tests to be performed on Carbon Steel pipes taken out of stock.

3.3 The present specification can conform, complete, or alter certain characteristic or tolerances of existing laws or specifications.

3.4 Before the order is placed, a Technical Audit could take place with Owner/Owner's representative.

4.0 CODES, NORMS AND STANDARDS

Latest edition of following standards are applicable.

4.1 ASME STANDARDS

ASME B31.8	Gas transmission and distribution piping systems
ASME VIII, DIV-1	Boiler and Pressure Vessels code.
ASME B31.3	ASME code for process piping.
ASME B 16.25	Butt Welding Ends
ASME B 36.10	Welded and Seamless Wrought Steel Pipe

4.2 ASTM STANDARDS

TM A 106	Seamless and welded steel pipe for high temperature. Service
TM A 370	Mechanical testing of steel products
TM E 112	Standard methods for determining the average grain size.

4.3 EN STANDARDS

EN 10204	Metallic products: types of inspection documents

4.4 ISO STANDARDS

ISO 9001	Quality Management Standards.
ISO 148	Determine the Impact strength of steel and energy absorbed by Charpy V-notch

In case of contradiction, the most stringent shall apply.

5.0 DESIGN AND CONSTRUCTION

5.1 The pressure temperature ratings of the pipes are in accordance with ANSI B31.3 and B31.8 (see piping class which one is applicable); the dimension standard shall be conform to ANSI B 36.10.

5.2 The temperature and pressure range of line pipe shall be in accordance with the indicated values on the relevant piping specification. (Piping Specification – 1C1 and 3C1, as applicable).

5.3 Wall thickness shall meet the following requirements:

- The maximum allowable stress in the base material and in the weld shall be equal to fifty per cent of

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the minimum yield strength guaranteed by the specification of the steel used.

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5.4 The specified pipe wall thickness/schedule and grade (with reference to the equivalent grade in ASTM spec.) with which the pipe is intended to be used is specified in the data sheet/piping class.

5.5 The design shall take into consideration performance requirements prescribed in paragraph 5.6.

5.6 All pipe under this specification shall be designed to withstand a field hydrostatic test pressure with noncorrosive water, after installation, during 24 hours at a following pressure level:

Minimum : P = 1.4 MOP

Maximum : Pressure 1.5 MOP

Where:

P = hydrostatic test pressure, bar

MOP = maximum operating pressure as indicated in relevant piping specifications.

The negative tolerance shall not exceed 12.5 %.

6.0 LENGTH OF PIPE

6.1 Pipe Length shall be between 6.0m and 7.0m for single random and 10.0m to 12.0m for double random.

6.2 Overall length tolerance shall be (-) zero and (+) 1 pipe length to complete the required quantity.

7.0 MATERIALS

7.1 The steel used in the manufacture of pipe shall be conform to the ASTM standard. The Manufacturer shall find the steel and grade in the present Particular Technical Specification.

7.2 The chemical composition of the steel meets the requirements shall be conform to the ASTM standard.

7.3 The steel used has tensile properties conforming to the requirements prescribed in the ASTM standard.

7.4 The ratio of yield strength to tensile strength shall not exceed 0.85.

7.5 The steel shall be fully killed, fine grain practice.

7.6 The steel used shall be suitable for field welding to other fittings, pipes, flanges, or valves manufactured under ASTM specifications A53, A105, A106, A234, A333, A350, A381, A420, A694, A707 or API standards specifications 5L, 6D, 605 or MSS standards SP-44, SP-72, SP-75 and EN10208-2.

7.7 If preheating of the material is required to ensure proper weldability under normal field conditions, the Manufacturer shall state so in the offer, specifying preheat requirements and if accepted by the purchaser this shall be permanently indicated on the pipe.

7.8 The Manufacturer of pipe must deliver a certificate EN 10204 3.1. Stating the quality, the mechanical properties (yield strength, tensile strength, percent elongation), the chemical analysis, the process of manufacture and the marking (for example the heat number of material) of the steel.

- A new chemical analysis (upgrading) shall be done on a specimen of pipe in presence of the TPIA; one per heat number, see par. 8.4.
- Notch toughness properties Charpy V: the standard impact test temperature is 0°C. The average value per series of 3 tests specimen shall be equal to 35 J/cm2. The minimum value per test specimen shall be equal to 35 J/cm2 this value may drop to 28 J/cm2 per only one test specimen per series.

7.9 Chemical composition:

For each heat the Manufacturer shall check a chemical analysis of the steel

Check analysis: Carbon equivalent shall be computed by the following equation:

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

And shall not exceed 0.43.

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8.0 PRELIMINARY CONDITIONS FOR UPGRADING TO 3.2 CERTIFICATE

Before proceeding to any qualification tests, the pipes shall meet following requirements.

8.1 Material

Carbon Steel piping to be supplied according to ASTM A 106 Gr. B.

8.2 Origin of pipes

8.2.1 The origin of pipes shall be mentioned.

8.2.2 Owner/Owner's representative or/and the Third-Party Inspection Agency reserves the right to approve or refuse the origin of pipes.

8.3 Identification

8.3.1 All pipes shall bear the original mill identification.

8.3.2 The marking shall be legible and shall include as a minimum:

- Manufacturer's name or brand.
- ASTM specification.
- Steel grade.
- Heat number or identification number traceable to the certificate.
- Size and schedule number.
- Process of manufacture.

8.4 Certification

8.4.1 The pipes shall have been manufactured according to material - ASTM A 106 Gr. B.

8.4.2 A mill certificate according to EN 10204 3.1 shall be supplied and shall mention as a minimum:

- The ASTM specification and steel grade.
- The type of pipe manufacturing process.
- The heat and/or identification number.
- The type of heat treatment.
- The chemical analysis of the heat.
- The mechanical properties as required by the ASTM specification.

8.4.3 The marking on each pipe shall be checked for conformity with the Manufacturer certificate.

8.4.4 The content of the certificate shall be reviewed before upgrading take place for conformity with the applicable ASTM specification.

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	TEST OF EXAMINATION	REFERENCE	NUMBER OF TESTS
By pipe Manufacturer	Heat analysis	ASTM A 106, Cl.No. 8.1	Each heat of steel
	Tensile test	ASTM A 106 table 2 & 3, Cl. No. 10.1 & 20.1	5 % from each lot On one pipe per lot
	Flattening test	ASTM A 106 Cl. No. 3.1 & 11.2 & 11.3 & 12.1	5 % from each lot On one pipe per lot
	Hydrostatic test	ASTM A 106, Cl. No. 13	Each length
	Marking	ASTM A 106, Cl No 24 & table 5 ASTM A 530 Cl No 24	Each length Traceability to be guaranteed on test report
	Visual and dimensional examination	ASTM A 530, Cl No 26	All pipes of prepared lot

8.5 Preparation of pipes for qualification

All pipes shall be new, and the interior and exterior surfaces shall be free of dirt, sand, debris and rust.

The pipes shall be sorted per specification, per heat number and dimensions.

A lot of pipes prepared for qualification shall only contain pipes of the same:

- manufacturing process,
- diameter and schedule,
- indicated heat number,
- finishing treatment,

marked with piping class number and with the TPIA's identification stamp on both ends of each pipe.

9.0 UPGRADING TESTS

9.1 Visual and dimensional examination

Before any other testing, each pipe length shall successfully undergo a visual and dimensional examination.

The good condition of the pipe shall be checked, particularly the external and internal surface aspects (cleanliness).

The dimensions shall be verified (thickness, diameters, out of roundness, straightness) and found to be within the tolerance of the specification.

For longitudinal pipes, all test required for the qualification of the welds and the HAZ will be redone specifically (tensile test).

9.2 Mechanical Testing

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The mechanical properties shall be verified after acceptance of the pipes as pertaining from one same lot.

The procedure for mechanical testing needs to provide with the required quantities of pipes, as per material specification sheet (Log Book) and as per prepared lot, the necessary over lengths for removal of testing specimens.

These over lengths are in no way included in the material specification sheet (Log Book).

The nature of mechanical tests to be performed is specified in the applicable ASTM specification. Number of tests shall be as per ASTM A 106 specification. In addition, the requirements of the impact testing at 0°C shall be followed.

Location and removal of specimens from pipe to be carried-out according to ASTM specification.

Test specimens may only be cut after a marking transfer by the TPIA.

The following mechanical tests shall be performed on material of stock (with ASTM A106 Gr. B); the supervision of the TPIA delegate and the certificates shall be added to the CMTR.

9.3 Tension test

Requirements

The material shall be conform with ASTM standard and the ratio of yield strength to tensile strength shall not exceed 0.85.

For pipes containing welds, the fracture must be happen outside of the weld. If there is a fracture in weld or HAZ, the tensile strength shall at least meet the requirements for tensile properties as per ASTM standards.

Test specimen

The test specimen shall represent all pipes from the same lot.

Number of tests

For pipes NPS 2 and greater the following number of test shall be performed:

- Base material : one tension test
- Weld (if any) : one tension test

Test locations and orientations

For base material, test specimens shall be orientated transversally and if this orientation is not feasible, it shall be orientated longitudinally.

For welds, the test specimen shall be orientated transversally to the weld.

Test method

Testing shall be performed in accordance with ASTM A 370 standard rectangular plate type 1-1/2" wide (Fig. 4-A370) or standard round (Fig. 5 or Fig. 6-A370). Yield strength shall be determined either by the 0.2 % offset or the 0.5 % extension under load (EUL) method.

Retest

If the tension test specimen from any lot fails to conform to the requirements of the particular grade ordered, the Manufacturer may elect to make retests on two additional pieces from the same lot, each of which shall conform to the requirements specified in the ASTM standard. If one or both of the retests fail to conform to the requirements, the whole lot of that specimen will be rejected.

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9.4 Impact test

Requirements

The standard impact test temperature is 0°C.

The average value of a set of 3 test specimens shall be equal to 35 J/cm^2.

The minimum value per test specimen shall be equal to 35 J/cm^2, but this value may drop to 28 J/cm^2 for only one test specimen per series.

Test specimen

The test specimen shall be machined from material obtained as in paragraph Test specimen for Tension test (par. 9.3).

Flattening of test specimens are not allowed.

Number of tests and orientation

Three test specimens shall constitute one test set.

For pipes NPS 2 and greater, the following number of tests shall be performed:

- Base material: 2 test sets, one set shall be orientated longitudinally and another one transversally.
- Weld: 1 test shall be orientated transversally.
- HAZ: 1 test shall be orientated transversally.

Test method

The notched bar impact test shall be made in accordance with ISO 148 - Charpy V - Notch.

If the wall thickness of the pipe or the coupon does not enable machining of full size specimens, the largest possible size must be used but not less than (10 x 5 mm). The axis of the notch shall be orientated through the wall thickness of the pipe.

9.5 Retreatment

If the result of the mechanical tests does not conform to the requirements specified in Cl. No. 9.3 & 9.4, the Manufacturer, with the acceptance of the Owner / Owner's Representative and the TPIA may retreat the pipes as applicable and repeat all the tests specified.

9.6 Chemical analysis

For each lot/item a new chemical analysis of the steel shall be done.

The chemical analysis shall be conform to the ASTM A 106 requirements.

The Carbon equivalent shall be computed by "check analysis": Cl. No. 7.9.

C.E. ≤ 0.43.

9.7 UT testing

After the mechanical testing, all pipes must be controlled with UT over all the surface, longitudinal seam weld and bevels.

- UT must be performed as per ASME code, section V, art. 23, SA - 388
- Acceptance criteria will be as follows:
  - for base material criteria:
  - ASME code, section VIII, division 1, UF-55 (angel probe will be used)
  - for longitudinal seam welds:

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- criteria : ASME code, section VIII, division 1, appendix 12

The following defects are unacceptable:

- Defects extending into the bevel provided the lamination is parallel to the surface and has a transverse dimension exceeding 6.35 mm.
- defects not parallel to the surface extending to the bevel

10.0 MARKING

10.1 All pipes furnished under this specification shall be clearly identified on the O.D. with the following information marked with low stress die stamps or interrupted dot stamps as noted:

- Manufacturer's name or trademark.
- Heat code identity.
- Pipe number: The Pipe number shall be made up of six figures specified as follows: the item and its number specified in the purchase order.
- The monogram of the TPIA. This marking shall only be applied after complete approval of the Certified Material Test Report.

10.2 In addition to the above, for NPS 2" and larger, it shall also include the following information:

Grade symbol: the grade symbol must designate the material of the pipe conforming to ASTM code.

10.3 Marking must be done prior to final inspection.

11.0 INSPECTION AND CERTIFICATION

a) Inspection and certification shall be done by the Quality Control department of the piping supplier and in presence of the TPIA' and apply to:

- Identification of pipes with respect to mill certificates.
- Visual and dimensional inspection.
- Sampling preparation for testing: stamping of specimens.
- Testing (destructive and non destructive).
- Hydrostatic test.
- Marking: all accepted pipe lengths shall be identified by TPIA's inspector.

b) Final certificate shall be of level DIN 50049.3.1. and shall include the results of all performed destructive, chemical check, hydrostatic test values and heat treatment data. This certificate shall be signed by the TPIA.

12.0 INSPECTION BY CONTROL OPERATIONS: L.O.C.

Control and tests are carried out by the Pipe Supplier under his responsibility and at his cost.

In order to ensure that material is in accordance with the applicable standard specification and with this specification, Supplier shall follow a program of inspection as set in the L.O.C. (List of Operations for Control).

The intended intervention points of the TPIA and of Owner/Owner's Representative inspection are indicated in the L.O.C. form attached.

It is the responsibility of the Quality Control department to fill in the L.O.C. sheet with their intervention points.

Each operation step, after checking of execution, shall be signed by the responsible Q.C. Inspector, and countersigned respectively by the C.O. or Third-Party Inspection Agency.

Notification to the TPIA or to the Owner/Owner's Representative, for witnessing of testing operations, shall be done five working days, by fax, prior to the date scheduled to perform the test.

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Each pipe in which injurious defects are found after delivery shall be rejected. The vendor shall be notified. In this case, the pipe shall be replaced immediately. All costs involved, including wages and travel expenses of the TPIA and Owner/Owner's Representative shall be borne by the Manufacturer.

13.0 CORROSION PROTECTION

The corrosion protection will be applied by the vendor after final inspection by the inspection agency.

The corrosion protection shall be line sealed oil at the outside of the pipe.

This product shall meet the following criteria:

- Guarantee a corrosion protection for a storage period in open air for at least 6 months.
- Shall be easily removable by wire brushing or by grinding.
- Shall not produce toxic vapour or smoke when heated by blow troches or during welding.
- The vendor shall deliver the necessary quantity of product (tri-chlore-ethylene) to remove this oil.

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	PTS – STATION PIPE	**P.019141** **G11077** **M009**

PIPING SUPPLIER	LIST OF OPERATIONS FOR CONTROL	Date: Page:
CUSTOMER	ORDER N°	PROJECT:	MAT. REQ.:
SPECIFICATION: A 106	MATERIAL: Gr. B	PRODUCT: DIA.: SCH:

OPER. N°	OPERATIONS	REFERENCE DOCUMENTS	INTERVENTION POINTS Q.C.	INTERVENTION POINTS TPIA	REMARK
1	Verification of EN 10204 3.1 certificate and conformity of marking	ASTM A 106			
2	Sorting of pipe per lot and marking by TPIA	This tech. spec.			
3	Visual and dimensional examination	ASTM A 530			
4	Sampling preparation for product analysis and mechanical testing	ASTM A 106, Tech. Spec.			
5	Mechanical testing. Tensile test	Tech. Spec.			
6	Hydrostatic testing	Tech. Spec.			
7	UT testing	Tech. Spec.			
8	Marking + TPIA Stamping	Tech. Spec.			
9	Packing				
10	Review of documents				

Intervention points: H = HOLD point W = WITNESS point R = REVIEW point	PREPARED BY: CHECKED BY:	REV.			
Code: Q.C. = Quality Control department TPIA. = Third Party Inspection Agency					

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BHAGYANAGAR GAS LIMITED (BGL)

COMPOSITE WORKS PACKAGE (CIVIL, MECHANICAL, INSTRUMENTATION AND ELECTRICAL WORKS) OF MOTHER STATIONS IN HYDERABAD GA

QA AND QC

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1.0 PURPOSE

The purpose of this document is for uniform understanding and implementation of quality management and quality control by contractor during construction to produce the product by combination of various activities and role of Owner/ Consultant in verification. The management of quality shall also cover co-ordination, review, approval audit and proper documentation of the works performed.

2.0 SCOPE

This document shall be applicable to all construction works to be executed by CONTRACTOR.

3.0 RESPONSIBILITY

It is CONTRACTOR's prime responsibility to arrange/produce the product conforming to contract specifications and inspect all equipment, materials and works at various stages of execution as per the approved QA Plans. In addition, they have to coordinate directly with the OWNER/ Consultant and other involved agencies to give adequate confidence that the activities are performed as per agreed ITPs and necessary documentation are available. Verification by Owner/ Consultant or his representative at any stage shall not relieve CONTRACTOR of his responsibility towards quality of the product.

The CONTRACTOR shall comply with all statutory rules & regulations in force during execution of work and interface with such authorities as required.

4.0 METHODOLOGY

The management of construction quality control is divided into the following categories: -

(1) Procurement of materials required for the construction work.

(2) Execution of work

(3) QA/QC Audits

4.1 Procurement of Materials Required for the Construction Work

The CONTRACTOR shall procure all the materials for CGS Station construction from the owner approved vendor list given in the tender document. Apart from the vendors detailed in the vendor list or items with no vendor list, the contractor may propose any other vendor having credentials for supply of respective items with the capability of the vendor to deliver the product in time with quality (for the same or higher size, pressure rating, schedule, capacity, etc as applicable) in the last 7 years in oil & gas applications (except for items meant for fire water service). in such cases the bidder shall provide supply records viz. copy of po, inspection reports, inspection release note, proven track record, experience details or any other documentary evidence to establish past supply, for owner's review and approval, as applicable. the acceptance of the same is at the discretion of the owner and shall require approval of pipelines head office, CONTRACTOR shall submit the Quality Assurance Plans for all major items and carry out their procurement in line with the approved plans. The CONTRACTOR can either provide his own adequate qualified staff for inspection or employ a separate third-party inspection agency with prior approval to Owner to carry out these functions. Involvement of Engineer-In-Charge / Consultant in the quality control plan, if required, shall be defined during approval of the same.

4.2 Execution of Work

4.2.1 The QA plans for execution shall be developed by the CONTRACTOR. OWNER/ Consultant's approval for the same shall be taken well before start of the work. The final Inspection & Test Plans (ITPs shall be developed by the CONTRACTOR as per contract specifications within fifteen (15) days after award of work for approval by OWNER/ Consultant. For the activities which are identified as Witness or Hold Point, specific inspection call shall be raised by the CONTRACTOR with OWNER/ Consultant in the requisite format well in advance.

4.2.2 CONTRACTOR shall be completely responsible for management of approved quality plans and OWNER/ Consultant involvement will be only of Surveillance in nature to randomly check the works at

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selective/critical junctures. Their role shall be to monitor that the CONTRACTOR is executing the quality plans as per the approved drawings, employing adequately qualified staff and other resources for various items of works. Any deviation to the specifications shall be brought to the notice of OWNER/ Consultant in prescribed formats by CONTRACTOR for approval.

4.2.3 Sub-Contracting of entire work is not allowed in this tender. CONTRACTOR may engage sub-contractor / Vendors for performance of part work in special conditions. CONTRACTOR shall be responsible for ensuring the implementation of approved QA plan, contract specifications and contract conditions through their sub-contractors to achieve the quality during all stages of construction. It shall be the responsibility of the CONTRACTOR to ensure proper coordination between his sub- contractor(s) and other agencies working at site.

4.2.4 The sub-contractor(s)/vendors selection shall be done after evaluation by the CONTRACTOR in line with contract requirements and shall be got approved by Owner/ Consultant before engaging them for the works.

4.2.5 Storage

All the materials procured shall be stored/stacked as per the standard norms and as recommended in various clauses of relevant codes and contract document. The storage of material shall be such as to avoid damage to life/properties (physical and chemical) of the materials. The storage shall not cause deterioration, rusting, mix-up etc. and hamper the other related works in any way. CONTRACTOR shall submit his detailed warehouse plan for OWNER/ Consultant approval to manage the above in open/covered areas.

The materials susceptible to fire shall be kept away in a separate protected place.

In general, the materials shall be kept systematically in order of their class, batch number and identification number, so that they are accessible for the inspection by OWNER/ Consultant whenever required and to avoid the mix up in those materials.

4.2.6 Use

The materials shall be stacked in such a way that the lot, which is procured first, will be consumed first. For materials which are having specific expiry date/ shelf life shall not be used beyond that date and shall be removed from site. Wherever there is any doubt about the change in properties of the materials, such materials shall be sent to reputed approved laboratory for testing and acceptance.

4.2.7 Inspection

The CONTRACTOR shall be responsible for carrying out inspection of the materials brought at site and conducting tests/ checks (at site or in approved laboratories) at predefined frequencies as per contract. It is the responsibility of the CONTRACTOR to ensure that the materials used at site shall conform to relevant codes/ standards and Manufacturer Test Certificates are available for correlation as and when required. The CONTRACTOR shall maintain the records of all materials brought at site and tests conducted on them.

4.2.8 In process and final Inspection

CONTRACTOR shall be responsible to arrange verification of products during in- process and final inspection. Relevant checks and tests shall be arranged for the works performed and records maintained. Tolerances achieved with respect to contract specification and execution drawings for various activities/processes shall be ascertained and submitted to OWNER/ Consultant for approval. Efforts shall be made to keep checks and controls in such a way that a non-conforming product is avoided. However, if in an isolated case, the tolerances are beyond the acceptable values given in the contract/execution drawings/codes, non-conformance resolution/Deviation permit need to be raised by the CONTRACTOR and got approved/resolved from OWNER/Consultant.

4.2.9 Any Observation on quality aspects, Owner/ Consultant shall raise OQA format (attached as Attachment-II) which has to be acknowledged & compliance to be done by the contractor within the agreed time period.

4.2.10 The contractor shall follow the requirements given for control of monitoring and measuring devices as per Attachment-III.

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4.3 Documentation

All the necessary documentation & records shall be maintained by CONTRACTOR till completion of project and handed over to OWNER/ Consultant in requisite copies as a part of completion documents. Wherever OWNER/ Consultant personnel were directly involved particularly in witness and hold point, the copies of the records shall also be provided to personnel on completing inspection of those activities. The documentation & records shall include the following as a minimum but not limited to:

1. Approved Quality Assurance Plan
2. Approved Inspection and Test Plans
3. Inspection and test documents covering:
   - A. Manufacturer Test Certificate
   - B. Material Receipt Report including Inspection Release Note, if applicable and Site Inspection and acceptance Report on quality and quantity of material
   - C. Site test/laboratory test Report reviewed by CONTRACTOR for acceptance vis-à-vis to contract/code requirements for materials/including PMI report at warehouse
   - D. In process Verification reports of CONTRACTOR representative and OWNER/ Consultant as applicable
   - E. Final verification report including any test checks done for compliance
   - F. As built vis-à-vis to contract/drawings including tolerances
   - G. As built for erection
   - H. Non conformance resolution raised by Contractor/Owner/ Consultant
   - I. Concession/Deviation approval by OWNER/ Consultant
   - J. Change order approval by OWNER/ Consultant in case there is variation from contract
   - K. QA/QC Audit Reports and compliance Reports thereof
   - L. Mechanical Completion formats

4.4 QA/QC Audits

During the execution of the works, CONTRACTOR shall carry out periodical Quality Audits at least quarterly in all areas of work. These audits will be conducted by a team of specialists in the respective areas. The auditors shall not be directly involved in the jobs being audited.

The CONTRACTOR shall prepare an Audit Plan and Procedure and submit the same to OWNER/ Consultant for approval.

A copy of the Audit Report containing the findings of the Audit team will be submitted to OWNER/ Consultant. After completion of rectification/modifications/corrective actions on the issues indicated in Audit Report, Compliance Report shall be submitted by the CONTRACTOR to OWNER/ Consultant for review.

Over and above the Contractor's Internal QA/QC Audits outlined above, OWNER/ Consultant shall also reserve the right to conduct QA/QC audits at the frequency decided by them. CONTRACTOR shall participate and provide full support to the Audit Team and furnish all documents / reports / records as desired by the Audit Team. The CONTRACTOR shall take all actions required to comply with the findings of the Audit Report and issue regular Compliance Reports for the same to OWNER/Consultant till all the findings of the Audit Report are fully complied.

In case major Non conformities are observed during execution of the works OWNER/ Consultant reserves the right to appoint an independent person/Third Party Agency to conduct QA/QC Systems Audit for full/part of the facilities being executed by the CONTRACTOR. This audit will be in addition to the audits described above and may be carried out intermittently/continuously for all or part of the facilities being executed by the CONTRACTOR. CONTRACTOR shall bear the total cost of such audits and shall participate & provide full support to the Audit Team and ensure compliance of the audit observations.

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4.5 Waiver & Deviation

Contractor shall strictly comply with specifications and no deviation shall be permitted. However, if the need for deviation arises under exceptional circumstances, such deviation shall be subject to the approval of Owner/Owner's representative and shall be submitted through Owner / Owner's representative in the prescribed "WAIVER /DEVIATION /EXCEPTION REQUEST" format. The WAIVER /DEVIATION / EXCEPTION REQUEST shall also indicate the cost benefit to the Owner.

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ATTACHMENT –I : WAIVER / DEVIATION PERMIT

Report No.: _____

Date: _____

Waiver/Deviation Permit

(TO BE RAISED BY CONTRACTOR / VENDOR)

Project :
Client :
Consultant :
Third Party Insp. :
Order/Contract No. :
Originator :
Originator Ref. :

S. No	Requirement as per Specification / Drawing	Description of Waiver / Deviation Sought	Remarks
1.			
2.			
3.			

Why the Waiver / Deviation is required?

Contractual Implications if Waiver / Deviation is granted.

Time taken shall be More / Less / No Change

Cost of item shall be More / Less / No Change

(Detailed Break up of cost implication to be attached in a separate sheet)

Performance requirement shall be Satisfied / Not Satisfied

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

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Date:	**Signature of the Originator:** **Name & Seal:**
Recommended by Consultant (Site): **Date:**	**Signature:** **Name & Seal:**
Justification by Consultant (HO) (When required): **Date:**	**Signature:** **Name & Seal:**
Recommended by Owner (Site): **Date:**	**Signature:** **Name & Seal:**
Recommended by TPIA (when required): **Date:**	**Signature:** **Name: & Seal**
Final Approval by PM Owner: **Date:**	**Signature:** **Name & Seal:**

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ATTACHMENT –II: FORMAT OBSERVATION ON QUALITY ASPECTS

OBSERVATION ON QUALITY ASPECTS	
Job No: No: Name of Work: Date of Issue: FOI/LOA No: Issued To : *M/s*	
Location Of Work: Item Of Work:	
Details Of Observation(Deficiency)	Recommended Course Of Action Time Allowed For Correction
Issued By: Name: Designation: Signature:	Received by: Name: Signature: Date and Time:
Corrective Action Report By Contractor/Vendor: Name: Date: Signature:	
Distribution Before Resolution: RCM/QA Mgr (EPC):	
a) Verification Of Resolution By Issuer/OWNER(Site)/PMC(Site): Name: Date: Signature:	
Distribution After Resolution: RCM/QA Mgr (EPC):	

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ATTACHMENT-III

REQUIREMENT FOR CONTROL OF MONITORING AND MEASURING DEVICES.

Sl. No.	Description	Calibration requirements	Frequency	Remarks
Civil-Survey				
1.	Theodolite	To check for permanent adjustments by traversing and observing the closing error	once in a year or project duration whichever is earlier	Record to be maintained (See note below)
2.	Levels	To check by Backsight/ Foresight readings, the temporary adjustments of level	Every use	Record to be maintained (See note below)
3.	Steel measurement tapes	a. "Freemans" make or BIS approved make shall be used b. Mutilated, or broken tapes shall not be used c. Legible markings	----	---
4.	Cross staff	Same as 3b&3c above	---	---
5.	Distomat	Actual Physical Verification at Site	Before using first time at site	Records to be maintained
6.	Total Station	To check for permanent adjustments by traversing and observing the closing error,etc.	once in a year or project duration whichever is earlier	Record to be maintained (See note below)
Civil Laboratory				
1.	All balances-Mechanical	Check for zero error	Whenever used	---
2.	Weigh Batcher/Batching Plant	Calibration of scales	Once in three months	Records to be maintained
3.	Cube testing machine	Calibration certificate from manufacturers or from reputed calibrating agency.	As per manufacturer specification or once a year whichever is earlier	Records to be maintained
4.	Moisture Meter	Calibration of scales	6 months	Records to be maintained
Mechanical/ Electrical/ Welding				
1.	Pressure Gauges	Calibration certificate from reputed laboratories or calibrate by dead weight testers with standard weights	Once in 6 months	Records to be maintained
2.	Dial gauges	Check for Zero Error	Whenever used	---

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3.	Dead Weight Tester	Calibration from manufacturer or reputed calibrating agency and calibration certificate shall not be older than one month from the date of mobilization.	As per manufacturer's recommendation or once in a six month whichever is earlier.	Records (Calibration certificate) to be maintained

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Sl. No.	Description	Calibration requirements	Frequency	Remarks
4.	Vernier caliper/ screw gauge	Check for Zero error	Whenever used	---
5.	Holiday tester	Calibration from manufacturer or reputed calibrating agency or by calibrating by zeep meter.	Once in 6 months	Records to be maintained
6.	Elcometer	Check with standard test films supplied by the manufactures	Before use	Records to be maintained
7.	Universal Testing Machine	Calibration Certificate from any reputed third party inspection agency. viz, CEIL, LRS, BV, ABS, DNV or IRS.	As per manufacturer's recommendation or once a year whichever is earlier	Records to be maintained
8.	Charpy V-notch Impact testing machine	Calibration Certificate from any reputed third party inspection agency. viz, CEIL, LRS, BV, ABS, DNV or IRS.	As per manufacturer's recommendation or once in a year whichever is earlier	Records to be maintained
9.	Hardness Testing Machine	Check with the standard test block supplied with the machine as per manufacturer's Recommendation	Before use	Records to be maintained
10.	Chemical Analysis, ex :PMI etc.	Check with the standard samples	Before use	Records to be maintained
11.	Various Digital and Analog meters	Calibration Certificate from reputed laboratories or the manufacturer	Once in Six Months or as per manufacturer's recommendation whichever is earlier.	Records to be maintained
12.	Variable current, voltage and resistance generators	Calibration Certificate from reputed laboratories	Once in Six months	Records to be maintained
13.	Temperature/ Pressure Recorders	Calibration from manufacturer or any reputed calibrating agency	Once in Six months	Records to be maintained
14.	Temperature gauges	Calibration Certificate from reputed laboratories	Once in Six months	To be discarded in case of damage or malfunctioning
15.	Thermocouples	Manufacturer's Certificate or Chemical Check	---	---
16.	Vibration probes	Calibration from reputed laboratory	Once in a year	To be discarded in case of damage or malfunctioning
17.	Decibel-meter	Calibration from reputed laboratory	Once in a Year	- do-

Note: If Error is found, it has to be sent to manufacturers or their agents for rectification and certification & reputed laboratory shall be NABL accredited for relevant testing.

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BHAGYANAGAR GAS LIMITED (BGL)

COMPOSITE WORKS PACKAGE (CIVIL, MECHANICAL, INSTRUMENTATION AND ELECTRICAL WORKS) OF MOTHER STATIONS IN HYDERABAD GA

HEALTH, SAFETY & ENVIRONMENT

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1.0 SCOPE

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

2.0 REFERENCES

This document should be read in conjunction with following.

1) General Condition of Contract (GCC)
2) Special Condition of Contract (SCC)
3) Job Specifications
4) Relevant IS codes
5) Reporting Formats

3.0 RESPONSIBILITY & ORGANISATION

Safety activities at site shall be under control of contractor's RCM. He shall be responsible for implementation of HSE provisions. The nominated or designated safety engineer/ officer shall assist and perform day to day HSE work as per his advice.

4.0 GENERAL REQUIREMENT

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

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

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

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

4.5 The contractor shall organize safety awareness programs regularly.

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

4.7 The contractors shall conduct daily toolbox talk.

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

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

4.10 The contractor shall adhere consistently to all provisions of HSE. In case of non- compliance or continuous failure the owner/ owner representative may impose stoppage of work without any cost time implication to owner. A penalty amount of Rs 1000/-shall be imposed on the contractor for the serious HSE violation.

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

5.0 ACCIDENT, INCIDENT AND NEAR-MISS REPORTING

Accident

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

Incident

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

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Near-miss

An unexpected, unwanted event not causing loss, injury, or illness but which under slightly altered conditions can lead to an accident.

can be defined as "Any event which under slightly unfavorable circumstances, may have resulted in any of the following:

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

Accident, Incident and Near miss reporting form listed in ANNEXURES

6.0 HSE REQUIREMENTS AT SITE

6.1 Personnel Protective Equipment

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

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

Safety Helmet

Coverall

Safety shoes/footwear

Safety Glasses

Hand Gloves (as per job requirement)

Other PPEs are depends upon nature of job like

Arc Welding – Welding face shield

Grinding – Grinding face shield

Height work – Full Body harness (above 2 meters)

Ask site supervisor for proper use and selection of protective clothing / equipment for specialized jobs

6.2 Welding

Ensure that welding machine is in order and approved by site engineer.

Ensure that welding cables are in order.

Ensure that welding machine is properly earthed.

Remove all combustible material from welding area to avoid fire

Place a fire extinguisher nearby welding premises.

Ensure welding holder, cable and its lugs in good condition and use only industrial power socket and plugs (3 Pin) to avoid electricity risk.

Make sure that welding machine is provided with ON/OFF switch and is earthed /grounding.

Do not overload electrical appliances and cable, Shocked pin etc.

Ground the work piece separately from the welding return connection only.

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6.3 Gas Cutting

Check the cylinder and its valve or leakage and move out any leaking cylinder immediately.

Ensure that flash back arresters are installed with torch and NRV (Non return valve) on the gas cylinders side.

Ensure cylinders in vertical position (Cylinder trolley) and far away from fall of sparks and hot metal.

Check the regulator and torches that they are inspected prior to every use.

Check for leaks around regulators, hoses/fittings & nozzle with soap solution.

Check the entire hose length if it is cracked or worn out cut that length of hose or replace the hose.

Check that flash back arrester used for the purpose is of approved make/specification only.

Place a fire extinguisher nearby welding premises.

Grinding Operation

- Grinding wheels should be stored in dry place.
- After expiry date, grinding wheel must be condemned, broken into pieces.
- Power supply cable of adequate current carrying capacity shall be used and it should be in good workable condition without abrasions, cuts or puncture in outer insulation.
- Socket pin provided at supply end and on/off switch in working condition.
- Proper earthing of the body in case of metallic body.
- Wheel guard properly fitted in position.
- Machine body without any damage like crack etc.
- Moving part (wheel) must be properly fixed to the machine with the help of spanner.
- Grinding wheel must be of suitable size as per the speed of grinding machine.
- Grinding wheel without manufacturer's sticker showing size, speed and expiry date must be condemned.
- Don't use portable grinding machine as bench grinder.
- Don't fit over size wheel than recommended size by machine/wheel manufacturer.
- Don't grind small, unstable object without fixing it in the vice.
- Don't over press the grinding wheel against the job for fast removal of metal.
- Put OFF the main switch, while machine is not in use (tea break etc.)
- Don't chip off grinding/cutting wheel for achieving fast cutting rate.

6.4 PPEs:

- Use of helmet, safety walking boot face shield or safety goggles (where face shield is not possible.) and hand gloves.
- The provision of edge protection (fall prevention of people and materials)
- Access and egress

6.5 Pipe Transportation and lowering

- All drivers shall hold a valid driving license for the class of vehicle.

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- Securing of the load shall be according to established and approved methods.

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

6.6 Pressure / Leak Testing

Hydraulic and Pneumatic Test

Access to the test area shall be limited to essential personnel only. before the test commences compliance is required with the following points:

Persons supervising pressure or leak tests must have sufficient knowledge and experience of testing to fully understand the hazards of the activity and the precaution, which must be taken

- Effective communication, including formal procedures, must be established between sites whenever the test envelope extends beyond one site, for example, pipelines.
- The area shall be cordoned off (using tape, shields, or barriers, etc) at an adequate distance from the equipment to be tested, as specified on the Permit to Work
- Warning signs shall be posted at access ways, at other strategic positions, and on the equipment to be tested (including the doors of test workshops or other designated areas)
- Pressuring equipment shall be provided with suitably calibrated pressure control / regulator devices.
- Pressuring equipment shall not be left unattended at any time during the test.
- Pressuring equipment shall be isolated from the equipment under test and where practicable disconnected, when the test pressure has been reached.
- Care must be taken to ensure that materials of construction have the required ductility at the test temperature to prevent brittle fracture.
- A safety valve should be fitted to the equipment/system being tested, set to relieve at a pressure that will prevent over pressurization
- Sufficient venting / draining points shall be provided in order to prevent trapping of pressurizing medium behind non-return valves, check valves, between isolation valves, or within dead legs of the pressure envelope
- The equipment/plant to be pressure tested must be subjected to thorough examination prior to testing. It may be necessary to 100% inspect all welds using visual, radiographic or other NDT techniques
- The gas supply must be isolated when test pressure has been achieved
- The pressure envelope must contain sufficient vents, to a safe location.

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- De-pressurization after pneumatic testing must be gradual

6.7 Scaffolding and Ladder

All working platform must be constructed with the specific requirement of job.

All portable ladders must be in good condition as per the site norms.

If the working platform is not permanent, then safety belt must be used.

- There shall be firm foundation for all scaffoldings. All scaffolding shall be made of sound material.
- Scaffolding material shall be inspected and used, only if found in good condition.
- Provide metal base plate is used under all upright or standard scaffoldings. Correct type of couplers shall be used for all connections.
- Plumb and level scaffoldings as erection proceeds, so that braces will fit without forcing. Fasten all braces securely.
- Working platforms shall be provided with guards. This should consist of top rail, mid rail, and toe board. The toe board shall be of minimum height 100 mm, while the mid rail and top rail shall be at heights of 600 mm and 1200 mm respectively.
- Do not use ladders or makeshift devices on top of scaffoldings to increase the height.
- Shall be placed at least 75 deg. to the floor.
- Ladder shall extend 3' to 4' above the point of Landing and topmost 3 rungs shall not be used.
- Ladder is checked visually for defects before every use.
- Ladders shall not be used in a horizontal position as runways or scaffoldings.
- Ladders shall not be placed in front of a door that opens toward the ladder unless the door is locked, blocked, or guarded.
- Fall arrestor to be used wherever applicable.

6.8 Work Permit Procedure

For working at more than 1.5m height the permission must be obtained from site in-charge.

For doing any hot work in the fire risk areas the permission must be obtained from site in charge or safety officer.

For any Excavation work it must be ensured that there are no underground utilities like cables, Water pipeline etc.

For any work inside confined space, entry permit must be obtained from site engineer.

6.9 Barricades and Warning Signs

- Area where work is being carried out above man height or below 1’ ground depth must be barricad

Follow the instruction of all types of warning signs like “NO SMOKING” “NO ENTRY” “DANGER” Work at height”

6.10 Emergency Plan and Procedures

1) All Contractor’s employees should be aware of site Emergency control plan
2) Periodic drill to train employees for their awareness & information should be followed.

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6.11 Road Safety Norms

1) For roadside working site to be barricaded as per approved barricading norms given in drg. No. TEIND-STD-G-M-9001. Penalty clause for road safety & barricading shall be applicable as per relevant clause of commercial part of tender.
2) Only eligible driver can drive required vehicle inside site
3) Speed limit norms of site must be followed
4) No riding or travelling on the back of open-end vehicle, forklift or trailers should be done.

6.12 Labour Welfare & Legal Requirement

1) All mandatory provisions with regard to safety as prescribed under contract Labour (Abolition & Regulation) Act 1970 and Rules made there under are applicable.
2) Workmen compensation insurance and registration under ESI should be maintained.
3) Time to time, all rules and regulations suggested by safety committee of site must be followed and implemented

6.13 Preventive measures for Project Sites from Covid -19

To protect from COVID-19 infection it is important to identify the source or way of infection during the various activities to be performed at sites. The following table will help to take the preventive measure but must be reviewed at site if any change of activity or new activities are identified:

Sr. No.	Activities	Precautionary Measure
1	Workforce Mobilization	• All employees and workers should not come on same day. They should come in phase wise manner based on their job/activity or as per the Government/Company Directives dictate.
2	Site Entry	• Thermal screening for all contractor employees and workers, all others permitted to enter the site must be done on daily basis and on each shift. If body temperature will be normal (less than or equal to 37 degree centigrade or 98.6-degree Fahrenheit), then individuals will be allowed to site. • Nobody should be allowed to enter the site without mask and other PPE as required for construction activities. • Aarogya setu app must be installed in all contactor employees and workers.

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Sr. No.	Activities	Precautionary Measure
3	Movement of construction equipment, machinery, and material	• All the materials, equipment, machinery, and vehicles coming to the sites should be disinfected on daily basis and after each shift. • Disinfection tag should be pasted over the equipment and machinery to identify whether the same has been disinfected or not.

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4	Site construction activities	• Mask shall be worn by all the people all the time whilst working at site • Usage of nitril gloves during paperwork or while moving at site for supervision & inspection. • Sanitising of Drawings/documents exchanged and no direct contact transfer • Social distancing i.e. min 2 mtr. distance must be maintained even during the site activities. Activity should be planned accordingly, and risk assessed • All the construction materials used by the construction people must be sanitize on daily basis. • Adequate quantity of sanitizer must be provided at all work locations, meaning; accessible to workers so that they sanitize their hand as and when required. • Make sure that staff, contractors and visitors have access to places where they can wash their hands with soap and water. Portable and moveable hand washing facility (soap and water) must be provided at site (readily accessible to worker) • All visitors/vendors etc shall be indicted which shall include Covid-19 preparedness for that particular site • Display posters promoting handwashing at all areas where people traverse on work locations. • Avoid spitting. Gutka/tobacco and cigarette are

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Sr. No.	Activities	Precautionary Measure
		strictly prohibited at the workplace. • PPE such as Helmet, shoe, goggles, earplug etc. must be disinfected on daily basis by the individual. • Coveralls must be washed on daily basis. • Discourage the sharing of personal belongings, food, water etc.
5	Site Storage	• Storage facility must be disinfected on daily basis. • Hand sanitizer must be provided near the storage area. • Use disposable hand gloves while handling the materials. • Avoid gathering near the store, give the requirement in advance or inform the store officer about the requirement to avoid waiting near the store. • Lock and key must be disinfected every day and after each shift.
6	Workers meeting and training	• Worker meetings such as toolbox talks and training keeping social distancing norms on safe procedure is an essential part for safe execution of all work-fronts. large gatherings of worker shall be avoided at all times • Training and/or meetings shall be conducted in small groups and at a distance of minimal. 6 ft. must be maintained between workers. • During meeting and/or training everybody must wear the mask. • Every meeting and/or training must be start with the do's and don'ts and symptoms related to COVID-19
7	Travelling (e.g. for leave, site transfer, daily commutation to site etc)	• Minimise the travel as much as possible. • Thermal screening must be done, and self-declaration must be taken from the people returned from leave or transferred from another

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Sr. No.	Activities	Precautionary Measure
		site • Vehicle must be sanitised on daily basis • Hand sanitizer must be provided inside the vehicle • As per government directives more than 2 person including driver is not allowed in a CAR. • Transport of the labours should be done through vehicle with capacity of no more than 40% • Drivers Health card checklist must be checked, and daily self-declaration must be obtained from him. • All drivers and/ passengers shall wear the appropriate face masks for the duration of the trip/s

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ANNEXURE – A

RELEVANT IS-CODES FOR PERSONNEL PROTECTION

IS : 2925 – 1984	:	Industrial Safety Helmets.
IS : 4770 – 1968	:	Rubber gloves for electrical purposes
IS : 6994 – 1973 (Part – I)	:	Industrial Safety Gloves (Leather & Cotton)
IS : 1989 – 1986 (Part – I & III)	:	Leather safety boots and shoes
IS : 3738 – 1975	:	Rubber knee boots
IS : 5557 – 1969	:	Industrial and Safety rubber knee boots
IS : 6519 – 1971	:	Code of practice for selection, care, and repair of Safety footwear
IS : 11226 – 1985	:	Leather Safety footwear having direct moulding sole
IS : 5983 – 1978	:	Eye protectors
IS : 9167 – 1979	:	Ear protectors.
IS : 3521 – 1983	:	Industrial Safety belts and harness

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ANNEXURE – B

FORMAT - 1.0

1.0: HEALTHY, SAFETY & ENVIRONMENT (HSE) PLAN

Project : ---------- Contractor: ----------

Date : ---------- Owner: ……

(To be prepared & submitted by each Construction Agency)

Activity Description	Procedure/ W.I./ Guidelines	Code of Conformance	Performing Function			Audit Function
			Performance	Checker	Approver	Customer Review/ Audit Requirements

PREPARED BY REVIEWED

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MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (1/6)

Project: _____ Contractor : _____

Date: _____ Owner : _____

Inspection By: _____

Note: write 'NC' (Not Concern) wherever any of the items are not applicable

Item	Yes	No	Remarks	Action
HOUSEKEEPING				
Waste containers provided and used				
Sanitary facilities adequate and Clean				
Passageways and Walkways Clear				
General neatness of working areas				
Proper Material Storage				
Wooden Boards properly stacked, and nails removed				
Cords, leads out of walk and traffic ways				
Scraps removed from the work site				
Other				
PERSONNEL PROTECTIVE EQUIPMENT				
Goggles: Shields				
Face protection				
Hearing protection				
Safety Shoes provided				
Hand protection				
Respiratory Masks etc.				
Safety Belts				
Safety Helmets				
Other				
EXCAVATIONS / OPENINGS				
Excavation permit				
Excavated earth kept away from edge				
Dewatering pump kept away from edge				
Safe access into excavated area				
Opening properly covered or barricaded				

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MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (2/6)

Item	Yes	No	Remark	Action
Welding Cutting				
Valid not work permit				
Flashback arrester provided for cylinders				
Power cable not crossing the welding cable				
Adequate earthing provided				
No combustible materials kept near welding & cutting works				
Gas cylinder chained upright & kept in trolleys				
Cables and hoses not obstructing				
Screens or shields used				
Flammable materials protected				
Fire extinguisher (s) accessible				
Other				
SCAFFOLDING				
Fully decked platform				
Guard and intermediate rails in place				
Toe boards in place & tied properly				

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MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (3/6)

Item	Yes	No	Remark	Action
HOISTS, CRANES AND DERRICKS				
Condition of cables and sheaves OK				
Condition of slings, chains, hooks and eyes OK				
Inspection and maintenance logs maintained				
Outriggers used				
Singh/ barricades provided				
Signals observed and understood				
Qualified operators				
Other				
MACHINERY, TOOLS AND EQUIPMENT				
Proper instruction				
Safety devices				
Proper cords				
Inspections and maintenance				
Other				
VEHICLE AND TRAFFIC				
Rules and regulations observed				
Inspection and maintenance				
Licensed drivers				
Others				

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MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (4/6)

Item	Yes	No	Remark	Action
TEMPORARY FACILITIES				
Emergency instruction posted				
Fire extinguishers provided				
Fire-aid equipment				
Secured against storm damage				
General nemeses				
In accordance with electrical requirements				
Other				
Fire Prevention				
Personnel instructed				
Fire extinguishers checked				
No smoking in prohibited areas				
Hydrants clear				
Other				
ELECTRICAL				
Proper wiring & earthing				
ELCB's provided				
Ground fault circuit interruptors				
Protection against damage				
Prevention of tripping hazards				
Proper electrical cable joints				
Light poles secured				
Clear way to power distribution board				
Proper rating of fuses				

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MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (5/6)

Item	Yes	No	Remark	Action
HANDLING AND STORAGE OF MATERIALS				
Properly stored or stacked				
Passageways clear				
Other				
FLAMMABLE GASES AND LIQUIDS				
Containers clearly identified				
Proper storage				
Fire extinguish HSErs nearby				
Other				
WORKING AT HEIGHT				
Erection plan				
Safety nets				
Safety belts tied properly				
Illumination				
No loose material at height				
No body under working area				
All openings covered				
Other				
ENVIRONMENT				
Chemical and other Effluents properly disposed				
Cleaning liquid of pipes disposed off properly				
Seawater used for hydrotesting disposed off as per agreed proceeding				
Lubricant Waste/ Engine oils properly disposed				
Waster from Canteen office, sanitation etc. disposed properly				
Disposal of surplus earth stripping materials, Oily rags and combustible materials done properly				
Green belt protection.				

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MONTHLY CHECKLIST CUM COMPLIANCE REPORT REGARDING HSE (6/6)

Item	Yes	No	Remark	Action
HEALTH CHECK				
Hygienic conditions at labour camps OL				
Availability of First Aid facilities				
Proper sanitation at site, office and labour camps				
Arrangements of medical facility				
Measures for dealing with illness				
Availability of potable drinking waters for workmen & staff				
Provision of cretches for children				
ERECTION				
Slings/ D'shakle checked				
Signal Man				
Tag line for guiding the load				
Protecting the slings from sharp edges				
No loose materials at height				
Ladder & platform welding inspected				
No one under the suspended load				
Stay rope				
SWL				

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MONTHLY HEALTH, SAFETY & ENVIRONMENTAL (HSE) REPORT
(TO BE SUBMITTED BY EACH CONTRACTOR)

Actual work start date:_____ For the month of:_____

Project:_____ Report No.:_____

Name of the Contractor:_____Status as on:_____

Name of Work:_____Name of Safety officer:_____

Item	This Month	Cumulative
Total strength (Staff – Workmen)		
Number of HSE meeting organised at site		
Number of HSE awareness programmes conducted at site		
Whether workmen compensation policy taken	Y/N	
Whether workmen compensation policy valid	Y/N	
Whether workmen registered under ESI Act	Y/N	
Number of Fatal Accident		
Number of Loss Time Accident (Other than Fatal)		
Other accident (non loss time)		
Total No. of accident		
Total man-hours worked		
Man-hour loss due to fire and accident		
Compensation cases raised with insurance		
Compensation cases resolved and paid to workmen		

Remark

Date:_____/_____/_____ Safety Officer/RCM

(Signature and name)

To: OWNER.....1 COPY
RCM/SITE-IN-CHARGE 1 COPY

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SUPPLEMENTARY ACCIDENT, INCIDENT & NEAR MISS REPORT

Project:_____Supplementary to Report No.:_____

(Copy enclosed)

Site:_____Date:_____

Contractor:_____

NAME OF THE INJURED……...
FATHER'S NAME…….
SUB-CONTRACTOR M/S……..
DATE & TIME OF ACCIDENT……
LOCATION……

BRIEF DESCRIPTION & CAUSE OF A ACCIDENT

NATURE OF INJURY / DAMAGE

COMMENTS FROM MEDICAL PRACTITIONER WHO ATTENDED THE VICITIM/INJURED

SUGGESTED IMPROVEMENT IN THE WORKING CONDITION IF ANY

LOSS OF MANHOURS AND IMPACT ON SITE WORKS

ANY OTHER COMMENT BY SAFETY OFFICER

Date : _____/_____/_____/ SIGNATURE OF CONTRACTOR WITH SEAL

To : OWNER.....1 COPY
: RCM/SITE-IN-CHARGE 1 COPY

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ACCIDENT REPORT

(To be submitted by Contractor after every accident within 2 hours of accident)

Report No._____

Date:_____

Name of Site:_____

COTRACTOR_____

NAME OF THE INJURED …….

FATHER'S NAME…….

SUB-CONTRACTOR M/S……...

DATE & TIME OF ACCIDENT……

LOCATION……

BRIEF DESCRIPTION OF ACCIDENT

CAUSE OF ACCIDENT

NATURE OF INJURY / DAMAGE

MEDICAL AID PROVIDED / ACTIONS TAKEN

INTIMATION TO LOCAL AUTHORITIES

Date : _____/_____/_____/ SIGNATURE OF CONTRACTOR WITH SEAL

To : OWNER.....1 COPY

: RCM/SITE-IN-CHARGE 1 COPY

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BHAGYANAGAR GAS LIMITED (BGL)

COMPOSITE WORKS PACKAGE (CIVIL, MECHANICAL, INSTRUMENTATION AND ELECTRICAL WORKS) OF MOTHER STATIONS IN HYDERABAD GA

PTS – SS BALL VALVE

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1.0 GENERAL

BHAGYANAGAR GAS LIMITED (BGL), (hereinafter referred as Owner), has been authorised by PNGRB for setting up infrastructure and operation of City Gas Distribution Network for the Hyderabad GA. Natural gas will be transported to residential, commercial, industrial (PNG) and automobile consumers (CNG) in the city.

The present document covers the technical specifications for the procurement of "**SS Ball valve**"

This document shall be read in conjunction with schedule of rate (SOR), Material Requisition (MR), specification, standards, drawings and other documents forming a part of the tender document.

2.0 SCOPE OF SUPPLY

The scope of this specification include design, manufacture/ supply, inspection/ testing/ marking/ packaging/ handling and dispatch of SS Ball Valves as per relevant codes.

Purchaser reserves the right to delete or order additional quantities during execution of order, based on unit rates and other terms & conditions in the original order

3.0 CODES & STANDARDS

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

MSS-SP-99 : Instrument valves

ANSI : Process Piping

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 Purchaser / Purchaser's Representative for his decision, which shall be binding on the bidder.

4.0 MATERIALS

4.1 The valve body shall be made our of material conforming to ASTM A479 Type 316 or A351CF3M or equivalent Material.

4.2 Material of construction of ball shall conform to ASTM A276 Type 316.

4.3 Material of construction of seat springs shall be Alloy X-750 or equivalent.

5.0 DESIGN & MANUFACTURE

5.1 All ball valves shall be designed in conformance with the requirements of ASME B31.3, MSS-SP-99 and other applicable code and 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 fittings shall be designed so that all parts/ components meet the requirements for the specified area classification

5.2 Valves shall be rated for a maximum working pressure of 6000 psig and shall be capable of operation between a temperature range of (-40) ° to 250°F

5.3 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 pressures and temperatures

5.4 Elastomeric seals, which require no packing adjustment, shall be used

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5.5 Valves stem shall be of Blow out proof design

5.6 Ball shall be blow out proof and trunnion mounted or floating.

5.7 Valves shall have positive wrench/ handle stops, Phenolic black wrench/ handle shall be provided. Wrench/ handle shall indicate the direction to flow. In the case of three way valves the stem/body shall also be provided with a visual indication of flow direction if the handle is removed.

6.0 INSPECTION AND TESTING

The valve manufacturer shall submit typical type test reports for the following test carrier out on similar valves

i) Hydrostatic seat leak test shall be carried out with de-ionised water. There shall be no detectable set leakage at 1.1 times the rated pressure of the valve

ii) Gas pressure test for seat and shell shall be carried out with nitrogen at 1000 psig. There shall be no detectable external leakage. Maximum allowable seat leakage shall be 0.1 atm-cc/min.

7.0 OTHER REQUIREMENTS

7.1 Manufacturer should confirm 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 Standard Association”

7.2 Spares and Accessories

i) If required, manufacturer shall furnish a list of recommended spares and accessories for valves required during start up and commissioning.

ii) If required, manufacturer shall furnish a list of recommended spares and accessories required for two years of manual operation and maintenance of valves

iii) Manufacturer shall quote for spares and accessories as per the material requisition

8.0 TEST REPORTS & CERTIFICATES

8.1 The manufacturer shall supply material compliance certificates.

8.2 The valve manufacturer shall provide test procedure and valve inspection and test report for type tests carried out on similar valves as per the requirements of clause 6.0

9.0 MARKING, PACKING & SHIPMENT

9.1 Heat code shall be marked on valve body to facilitate tractability

9.2 All the items shall be suitably wrapped and packaged to with stand rough handling during ocean shipment and inland journey

9.3 Each item shall be properly tagged and package separately to facilitate easy identification

9.4 All items shall be wrapped and packaged in such-a-way that they can be preserved in original as new condition

10.0 DOCUMENTATION & TRAINING

Prior to shipment, manufacturer shall submit following test certificates and documents

i) Test certificate of chemical, mechanical testing

ii) Manufacturers standard test reports

iii) The procedure and certificates to be submitted as per the requirements of clause 7.0 of this specification

iv) Manual for installation, erection, maintenance and operating instructions including a list of recommended spares for valves.

v) Vendor shall provide complete training to Owner on installation of Ball valves at sites and other aspects like safety, operations & Maintenance, Repairing etc.

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11.0 GUARANTEE

11.1 Manufacturer shall guarantee that the design, materials, manufacturing and testing of Ball Valves comply with the requirement of this specification and applicable codes and standards. Manufacturer shall replace all Valves which should result defective or fail during field pressure testing or fail to perform satisfactorily due to inadequate engineering, substandard material and workmanship at Manufacturer's end.

11.2 The manufacturer shall guarantee against any defect, failure or malfunctioning occurring during 12 months from the date of commissioning or 24 months from the date of supply whichever is earlier.

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	PAINTING	P.019141 G11077 M012

BHAGYANAGAR GAS LIMITED (BGL)

COMPOSITE WORKS PACKAGE (CIVIL, MECHANICAL, INSTRUMENTATION AND ELECTRICAL WORKS) OF MOTHER STATIONS IN HYDERABAD GA

PAINTING SYSTEM & COLOUR CODE FOR FINAL LAYER

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Date: 2026.09.11 18:16:52 IST

	PAINTING	**P.019141** **G11077** **M012**

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2.0 DEFINITIONS 1

3.0 COLOUR CODE SYSTEM.....1

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1.0 INTRODUCTION

This Document (PTS - Particular Technical Specification for Painting) lists the Specification for the project.

This present document covers the technical specification for the procurement of Painting used in high pressure natural gas transmission systems. It describes the general requirements, controls, tests, QA/QC examination and final acceptance criteria which need to be fulfilled.

In case of any conflict of Specification, PTS will supersede General Technical specification (GTS) and Data sheet will supersede PTS.

2.0 DEFINITIONS

Client / Owner	Shall mean BGL
Manufacturer	Means the Manufacturer of the Paint.
Contractor	The party which carries out all or part of Engineering, Procurement, Construction, Pre-commissioning & Commissioning of the project. It shall mean Pipe laying contractor in the present context.
Third Party Inspection Agency (TPIA)	Means the Inspection Agency to be appointed by the Pipe laying contractor
Consultant / Owner Representative	**S**hall means PMC/ BGL / The entity of the purchaser or the company nominated by the purchaser to design the natural gas transport or distribution system and to specify the equipment
PTS	Means the present <<Particular Technical Specification P.014902 G11077 M012>>and its entire appendix, if any.

3.0 COLOUR CODE SYSTEM

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

S. No.	DESCRIPTION	FINAL LAYER COLOUR SHADE	RAL CODE
1	Pipe Work	Yellow	RAL 1004
2	Piping Support	Grey	RAL 7043
3	Handrail	Orange	RAL 2003
4	Gas O/L Actuator	Blue	RAL 5015
5	Valve Handle/Wheel	Black	RAL 9005
6	All Valves	Grey	RAL 7038

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	PAINTING	**P.019141** **G11077** **M012**

S. No.	DESCRIPTION	FINAL LAYER COLOUR SHADE	RAL CODE
7	IJ	Grey	RAL 7038
8	Filter	Grey	RAL 7038
9	Pig launcher & Receiver	Grey	RAL 7038
10	Bolts & Nuts	Grey	RAL 7038
11	Grating	Hot Galvanized	
12	Metering Station Shed		
12.1	Steel Frame	Beige	RAL 1018
12.2	Roof / Vertical Shed	Grey	RAL 7030
12.3	Control Panel	Grey	RAL 7032

The recommended painting system should be of Category C5 – I Very high (Industrial) with high durability as specified in the Standard ISO 12944 Part 1 to 8. The proposed Painting system shall conform to Table A5 of ISO 12944 – 5 Standard.

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Table A.5 — Paint systems for low-alloy carbon steel for corrosivity categories C5-I and C5-M

Substrate: Low-alloy carbon steel

Surface preparation: For Sa 2½, from rust grade A, B or C only (see ISO 8501-1)

System No.	Priming coat(s)				Subsequent coat(s)	Paint system		Expected durability		
	Binder	Type of primer [a]	No. of coats	NDFT [b] in µm	Binder type	No. of coats	NDFT [b] in µm	Low	Med	High
C5-I										
A5I.01	EP, PUR	Misc.	1-2	120	AY, CR, PVC [c]	3-4	300			
A5I.02	EP, PUR	Misc.	1	80	EP, PUR	3-4	320			
A5I.03	EP, PUR	Misc.	1	160	EP, PUR	2	300			
A5I.04	EP, PUR, ESI [d]	Zn (R)	1	60 [e]	EP, PUR	3-4	240			
A5I.05	EP, PUR, ESI [d]	Zn (R)	1	60 [e]	EP, PUR	3-5	320			
A5I.06	EP, PUR, ESI [d]	Zn (R)	1	60 [e]	AY, CR, PVC [c]	4-5	320			
C5-M										
A5M.01	EP, PUR	Misc.	1	160	EP, PUR	2	300			
A5M.02	EP, PUR	Misc.	1	80	EP, PUR	3-4	320			
A5M.03	EP, PUR	Misc.	1	400	—	1	400			
A5M.04	EP, PUR	Misc.	1	260	EP, PUR	2	600			
A5M.05	EP, PUR, ESI [d]	Zn (R)	1	60 [e]	EP, PUR	4	240			
A5M.06	EP, PUR, ESI [d]	Zn (R)	1	60 [e]	EP, PUR	4-5	320			
A5M.07	EP, PUR, ESI [d]	Zn (R)	1	60 [e]	EPC	3-4	400			
A5M.08	EPC	Misc.	1	100	EPC	3	300			

Binder for priming coat(s)	Type	Water-borne possible	Binder for subsequent coat(s)	Type	Water-borne possible
EP = Epoxy	2-pack	X	EP = Epoxy	2-pack	X
EPC = Epoxy combination	2-pack		EPC = Epoxy combination	2-pack	
ESI = Ethyl silicate	1- or 2-pack	X	PUR = Polyurethane, aliphatic	1- or 2-pack	X
PUR = Polyurethane, aromatic or aliphatic	1- or 2-pack	X	CR = Chlorinated rubber	1-pack	
			AY = Acrylic	1-pack	X
			PVC = Poly(vinyl chloride)	1-pack	

[a] Zn (R) = Zinc-rich primer, see 5.2. Misc. = Primers with miscellaneous types of anticorrosive pigments.

[b] NDFT = Nominal dry film thickness. See 5.4 for further details.

[c] It is recommended that compatibility be checked with the paint manufacturer.

[d] It is recommended for ESI primers that one of the subsequent coats be used as a tie coat.

[e] It is also possible to work with an NDFT from 40 µm up to 80 µm provided the zinc-rich primer chosen is suitable for such an NDFT.

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BHAGYANAGAR GAS LIMITED (BGL)

COMPOSITE WORKS PACKAGE (CIVIL, MECHANICAL, INSTRUMENTATION AND ELECTRICAL WORKS) OF MOTHER STATIONS IN HYDERABAD GA

PTS – SS TUBES

0	26.09.2024	Issued for Tender	AML	GGA	SM
Rev.	**Date**	**Description**	**Prepared by**	**Checked by**	**Approved by**

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Date: 2026.09.11 18:16:52 IST

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1.0 GENERAL

BHAGYANAGAR GAS LIMITED (BGL), (hereinafter referred as Owner), has been authorised by PNGRB for setting up infrastructure and operation of City Gas Distribution Network for the Hyderabad GA. Natural gas will be transported to residential, commercial, industrial (PNG) and automobile consumers (CNG) in the city.

The present document covers the technical specifications for the procurement of "**SS Tube**s"

This document shall be read in conjunction with schedule of rate (SOR), Material Requisition (MR), specification, standards, drawings and other documents forming a part of the tender document.

2.0 SCOPE OF SUPPLY

2.1 The scope of work not limited to manufacture, supply, Inspection & testing at workshop, marking, packing, handling and dispatch SS Tubes as per quantities given in MR and complying all the requirements as per ASTM A 269, ANSI B31.3.

2.2 All codes & Standards for manufacturing, testing, inspection etc. shall be of latest edition.

2.3 All tubes shall be designed as per applicable codes & standards.

2.4 All part/ component shall meet the requirement for the specified area's classification.

2.5 Area classification shall be Class-I, Division-I; Group-D as per NEC or Zone-I Group IIA/ IIB as per IS/ IEC Specification or equivalent specifications.

3.0 CODES & STANDARDS

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

ASTM A269 : Seamless and Welded Austenitic Stainless-steel tubing for general service

ASTM A450 : General requirements for carbon, ferritic alloy and austenitic alloy steel tubes

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.

4.0 OTHER TECHNICAL REQUIREMENTS

The Contractor shall carry out the work in accordance with Specifications, Standards and ASME B 31.3 - Process Piping / ASME B 31.8 – Gas Transmission and Distribution Piping System, Oil Industry Safety Directorate (OISD) norms.

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.

5.0 TECHNICAL SPECIFICATION

All the items shall be suitable for compressed natural gas service and meet following specifications.

5.1 Tube material shall be stainless steel as per ASTM A269 (Grade TP 316).

5.2 Tubing material shall have minimum molybdenum content 2.5%, carbon content of max. 0.030%

5.3 Tube shall be bright annealed.

5.4 Tube shall be seamless.

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5.5 Tube hardness shall be less than Rb 80. Tubes shall be NACE MR 0175 certified for hardness. Hardness test shall be carried out on each tube.

5.6 10% lot shall be hydro tested as per requirement of ASTM A450 clause 22.3, at a hydro test pressure of 350 kg/cm2(g). However, it shall be ensured that the test pressure does not result in stresses exceeding the yield strength at test pressure.

5.7 The min. Strength & yield strength shall be verified by a means of tensile strength.

5.8 All S.S tubes shall be online 100% eddy current Tested as per ASTM A450.

5.9 Tolerance on outer diameter shall be ± 0.005".

5.10 Tube shall be of 6 meter in length with tolerance as per ASTM A269 (-0mm, +3.2mm)

5.11 Minimum thickness shall be as per following table:

Tube OD	***Minimum Wall Thickness***
8mm	1mm
10mm	1mm
¾"	0.095"
½"	0.083"
1"	0.120"

Note: Bidder to reconfirm maximum allowable working pressure for each tube size.

5.12 Following documents/ certificates to be submitted

i) Chemical composition for heat

ii) Chemical composition for products

iii) Tensile test

iv) Hardness test

v) Flaring test

vi) Eddy current test

vi) Leak test

vii) Visual inspection and dimensional check

5.13 Tubing should be clearly marked with the specifications given in the inspection certificate with heat code, lot code, outer diameter and wall thickness with inspection certificate no.

5.14 Tubes should be supplied with both ends plugged with clean interior & each packing containing tubes shall carry the following stamped or written in indelible ink, manufacturer's name or trade mark, designation of tubes, lot no, etc.

6.0 INSPECTION AND TESTING

6.1 Inspection shall be carried out as per tender technical specification, relevant Codes/ Standards and inspection Plan /QAP/ QCT. Vendor to prepare detailed QAP. Vendor to prepare detailed QAP and submit the same for approval to Purchaser/ Purchaser's representative.

6.2 Bidder/vendor furnish all the material test certificates, proof of approval/ license from specified authority as per specified authority as per specified standard, if relevant, internal test/ inspection reports as per tender technical specification and specified code for 100% material, at the time of final inspection of each supply lot of material.

6.3 For any control test or examination required under the supervision of TPIA/ Purchaser/ Purchaser's representative

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7.0 PACKING & SHIPMENT

7.1 All the items shall be suitably wrapped and packaged to with stand rough handling during ocean shipment and inland journey. Tubes should be supplied with both end plugged

7.2 The item shall be properly tagged and package separately to facilitate easy identification

7.3 Items shall be wrapped and packaged in such-a-way that they can be preserved in original as new condition.

8.0 DOCUMENTATION & TRAINING

Following test certificates shall be furnished along with shipment

- Test certificate of visual, chemical, mechanical testing (incl. tensile, hardness, flaring, Eddy current and leak test)
- Manufacturers standard shop inspection & test report for all items
- The test report for specified tests
- Third party inspection report as applicable to meet the requirements of specified codes & standards as applicable
- Vendor shall provide complete training to Owner on installation of Tubes at sites and other aspects like safety, operations & Maintenance, Repairing etc.

9.0 GUARANTEE

- Manufacturer shall guarantee that the design, materials, manufacturing and testing of tubes conform to the requirement of this specification. Manufacturer shall replace all tubes free of costs which fail during field pressure testing or do not perform satisfactorily due to inadequate engineering, substandard material and poor workmanship at Manufacturer's end.
- The manufacturer shall guarantee against any defect, failure or malfunctioning occurring during 12 months from the date of commissioning or 24 months from the date of supply whichever is earlier.

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BHAGYANAGAR GAS LIMITED (BGL)

COMPOSITE WORKS PACKAGE (CIVIL, MECHANICAL, INSTRUMENTATION AND ELECTRICAL WORKS) OF MOTHER STATIONS IN HYDERABAD GA

FITTINGS AND FLANGES

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Date: 2026.09.11 18:16:52 IST

	PTS – FITTINGS AND FLANGES	P.019141 G11077 M013

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1.0 GENERAL

BHAGYANAGAR GAS LIMITED (hereinafter referred as Owner), is executing the City Gas Distribution project.

The fittings & flanges have to be delivered in accordance to the particular specification: Codes, Norms and standards (latest revision); but not limited to:

ANSI B16.5	Pipe flanges and flanged fittings
ANSI B16.9	Factory - made wrought steel butt welding fittings.
ANSI B 16.11	Forged steel fittings
ANSI B16.28	Wrought steel butt welding short radius elbows and returns
ANSI B31.3	ASME code for process piping.
ANSI B31.8	Gas transmission and distribution piping systems.
ANSI B36.10	Welded and seamless wrought steel pipe
ANSI B16.25	Butt Welding Ends
ASTM A 105/ A 105 M	Forging, carbon steel, for piping components.
ASTM A 203	Pressure vessel plates, alloy steel, nickels
ASTM A 234/ A 234 M	Piping, fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures
ASTM A 333	Seamless and welded steel pipe for low temperature
ASTM A 350/ A 350 M	Forging, carbon, and low alloy steel, requiring notch toughness testing for piping components.
ASTM A 370	Mechanical testing of steel products.
ASTM A 420/ A 420 M	Piping fittings of wrought carbon steel and alloy steel for low temperature service.
ASTM E 112	Standard methods for determining the average grain size.
MSS SP 25	Standard marking system for valves, fittings, flanges, and unions.
MSS SP 55	Quality standard for steel castings for valves, flanges and fittings and other piping components (visual method).

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MSS SP 75	Specification for high test wrought butt welding fittings. ASME Boiler and Pressure Vessel code.
MSS SP 44	Specification for Steel Pipeline Flanges
MSS SP 97	Specification for Forged Carbon steel branch outlet fittings – Socket, Threaded and Butt-Welding ends.
DIN 2413	Design of Steel Pressure Pipes
EN 10204	Type of Inspection documents
ISO 148	Metallic Material - Charpy Pendulum impact test
ISO 9001	Quality management standard

The present specification can confirm, complete, or alter certain characteristics or tolerances of existing laws or specifications.

In his offer, the manufacturer or vendor shall specify all proposed modifications or alternatives to the present specification. In all cases, each modification has to be submitted to the Owner/EPMC. All consequences after eventual order for non-r espect of this obligation are at the manufacturer's charge and responsibility.

A valid copy of the ISO 9001 certificate shall be included in the offer.

The Owner / EPMC keeps the right to audit the manufacturer's and their subcontractor's manufacturing process and control methods.

The manufacturer's specification of the steel, the manufacturing procedure itself and the laboratories in which testing takes place, shall be approved by the client/consultant.

The Owner/ EPMC may verify the control equipment of the manufacturer, its calibration and the points at which it is located. If during the control of the fittings certain problems arise the Owner/EPMC may demand supplementary tests at the cost of the manufacturer.

At all times while work on the contract of the Client is being performed, the inspector representing the Client shall have free entry to all parts of the manufacturer's facilities and those of all subcontractors, who are involved in the manufacturing of the fittings. All reasonable facilities shall be afforded to the inspector to satisfy him that the product is being furnished in accordance with these specifications. All tests and inspections called for by these specifications will be made in the manufacturer's plant prior to shipment and at the manufacturer's expense, unless otherwise, and shall be conducted as not to interfere unnecessarily with the operations of the manufacturer's plant. The manufacturer shall notify the Client prior to completion or shipment of all fittings requiring such inspection.

Eventual interpretations and deviations to this specification by the Manufacturer shall be requested by writing in his offer with detailed justification and approved by the Client/Consultant before eventual order to the Manufacturer. The latter is responsible and shall indemnify the Client/Consultant for any damage resulting from the non-respect of this obligation.

An approval of documents can never be considered as an acceptance of deviations or relaxations to requirements. A deviation is only possible after specific request to the Client/Consultant.

1.1 Glossary

Client/Owner	Shall mean the Purchaser of fitting & Flanges as mentioned in "Introduction" chapter.
Manufacturer	means the Manufacturer of the Fittings & Flanges

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PTS	means the present Particular Technical Specification and all its appendices, if any.
Third Party Inspection Agency (TPIA)	means the Inspection Agency
Consultant/Owner's Representative/EPMC	**shall** means BGL/PMC
Representative	The entity of the Client or the company nominated by the Client to design the natural gas transport or distribution system and to specify the equipment

2.0 DESIGN AND CONSTRUCTION

2.1 The pressure temperature ratings for tee, weldolets, elbows and flanges shall be calculated respectively in accordance with ANSI B31.8, DIN2413 and ANSI B16.5. For all other types of fittings (caps, reducers, nipple) ASME section VIII shall apply.

The standard dimension shall be in accordance

Flanges such as weld neck flanges and blind flanges shall conform to the requirements as follows - ASME B16.5 upto sizes DN 600 mm (24") excluding DN 550 mm (22"),

- MSS-SP-44 for sizes DN 550 mm (22").
- With ANSI B16.9 for the tees, reducers and elbows (except for short radius elbows which should be in accordance with ANSI B16.28)
- All Butt welded end fittings up to 16" such as tees, elbows, reducers, etc. shall conform to ASME B16.9. Socket weld and screwed end fittings shall conform to ASME B 16.11.
- All Butt welded end fitting above 16" such as tees, elbows, reducers, etc. shall be comply with the requirement of MSS-SP-75.

Fitting such as weldolets, sockolets, nippolet, etc shall be manufactured in accordance with MSS-SP-97.

With ANSI B 16.9 for the caps,

With ANSI B 36.10 for the nipples,

And with ANSI B16.5 / MSS SP 44 for the flanges

2.2 The temperature and pressure range shall be as per the relevant piping specifications.

2.3 The wall thickness shall meet the following requirements:

2.3.1 The maximum allowable stress in the base material and in the weld shall be equal to fourty per cent (40%) of the minimum yield strength guaranteed by the specification of the steel used.

2.3.2 The minimum wall thickness must be greater than the following:

a. Thickness calculated in line with requirements given in ASME B 16.9 and cl. no. 2.7 of this specification.

b. Nominal Thickness of pipe

Thickness calculation is to be submitted to Owner/EPMC for prior approval before manufacturing.

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2.3.3 If the fitting has yield strength lower than the yield strength of the pipe to which it is intended to be welded, the wall thickness in each zone of the fitting is at least equal to the largest value define "tr" of either.

- The specified pipe wall thickness times the ratio of the minimum yield strength guaranteed by the standard of the steel of the pipe and the minimum yield strength guaranteed by the standard of the steel of the fitting;
- The absolute minimum thickness required by the applicable code(s).

2.3.4 The specified pipe wall thickness and grade (with reference to the equivalent grade in ASTM spec. or API 5L spec.) with which the fitting and flange is intended to be used is specified in the piping material specification.

Fittings such as tees, elbows, reducers, etc. shall be either welded or seamless type. All welded fittings shall be subjected to heat treatment. All fittings (except weldolets) shall comply with The requirements of MSS-SP-75. Fittings such as weldolets etc. shall be manufactured in accordance with MSS- SP-97.

Welded pipes used for fittings shall be LSAW type only.

2.3.5 The thickness at the welding end shall not exceed 1.5 times the nominal wall thickness of the pipe to be matched.

2.3.6 All the above requirements also apply to the welding ends of the flanges.

2.4 The manufacturer shall submit for approval to the Client and consultant the dimensional drawings, calculations, and the material part lists for all the types of fittings and flanges. All the documents must be identified with the Client's order number.

2.5 The design shall take into consideration performance requirements prescribed in paragraph 2.6.

The design of tees, reducers or elbows must be established, by proof testing, in accordance with par. 2.7. The design of the other fittings must be established by mathematical analysis according to ASME code.

2.6 All fittings under this specification shall be designed to withstand a field hydrostatic test pressure with non corrosive water, after installation, during 24 hours at a following pressure level:

Minimum: P = 1.5 Design Pressure

Where:

P = hydrostatic test pressure, bar

Design Pressure = 49 barg.

2.7 Design Proof Test

This applies to fitting only and not to flanges.

2.7.1 In addition to the requirements of par. 2.3.1 to 2.3.4 proof tests shall be made as evidence of the adequacy to the design references. Records of design or successful proof tests shall be available at the facility for inspection by the Client and copy shall be added to the Certified Material Test Report (CMTR, par. 9.2.).

2.7.2 Unless otherwise agreed upon between manufacturer and Client, the only required proof test is a bursting strength test.

2.7.2.1 Prototype fittings, representatives of production (same size production fittings), selected for test shall be identified as to material, grade, and lot, including heat treatment. They shall be inspected for dimensional compliance to this standard.

2.7.2.2 Straight seamless or welded pipe sections, whose calculated bursting strength is at least as great as that calculated for the fittings, shall be welded to each end of the fitting to be tested. Any internal misalignment greater than 0.06 inch (1.6 mm) shall be reduced by taper boring at a slope not over 1:3. Length of pipe sections for closures shall be at least twice the pipe O.D. Shorter lengths may be used as follows:

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2.7.3 The assembly must withstand at least 110 % of the pressure computed in 2.7.5.

2.7.4 Minimum length of pipe shall be one pipe O.D. for sizes NPS 8" and smaller. Test fluid shall be water or other liquid used for hydrostatic testing.

2.7.5 Hydrostatic pressure shall be applied until the fitting ruptures. The actual test pressure prior to rupture must at least be equal to the adjusted proof test pressure defined as follows:

$$P\ (adj.) = P \times \frac{S(act.)}{s}$$

where

P (adj.) = the adjusted proof test pressure, bar

P = the computed proof test pressure at burst of any part of the assembly, bar

S = minimum specified tensile strength of the pipe for which the fitting is intended to be used, N/mm^2

S (act.) = the actual tensile strength of the material of the test fitting (determined on specimen representative of the test fitting), N/mm^2 The computed proof test pressure shall be determined as follows:

Which refers to the pipe which the fitting's marking identifies and, where

$$P = \frac{20S.t}{D}$$

Where

P = Computed bursting pressure of the pipe, bar

S = Minimum specified tensile strength of the pipe, N/mm^2

t = Nominal pipe wall thickness, mm

D = Specified outside diameter of pipe, mm

2.7.6 A successful proof test on a identical prototype fitting, selected as required in subsection 2.7.2.1., may be used to qualify other fittings from the same lot of production.

2.7.7 Vendor shall produce test certificate for the burst test.

2.7.8 Test shall be witnessed & certified (3.2 certification) by TPIA.

2.8 Fitting dimensions

One of the principles of this standard is the maintenance of a fixed position for the welding ends with reference to the centreline of the fittings or the overall dimensions, as the case may be.

Dimensional standards will be in accordance with §2.1.

2.9 Fitting and Flanges Tolerances

2.9.1 Tolerances for welding ends, out-of-roundness at the welding ends and inside diameter at the bevel are shown hereafter. Other tolerances wall thickness are as per corresponding codes: ANSI B16.9 standard and for short radius elbows ANSI B16.28 standard.

2.9.2 Welding ends

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The welding end and bevel shall be in accordance with Figure 1 for wall thickness up to 20.0 mm ; for thicker walls, refer to Figure 2. The welding end land of the fitting & flanges shall be machined flat and shall not vary from the plane by more than 0.03 in (0.8 mm) at any point. If a fitting & flange has a thickness unequal to the pipe with which it is intended to be used, the welding end preparation at the joint has to conform with applicable I-5 of ASME B 31.8 Figure 3.

2.9.3 Out-of-roundness at the welding ends

The out-of-roundness, defined as the difference between the maximum and the minimum inside diameter at the welding ends shall not exceed 1 % of the specified inside diameter for sizes NPS 4 and smaller. Fittings & flanges NPS 4 and larger shall be machined true round.

2.10 Inside Diameter

The inside diameter at any place at end (bevel) shall be the following:

NPS	Tolerance of inside Øat end (mm)
1/2" – 24”	+ 1.6 - 0.4

(1) The tolerance refers to variation from nominal I.D. calculating by (O.D. nom. - 2 t nom.). (2) Flange Bore to match with I.D. of the pipe.

3.0 MATERIALS

3.1 The steel used in the manufacture of fittings & flanges shall be selected by the manufacturer and submitted for approval to the Client at the time of the offer. The manufacturer shall fill in the data sheet.

3.2 The chemical composition of the steel meets the requirements of Table 1.

3.3 The steel used has tensile properties conforming to the requirements prescribed in the ASTM standards.

3.4 The ratio of yield strength to tensile strength shall not exceed 0.90.

3.5 The material for fittings shall consist of blooms, billets, slabs, forging quality bar, plate, seamless or fusion welded tubular products with filler metal added.

3.6 The steel shall be fully killed, fine grain practice.

3.7 The steel used shall be suitable for field welding to other fittings, pipes, flanges, or valves manufactured under ASTM specifications A333, A350, A352, A381, A420, A694, A707 or API standards specifications 5L, 6D, 605 or MSS standards SP-44, SP-72, SP-75, EN 10208-2 in line with Piping Specification 6C1 attached with the tender document.

3.8 If preheating of the material is required to ensure proper weldability under normal field conditions, the manufacturer shall state so in the offer, specifying preheat requirements and if accepted by the Client this shall be permanently indicated on the fitting & flanges.

3.9 The Manufacturer must deliver a 3.2 certificate EN 10204, stating the quality, the mechanical properties (yield strength, tensile strength, percent elongation, impact test, chemical analysis, the process of manufacture and the marking (for example the heat number of material) of the steel.

3.10 Chemical Composition

3.10.1 For each heat the manufacturer shall check a chemical analysis of the steel (see Table 1).

3.10.2 Check analysis

Carbon equivalent shall be computed by the following equation:

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

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And shall not exceed 0.43

4.0 FABRICATION AND TEST

For all forging materials, the specimen shall be taken from the integral part of the forging. The par.4.1 to 4.2 are only applicable on welded fittings.

4.1 Welding Fabrication

4.1.1 All welds and repair welds shall be performed according to written procedures. The welding procedure must be submitted for approval to the Owner/EPMC before any fabrication.

Only qualified & approved welders and welding operators shall be used in production.

4.1.2 The joints shall be furnished in accordance with the requirements of Section VIII of ASME Boiler and Pressure Vessel Code.

4.1.3 Machine welding shall be done by an electric process, preferably by submerged arc.

4.1.4 All butt welds shall have full penetration. Submerged arc machine welding shall be done with at least one pass from the inside, except when accessibility makes this impossible, then a manual or machine root bead may be employed provided that a visual inspection of the root bead is possible. Backing rings shall be not used.

4.1.5 Repair, chipping or grinding of welds shall be done in such a manner as not to gouge, groove, or reduce the original metal thickness by more than 6 1/2 % of nominal specified wall.

4.1.6 Except for bar in the tees, fillet welds shall not be permitted.

4.1.7 Welded-on braces, if used, should be removed before heat treatment and the weld spot shall be repaired and ground flush and smooth. However, when braces are required for heat treatment, they shall be cut out and the surface shall be ground flush and smooth after heat treatment. Except for bar in the tees, welding shall not be permitted after heat treatment. The ground areas shall be inspected by magnetic particle or liquid penetrant testing.

4.2 Welding Procedures

4.2.1 All welds, repair welds and repair by welding shall be performed according to written procedures. These welding procedures shall be qualified according to the requirements of the ASME Boiler and Pressure Vessel Code, Section IX.

The welding procedure tests are required on material which is on the high side of the chemistry specification.

The manufacturer shall maintain a weld record of the procedure and performance test results. The test coupons shall be submitted to the same fabrication and heat treatment as the actual fittings.

The welding procedure qualification must include an impact test set in the weld and in the HAZ with requirements of paragraph 5.1.2 and a macrographic examination described in paragraph 4.2.2. These tests shall be performed after eventual final heat treatment.

4.2.2 Macrographic examination: the etched surface of the macro test specimen viewed macroscopically must display the image of a well performed welded joint with sufficient penetration, free from linear defects and important inclusions. In case of doubt, the etched surface must be examined microscopically and additional macroscopical examinations of other areas may be required.

The macrographic examination will include hardness measurements in the weld and the HAZ. The hardness will not exceed the values measured on the parent metal by more than 80 points for the welds and 100 point for HAZ, with an absolute maximum of 350HV10.

The acceptance of inclusions can be decided upon with the NDE of the welded plates (see paragraph 6).

4.2.3 Transverse guided bend test

4.2.3.1. Test method

Transverse weld test specimens shall be subjected to face and root guided bend tests. The specimens shall be approximately 1.5 in (38 mm) wide, at least 6 in (152 mm) long with the weld at the centre, and

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shall be machined in accordance with Figure 4. The face bend specimen shall be bent with the inside surface of the pipe against the plunger, and the root bend specimen with the outside surface against the plunger. The dimensions of the plunger for the bending jig shall be in accordance with Figure 5 and the other dimensions shall be substantially as shown in Figure 5.

The manufacturer shall use a "jig" based on this dimension or a smaller dimension at this option.

4.2.3.2. Test specimen

The weld bend test specimens, as described hereabove shall be cut from the coupon. The specimens may be taken from a fitting or from sample plates as described in par. 4.2.3.1.

4.2.3.3. Acceptance criteria

The bend test shall be acceptable if no cracks or other defects exceeding 0.12 in (3.2 mm) in any direction are present in the weld metal or between the weld metal and the fitting metal after the bending. Cracks which originate along the edges of the specimen during testing and which are less than 0.25 in (6.4 mm) measured in any direction, shall not be considered unless obvious defects are observed.

4.2.3.4. Retest

If either test fails to conform to specified requirements, the manufacturer may elect to make retests on two additional specimens from the same lot, each of which shall conform to the requirements specified hereabove. If any of these specimens fail to conform to the requirements, the welding procedure qualification test is not accepted.

(*) A lot consists of all fittings/flanges from one heat of steel with same initial wall thickness, from the same furnace charge for final normalizing heat treatment, from the same shape and the same main pipe dimension.

4.2.4 Number of tests

The nature and number of tests are specified in the Table below and only one retest is allowed.

		Specification test	**Number**
Non destructive test		par. 6.	par. 6
X-ray and U.S. testing		par. 6	par.6
Destructive test		All specimens shall be taken transverse to the weld	
Tensile		par. 5.1.1.	2
Bend test	Face	par. 4.2.3.	2
	Root	par. 4.2.3	2
Impact	Weld	par. 5.1.2.	1 set of 3 specimens
	HAZ	par. 5.1.2.	1 set of 3 specimens
Macrographic examination		par. 4.2.2	1

4.3 Normalising Heat Treatment

Start & stop temperature chart shall be signed by TPIA, also power failure log shall be maintained.

4.3.1 After forming and welding, all fittings & flanges shall be heat treated by normalising. Normalising shall be carried out in such a way that the base material acquires a fine grained perlitic structure. If the manufacturer can give proof by qualified manufacturing procedure that after forming, the steel of the fitting & flanges has a homogeneous fine grained perlitic structure, he can ask for a derogation supported by technical file to the Client and TPIA.

The normalizing procedure requires the approval of the TPIA. Good care shall be taken to avoid direct contact of the flames with the material to be heated.

During the normalizing period, the temperature of the heat treatment lot shall be automatically recorded by a sufficient number of thermocouples attached to the material surface. The thermocouples shall be adequately protected against the influence of heat radiation. Temperature variations shall be within ± 20°C. The manufacturer shall furnish time temperature charts of each heat treatment lot. The fittings & flanges belonging to each treatment lot shall be specified on the charts. Temperature measurements by other means are permitted only if approved by the TPIA.

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4.3.2 The fine grained perlitic structure of the steel shall be verified by at least one micrographic examination per lot (definition in §4.2.4), according to ASTM E 112. The grain size shall be in the range of 8 to 12.

4.3.3 The manufacturer shall include in the CMTR data of this treatment

5.0 PHYSICAL TESTING

5.1 Mechanical Tests

The following mechanical tests shall be performed by the vendor under the supervision of the TPIA and the certificates shall be added to the CMTR.

Test specimens may only be cut after a marking transfer by the Authorised TPIA. All the tests shall be performed after final heat treatment.

Certification requirements to comply with EN 10204 – 3.2 certificates shall issued by TPIA

5.1.1 Tension test

5.1.1.1. Requirements

The material shall be in conformance with the ASTM standards and the ratio of yield stress to tensile stress shall not exceed 0.90.

For fittings containing welds, the fracture must be outside of the weld. If there is a fracture in weld or HAZ, the tensile strength shall at least meet the requirements for tensile properties as per ASTM standards.

5.1.1.2. Test specimen

The test specimen shall represent all forgings from the same lot. Test specimens shall be taken from the fitting after final heat treatment or from a piece of pipe or plate of the same nominal thickness, same heat of steel from which the fitting is made and which has been heat treated in a lot with any of the fitting(s) it represents. For welded fittings, this coupon (piece of pipe or plate) shall contain a weld in prolongation of the weld of the fitting.

5.1.1.3. Number of tests

For fittings NPS 2 and greater the following number of test shall be performed:

Base material : one tension test

Weld : one tension test

5.1.1.4. Test locations and orientations

For welds, the test specimen shall be orientated transversally to the weld. For base material, test specimens shall be orientated transversally and if this orientation is not feasible, it shall be orientated longitudinally.

For flanges, the test location shall be in accordance with ASTM A350§6.1.3.

5.1.1.5. Test method

Testing shall be performed in accordance with ASTM A 370 standard rectangular plate type 1-1/2" wide (Fig. 4- A370) or standard round (Fig. 5 or Fig. 6-A370). Yield strength shall be determined either by the 0.2 % offset or the 0.5 % extension under load (EUL) method.

5.1.1.6. Retest

If the tension test specimen from any lot fails to conform to the requirements of the particular grade ordered, the manufacturer may elect to make retests on two additional pieces from the same lot. If one or both of the retests fail to conform to the requirements, the whole lot of that specimen will be rejected.

5.1.2 Impact test

5.1.2.1. Requirements

For product, the Charpy V- Notch test shall be conducted as per following requirements:

Material	Impact Test Temperature	Energy Absorption Value (Minimum)

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Carbon Steel Material	0 Deg C	- At 0°C Minimum Average Absorbed Energy shall be SMYS (Mpa)/10, with a minimum of 27 J, for the transverse direction. - At 0°C Minimum Individual Energy value shall not be less than 80 % of the Minimum required average value, for the transverse direction.

SMYS = Specified minimum yield strength.

5.1.2.2. Test specimen

The test specimen shall be machined from material obtained as in paragraph Test specimen for Tension test (par. 5.1.1.2.).

Flattening of test specimens are not allowed.

5.1.2.3. Number of tests and orientation

Three test specimens shall constitute one test set.

For fittings NPS 2 and greater, the following number of tests shall be performed :

Base material : 2 test sets, one set shall be orientated longitudinally and another one transversally.

Weld : 1 test shall be orientated transversally.

HAZ : 1 test shall be orientated transversally.

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5.1.2.4. Test method

The notched bar impact test shall be made in accordance with ISO 148 - Charpy V - Notch.

If the wall thickness of the fitting or the coupon does not enable machining of full size specimens, the largest possible size must be used but not less than (10 x 5 mm). The axis of the notch shall be orientated through the wall thickness of the fitting.

5.1.3 Flattening test

This is not applicable to the flanges.

5.1.3.1. Requirements

Flatten to 1/3 original O.D. without cracks or breaks in the fitting, continue flattening until meeting opposite walls of the fitting.

No evidence of lamination of burnt metal may develop during entire test.

5.1.3.2. Test specimen

The test specimen represents all the fittings from the same heat of steel of the same shape and of the same main pipe dimension of the fittings.

5.1.3.3. Number of tests

For fittings size lower than 2" one flattening test shall be made per test specimen.

5.1.4 Retreatment

If the result of the mechanical tests does not conform to the requirements specified in par. 5.1.3.1., the manufacturer, with the acceptance of the Owner/EPMC and the TPIA, may reheat treat the fittings as applicable and repeat all the tests specified.

5.2 Chemical Analysis

For each lot/item a new chemical analysis of the steel shall be done.

The chemical analysis shall conform to the ASTM requirements specified in the specification. The carbon equivalent shall be computed by "check analysis": see par. 3.10.2 with C.E. $\leq$ 0.43. The reports shall be added to the CMTR reports and approved by the TPIA.

6.0 NON-DESTRUCTIVE EXAMINATIONS (NDE)

The following mechanical tests shall be performed by the vendor under the supervision of the TPIA and the certificates shall be added to the CMTR.

6.1.1 Radiography

All butt and repair welds shall be 100% radiographed in accordance with ASME section V - non destructive examination - article 2 - using fine grain film and lead screens. Acceptance criteria shall be as be ASME B 31.4 or ASME B 31.8 as applicable and API 1104. Radiography shall be performed after the final heat treatment.

6.1.2 U.S., Magnetic, Visual and Dimensional examination

6.1.2.1. Non destructive examinations

In the presence of the TPIA, the manufacturer shall perform the following non destructive examinations on the fittings after the mechanical tests and according to an inspection procedure to be submitted for approval

For fitting with wall thickness larger than or equal to 6 mm, ultrasonic inspection on the whole surface (with angle probe and straight probe) to the maximum extent possible.

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All finished wrought weld ends shall be 100% tested for lamination type defects by ultrasonic test. Any lamination larger then 6.35 mm shall not be acceptable.

When elbows of size > DN 450 mm (18") are manufactured, the first elbow of each radius, diameter and wall thickness shall be ultrasonically checked for sufficient wall thickness in areas where a minimum wall thickness is to be expected. This shall be followed by random inspection of one out of every three elbows of the same radius, diameter and wall thickness.

Magnetic Particle or Liquid Penetrant Examination shall be performed on cold formed.

Butt welding tees with extruded outlets as per applicable material standard.

Welds, which cannot be inspected by radiographic methods, shall be checked by Ultrasonic or Magnetic particle methods. Acceptance criteria shall be as per ASME section VIII Appendix U and Appendix VI respectively.

Magnetic particle inspection on the whole external surface and the accessible internal surface.

6.1.2.2. Ultrasonic inspection

Ultrasonic inspection of all welds and 25 mm of base material at each side of the weld shall be done.

6.1.2.3. Visual examination

All fitting & flanges shall be visually examined.

6.1.2.4. Test after machining

After machining, all the finished bevels shall be submitted to the following tests:

Magnetic particle or liquid penetrant

For fitting and flanges with wall thickness larger than or equal to 6 mm, ultrasonic inspection on 25 mm of base material.

6.1.2.5. Dimensional examination

For fittings up to NPS 6, the TPIA shall choose 10 % with a minimum of one piece per item of the order and these pieces shall be submitted to a dimensional examination.

For fittings larger than NPS 6, all pieces shall be submitted to a dimensional examination

All flanges shall be submitted to a dimensional examination.

6.1.3 Acceptance criteria of the different NDE

6.1.3.1. Visual examination

The following defects are unacceptable:

Undercuts exceeding 1 mm in depth and 25 mm in length.

Undercuts of the outside weld which overlap undercuts of the inside weld.

Lack of penetration.

Continuous occurrence of under-cutting

6.1.3.2. Magnetic particle inspection

Magnetic particle inspection on the external surface. ASME code, section VIII, division 1, appendix VI.

6.1.3.3. Ultrasonic inspection

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For the longitudinal welds: ASME code, section VIII, division 1, appendix 12.

For welding ends, see § 6.1.3.5.

For base material :

Procedure: ASME code, section V, art. 23, SA-388.

Criteria: ASME code, section VIII, division 1, UF-55 (angle probe will be used).

6.1.3.4. Radiographic examination

For longitudinal seam welds :

Criteria : ASME code, section VIII, division 1, UW 51

For girth welds :

Criteria: API standards 1104, section 6.0.

6.1.3.5. Magnetic particle or liquid penetrant on the finished bevel

The following defects are unacceptable:

Defects extending into the bevel provided the lamination is parallel to the surface and has a transverse dimension exceeding 6.35 mm.

All defects not parallel to the surface extending into the bevel.

7.0 INSPECTION AND TESTING

7.1 Information

The manufacturer shall inform the TPIA MIN. 5 working days (15 in case of foreign supplier) in advance of any intervention required by this specification and shall send a copy (fax) of it to the Client/Consultant.

Hydrostatic testing by the manufacturer is not required, but welding fittings shall be capable to withstand a field hydrostatic testing in accordance with par. 2.6.

7.2 Workmanship and Finish

7.3 Fittings & Flanges shall be free of injurious defects and shall have workmanlike finish.

7.4 Injurious defects are defined as those having a depth in excess of 6-1/2 % of specified nominal wall.

7.5 Machining and grinding of surface defects shall be treated as follows: sharp defects such as notches, scratches, scraps, seams, laps, tears, or slivers not deeper than 6-1/2 % of nominal wall thickness shall be removed by grinding. Repair of injurious defects by welding shall be permitted only after agreement by the Client and the TPIA, except that welding of injurious defects shall not be permitted when the depth of defects exceeds 33-1/3 % of the nominal wall thickness, or the length of repair exceeds 25 % of the specified diameter. Defects must be completely removed and welding performed by a welder qualified specifically for repair welding, as per par. 4.2.1. Such repair welding shall be ground flush with the surface and all welding shall be done before final heat treatment. Repair welding shall be done with low hydrogen electrodes in shielded metal arc welding, gas metal arc process or submerged arc process. In no case, repair welding or cracks nor repair or repairs is allowed. Repair welding will not be permitted for flanges.

7.6 Repair welding shall be done before the last heat treatment. Adjusting weld preparations, intended for field welding, by means of welding is not allowed. For "standard fitting" repair by welding is not permitted.

7.7 Repair welding on the welds & in the body shall be 100 % radiographed and U.S tested.

7.8 At the discretion of the TPIA, finished fittings & flanges shall be subject to rejection if surface imperfections acceptable under cl. no. 7.3 are not scattered but appear over an area in excess of what is considered

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as a workmanlike finish.

7.9 Rejection

Each fitting or flange in which injurious defects are found during inspection and after delivery shall be rejected. The manufacturer shall be notified. In this case, the fitting shall be replaced immediately. All the costs involved, including wages and travel expenses of the TPIA/Client/ Consultant shall be borne by the manufacturer.

8.0 MARKING

8.1 All fittings and flanges furnished under this specification shall be clearly identified on the O.D. with the following information marked with low stress die stamps or interrupted dot stamps as noted (refer to MS SP25):

Manufacturer's name or trademark.

Heat code identity.

Fitting or flange number: the fitting or flange number shall be made up of six figures specified as follows:

the item and his number specified in the purchase order.

The monogram of the Owner/EPMC. This marking shall only be applied after complete approval of the Certified Material Test Report (see par. 9.2.).

8.2 In addition to the above, for NPS 2" and larger, it shall also include the following information:

Grade symbol: the grade symbol must designate the material of the fitting or flange.

8.3 Marking must be done prior to final inspection.

9.0 DOCUMENTATION

9.1 Before starting any control, the manufacturer shall submit for approval to the Third Party inspection agency and the Client/Consultant the following documents:

Detailed fabrication drawing and calculations.

Fabrication and control procedure

List of Operations of Control (LOC) in accordance with PTS (if new -not if upgraded).

Material list.

Qualified welding procedures (if new -not if upgraded).

Welder’s performances qualifications (if new -not if upgraded).

Heat treatment procedure-(if new -not if upgraded).

Non destructive testing procedures.

Each company dealing in the order by fabrication and/or control shall implement a LOC for all operations and interventions performed in its organization. They shall also be responsible for the implementation of the same by their subcontractors.

9.2 Certified Material Test Report

A Certified Material Test Report (CMTR) shall be furnished listing as built drawing and calculations, the LOC (see paragraph 9.1.), the proof test certificate, the base material certificate, the chemical check analysis. The certificate of the heat treatment, the mechanical tests, the non-destructive examination, the mechanical properties, the quality release note (see paragraph 9.3) and any special test required by the purchase order the fitting or flange individual number (see paragraph 8.1.1.) must be indicated in the CMTR to permit the correct traceability of each piece. The manufacturer shall furnish one copy of the CMTR to

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the TPIA and one original and one copy to the Client/Engineer.

9.3 IRN

After final approval of fittings/flanges and the acceptance of the CMTR, the Third Party inspection agency's delegate shall furnish to the Client/Consultant and to the manufacturer an Inspection Release Note (IRN). The manufacturer shall deliver one copy of the IRN with the fittings/flanges and one copy shall be included in the CMTR (see paragraph 9.2.)

All documents shall be in English language.

10.0 CORROSION PROTECTION

The corrosion protection will be applied by the manufacturer after final inspection by the TPIA. The product shall meet the following criteria:

- Guarantee a corrosion protection for a storage period in open air for at least 6 months.
- Shall be easily removable by wire brushing or by grinding.
- It shall not produce toxic vapour or smoke when heated by blow torches or during welding

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TABLE 1

CHEMICAL COMPOSITION FOR FITTINGS

Maximum limit of chemical elements which may be used in material under this standard.

	% MAXIMUM
C	0.230
Mn	1.60
Si	0.50
P	0.030
S	0.025
Nb	0.080
V	0.120
Mo	0.250
N_t	0.0150

Alternate alloy elements may be used but they shall be discussed with the user prior to delivery of the material. This table is not intended to represent the composition of any heat of steel, but merely to record the maximum permissible amounts of one element. The combination of elements of any heat must conform to the carbon equivalent, subsection 3.10.2.

For each heat the manufacturer shall analyse the following elements: C, Mn, Si, P, S, Nb, V, Cr, Mo, Ni and Cu.

The intentional addition of elements other than those specified is not permitted unless agreed upon by the Client.

In any case, for unintentional additions, the following limitations shall be respected:

$Ni \leq 0.30$ % $Co \leq 0.01$ % $Al \leq 0.07$ %

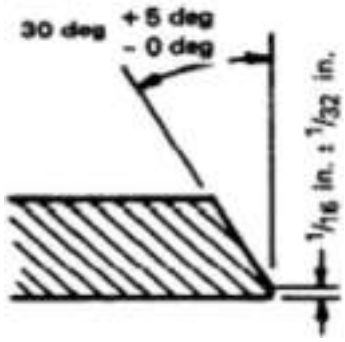
The content of N total (N_t) may be up to 0.0150 % and must be guaranteed by the manufacturer. If the manufacturer cannot give any guaranty of N content, he shall analys this element.

The total content for Nb + V will be limited to 0.150 %.

For each reduction of 0.01 % below the maximum carbon content, an increase of 0.05 % manganese above the specified maximum is permissible, up to a maximum of 1.70 %.

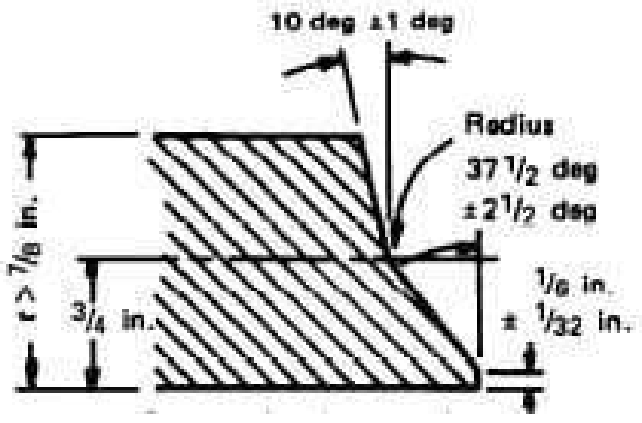
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FIG. 1



Fitting size 24" and smaller may be furnished with 37° ½ bevel at manufacturer's option. Recommended bevel for wall thickness (t) at end of fitting: 20 mm or less.

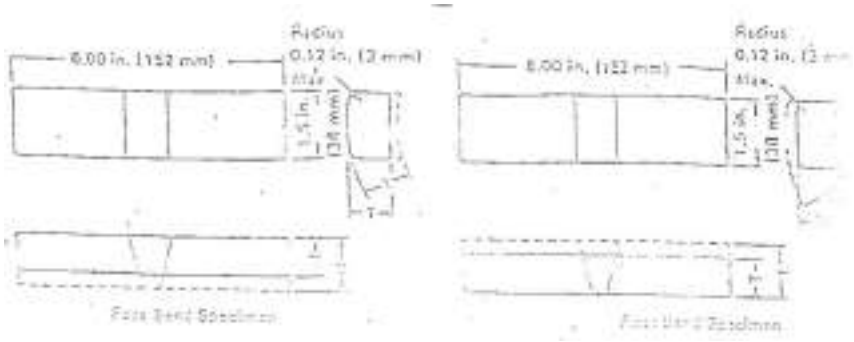
FIG. 2



Recommended bevel for wall thickness (t) at end of fitting, greater than 20 mm

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FIG. 3

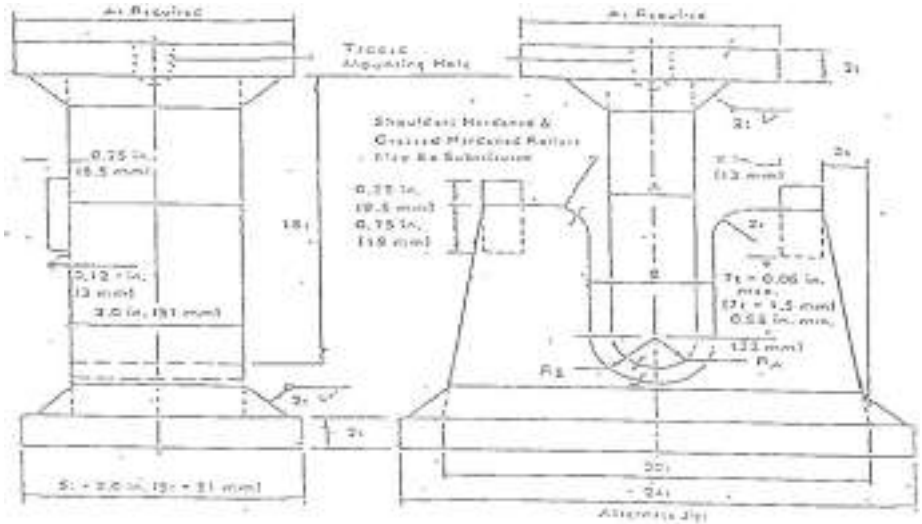


TRANSVERSE FACE AND ROOT BEND TEST SPECIMENS

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FIG 5

GUIDED-BEND TEST JIG DIMENSIONS



Radius of male member R A Radius of female member R B Width of male member, A Width of groove in female member, B	CLASS OF STEEL			
	Y52 and low-grade	**Y56**	**Y60**	**Y70**
	½A	½A	½A	½A
	½B	½B	½B	½B

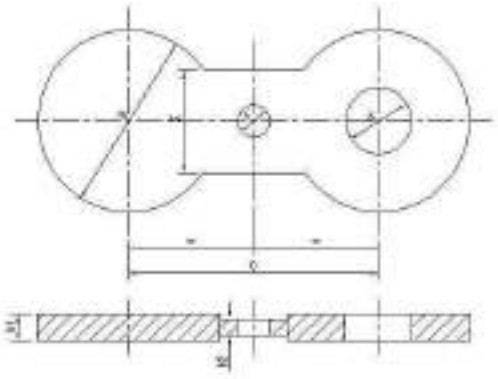
t = specimen thickness

The manufacturer shall use a jig based on this dimension, or a smaller dimension at his option.

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FIG. 6

SPECTACLE FLANGE



Size NB (inch)	Class 150							Class 300							Class 600						
	H	d	C	E	b1	b2	F	H	d	C	E	b1	b2	F	H	d	C	E	b1	b2	F
1/2"	41	16.0	48	28	8.5	4	16	51	16.0	67	38	8.5	4	16	51	16.0	67	38	8.5	4	16
3/4"	46	22.0	78	38	8.5	4	16	62	22.0	83	45	8.5	4	16	62	22.0	83	45	8.5	4	16
1"	63	28.5	79	35	8.5	4	16	78	30.5	88	40	8.5	4	16	70	28.5	89	48	8.5	8	16
1 1/4"	75	36.0	89	48	8.5	4	16	79	35.0	98	45	8.5	4	16	79	36.0	98	58	9.5	8	16
1 1/2"	82	41.5	98	58	8.5	4	16	90	41.5	114	55	8.5	4	22	90	41.5	114	55	9.5	8	25
2"	101	54.0	127	58	8.5	4	18	108	54.0	127	58	8.5	4	18	105	54.0	127	28	9.5	8	30
2 1/2"	120	66.5	143	58	9.5	4	18	127	66.5	140	55	8.5	4	22	127	63.0	143	28	12.5	8	25
3"	145	78.5	162	60	8.5	4	18	146	78.5	168	60	8.5	8	22	146	78.5	168	60	14.0	16	25
3 1/2"	158	90.0	178	48	8.5	4	18	165	92.0	184	45	8.5	8	22	159	90.0	184	45	15.0	16	25
4"	171	103.0	191	58	8.5	4	18	178	100.0	208	50	10.0	8	22	190	105.0	216	55	16.0	16	30
5"	195	133.5	216	58	8.5	8	22	213	133.5	238	60	12.5	8	22	238	136.0	267	78	22.5	16	25
6"	219	155.0	241	68	8.5	8	22	247	150.0	276	45	16.0	8	22	265	155.0	292	48	25.5	16	25
8"	276	204.0	298	78	12.5	8	22	305	200.0	335	55	19.0	16	22	317	203.0	348	58	32.0	24	25
10"	328	256.5	362	68	15.0	12	25	356	260.5	387	45	21.5	16	22	380	257.0	432	48	39.0	24	25
12"	408	305.0	432	78	17.5	12	28	419	305.0	462	50	24.5	16	22	434	306.0	488	48	44.5	28	25
14"	441	338.5	478	78	25.5	16	28	476	330.5	514	45	33.0	20	22	482	334.0	527	48	51.0	28	25
16"	505	387.5	548	78	25.5	16	28	538	387.5	572	50	36.5	22	22	583	387.5	600	58	57.0	48	25
18"	540	438.0	578	78	25.5	16	32	597	438.0	638	45	41.5	24	22	599	438.0	654	58	63.0	56	25
20"	557	489.0	638	88	28.5	16	32	648	489.0	686	50	44.5	24	22	679	488.0	724	68	70.0	64	25
22"	657	540.0	692	68	36.0	20	35	705	540.0	743	50	44.5	24	22	730	548.0	778	66	70.0	64	25
24"	708	588.5	748	78	36.0	20	35	756	590.5	810	60	54.0	48	22	787	594.5	838	58	82.0	48	25
26"	762	641.5	808	78	51.0	32	38	810	641.5	876	50	73.0	48	22	851	641.5	915	58	104.0	80	25
28"	838	693.0	864	68	51.0	32	38	865	692.0	948	60	73.0	68	22	941	693.0	965	55	101.0	80	25
30"	870	743.0	914	88	54.0	36	38	948	743.0	997	60	85.0	72	22	959	743.0	1022	68	110.0	96	25
32"	933	794.0	978	98	64.0	36	41	1003	794.0	1064	65	92.0	72	22	1110	794.0	1068	68	130.0	96	25
34"	978	844.5	1029	55	67.0	36	41	1044	844.5	1118	70	98.0	88	22	1080	844.5	1138	65	117.0	136	25
36"	1035	895.5	1086	68	67.0	36	41	1105	895.5	1188	55	98.0	88	22	1117	895.5	1194	68	134.0	136	25

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BHAGYANAGAR GAS LIMITED (BGL)

COMPOSITE WORKS PACKAGE (CIVIL, MECHANICAL, INSTRUMENTATION AND ELECTRICAL WORKS) OF MOTHER STATIONS IN HYDERABAD GA

INSULATING GASKET KIT

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1.0 INTRODUCTION

This Document (PTS - Particular Technical Specification for – Insulating Gaskets) lists the Specification for Manufacturing/Supplier of Insulating Gasket, for the project.

This present document covers the technical specification for the procurement of Insulating Gaskets used in high pressure natural gas transmission systems. It describes the general requirements, controls, tests, QA/QC examination and final acceptance criteria which need to be fulfilled.

2.0 DEFINITIONS

Client / Owner	Shall mean BHAGYANAGAR GAS LIMITED
Manufacturer	Means the Manufacturer of the Insulating Joint.
Laying Contractor / Contractor	The party which carries out all or part of Engineering, Procurement, Construction, Pre-commissioning & Commissioning of the project. It shall mean Laying Contractor/Contractor in the present context.
Third Party Inspection Agency (TPIA)	Means the Inspection Agency to be appointed by the contractor
Consultant / Owner Representative	**S**hall means BGL/PMC / The entity of the purchaser or the company nominated by the purchaser to design the natural gas transport or distribution system and to specify the equipment
PTS	Means the present <<Particular Technical Specification P.019141 G11077 M014 >>and its entire appendix, if any.

3.0 TECHNICAL SPECIFICATION

3.1 The material of insulating gasket kit shall be as follows:

i. Insulating Gaskets: It shall be machined glass reinforced epoxy (GRE) resin (G 10 or G11) with O-ring or spring energised seal made from rubber/PTFE.

ii. Insulating Washer: - Material shall be GRE.

iii. Insulating sleeve: - Material shall be GRE. Insulating length shall be two flange thickness including raised face, plus gasket, plus two insulating washers, plus one steel washer.

iv. Steel machine cut washer: - It shall be zinc plated steel.

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3.2 One Insulating Gasket kit shall consist of Two (2) nos. of Flange, Stud Bolts, one (1) no. central insulating gasket, one (1) no. insulating sleeve per bolt, two (2) nos. insulating washer per bolt and two (2) nos. metallic washer per bolt.

3.3 Manufacturer shall guarantee that Insulating Gasket shall with stand test pressure equal to 1.5 times design pressure of Pipeline.

3.4 The dimensions of the gaskets shall be suitable for WNRF flange as per ASME B 16.5

3.5 The minimum thickness of insulating gasket shall be 3 mm.

3.6 Insulating gaskets shall have bolt holes punched out.

3.7 Asbestos shall not be used.

3.8 The insulating gaskets shall match flanges (Weld neck raised face & Blind face) to ASME 16.5

3.9 Packing size of Insulating Gaskets Kit to be mentioned to ensure uniformity in delivery conditions of the material being procured. Bidder shall submit the packaging details during offer and also complied with at the time of delivery.

3.10 Following electrical properties:

- Dielectric Strength (min.) = 550 VPM
- Electrical Resistance = 25 Mega Ohm

(When tested with 500-1000V DC megger).

3.11 Each kit shall be clearly marked with the size, rating, material specification etc.

3.12 Inspection shall be carried out as per Technical Specification.

Owner Representative or Third-Party Inspection Agency appointed by Supplier shall carry out stage wise inspection during manufacturing / final inspection.

Vendor shall furnish all the material test certificates, proof of approval / licence from specified authority as per specified standard, if relevant, internal test / inspection reports as per Owner Tech. Spec. & specified code for 100% material, at the time of final inspection of each supply lot of material.

4.0 INSPECTION AND TESTING

The manufacturer shall perform all inspections and tests as per the requirements of this specification and the applicable codes at his works prior to shipment. Such inspections and tests shall be, but not be limited to the following:

4.1 All the insulating gasket assemblies shall be visually inspected.

4.2 Insulating flange assembly shall be hydrostatically tested to a pressure equal to 1.5 times design Pressure in following manner.

- 5 minutes at a hydrotest pressure.
- Reduce to Zero.
- Repeat the above procedure twice

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4.3 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 shallbe accepted.

4.4 Dimensional checks shall be carried out as per Approved Drawings.

4.5 Chemical composition and mechanical properties shall be checked as per relevant material standards and this specification, for each heat of material used.

4.6 Each insulating gasket 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.

4.7 The insulation resistance of each insulating gasket assembly shall be at least 25 mega ohms when checked with 500V - 1000V D.C. This test shall be carried out in dry conditions.

4.8 Each Insulating Gasket Assembly shall be Dielectric Tested before and after hydrostatic Test.

4.9 Purchaser reserves the right to perform stage wise inspection and witness tests as indicated above 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 Inspector. Inspections and tests performed/witnessed by the Inspector shall in no way relieve the Manufacturer of his obligation to perform the required inspection and tests.

For any control, test or examination required under the supervision of TPIA/Owner/Owner's representative, latter shall be informed in writing one (1) week in advance by vendor about inspection date and place along with production schedule.

Even after third party inspection, Owner reserves the right to select a sample of pipes randomly from each manufacturing batch & have these independently tested. Should the results of these tests fall outside the limits specified in Owner technical specification, then Owner reserves the right to reject all production supplied from the batch.

5.0 TEST CERTIFICATES

Manufacturer shall submit following certificates to laying Contractor /owner/Owner's representative:

a) Test certificates relevant to the chemical analysis and mechanical properties of the materials used for construction as per this specification and relevant standards.

b) Test reports as per QAP

c) Recorded and Certified Voltage and leakage

6.0 MARKING AND SHIPMENT

6.1 Marking

In addition to the marking required by the applicable standard, the following information shall be marked by cold stamping on the centering ring of each insulating gasket:

a. The MANUFACTURER's name and trademark
b. The diameter
c. The rating

6.2 Packing

The gaskets must be packed in sea-packing, which must be tight and meet the requirements of all stages of transport (rail, road, air, etc.).

7.0 DOCUMENTATION

Within two weeks of placement of order, the manufacturer shall submit two copies of the drawings, documents and specifications for approval.

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Once the approval has been given by Owner/Owner's Representative. Any change in design, material method of manufacture shall be notified to Owner/Owner's Representative whose approval in writing of all changes shall be obtained before the manufacturing.

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BHAGYANAGAR GAS LIMITED (BGL)

COMPOSITE WORKS PACKAGE (CIVIL, MECHANICAL, INSTRUMENTATION AND ELECTRICAL WORKS) OF MOTHER STATIONS IN HYDERABAD GA

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1.0 GENERAL

BHAGYANAGAR GAS LIMITED (BGL), (hereinafter referred as Owner), has been authorised by PNGRB for setting up infrastructure and operation of City Gas Distribution Network for Hyderabad GA. Natural gas will be transported to residential, commercial, industrial (PNG) and automobile consumers (CNG) in the city.

The present document covers the technical specifications for the procurement of "**SS Fittings**"

This document shall be read in conjunction with schedule of rate (SOR), Material Requisition (MR), specification, standards, drawings and other documents forming a part of the tender document.

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 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
Stainless Steel EN10088-3 – 1.4404+1D / (AISI 316L)

Forging : ASME SA-182-316 or DIN 4401 or BS:970- 316-S31
Stainless Steel EN10088-3 – 1.4404+1D / (AISI 316L)

Thread : NPT ANSI B 1.20.1/ NPT ASME B1.20.1

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:

4.1 Materials

4.1.1 Fittings shall be manufactured from the following materials:

i) Bar stock shall be as per BS: 970-316-S31, DIN 4401 or ASME 479-316 but with carbon content less than 0.05% to provide increased resistance to corrosion

ii) Forgings shall be as per BS: 970-316-S31, DIN 4401 or ASME SA- 182-316

4.1.2 The fittings end connections shall be compatible to tube of hardness ≤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

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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 pull up of the nut.

4.2.4 The threaded ends of fittings shall be NPT/METRIC as per ANSI B1.20.1/ NPT ASME B1.20.1

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 or as per assembly instruction mentioned under point 4.2.3. 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.

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 effect 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.

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

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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 as per ASTM F 1387 standard 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 remarks at 5000 Psig. No leakage should be detectable even after 25 remarks

iv) Impulse & vibration testing by "rotary beam method" for 5,00,000 impulse cycles and 20 million vibration cycles with no detectable leakage at full working pressure throughout till the end of the test

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 & TRAINING

Following test certificates shall be furnished along with shipment

- Test certificate of visual, chemical, mechanical testing (incl.tensile, hardness, flaring, Eddy current and leak test)
- Manufacturers standard test report for all items
- The test report for specified tests
- Third party inspection report as applicable to meet the requirements of specified codes & standards as applicable
- Vendor shall provide complete training to Owner on installation of Fittings at sites and other aspects like safety, operations & Maintenance, Repairing etc.

9.0 GUARANTEE

9.1 Manufacturer shall guarantee that the design, materials, manufacturing and testing of fittings comply with the requirement of this specification and applicable codes and standards. Manufacturer shall replace all the fittings which should result defective or fail during field pressure testing or fail to perform satisfactorily due to inadequate engineering, substandard material and workmanship at Manufacturer's end.

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9.2 The manufacturer shall guarantee against any defect, failure or malfunctioning occurring during 12 months from the date of commissioning or 24 months from the date of supply whichever is earlier.

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COMPOSITE WORKS PACKAGE (CIVIL, MECHANICAL, INSTRUMENTATION AND ELECTRICAL WORKS) OF MOTHER STATIONS IN HYDERABAD GA

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1. SCOPE

This specification completes the description shown on individual piping material classes and covers the technical requirements for the fabrication, inspection, and shipment of spiral-wound gaskets, and ring joints used for pipeline and piping flanges.

2. REFERENCE DOCUMENTS

ASME B 31.8	Gas Transmission and Distribution Piping System.
ASME B 16.20	Metallic Gaskets for Pipe Flanges - Ring-Joints, Spiral-Wound, and Jacketed.
ASME B 16.5	Steel Pipe Flanges and Flanged Fittings.
ASME B 16.47	Large Diameter Steel Flanges (NPS 26 through NPS 60).
ASTM F 36	Standard Specification for Test Method for Compressibility and Recovery of Gasket Materials.
EN 10204	Metallic products - Type of inspection documents.

3. DESCRIPTION OF THE MATERIALS

3.1. General

All gaskets shall conform to the codes/standards and specifications given in the requisition. Vendor shall strictly comply with Purchase Requisition stipulations and no deviations shall be permitted.

Process of manufacture, dimensions and tolerances not specified in requisition shall be in accordance with the requirements of the manufacturer's standards.

Asbestos containing gaskets are prohibited.

Materials, dimensions, tolerances and markings shall comply with ASME B 16.20.

3.2. Spiral Wound Gaskets

The gaskets shall be in accordance with the standard ASME B16.20 and their spiral-wound portion shall be made from type 316 stainless steel (or higher grade, depending on the relevant piping material specification) strip.

Filler material for spiral wound gaskets shall not have any colour or dye.

GRAPHITE based fillers shall incorporate an adequate corrosion inhibitor in order to prevent from possible galvanic corrosion.

All spiral wound gaskets shall be supplied with Outer ring& Inner ring irrespective of their class, rating & Size unless otherwise specified.

The gaskets shall have an external centering ring and an inner ring.

Inner compression ring material shall be same as winding material. The outer rings are made of either coated carbon steel or of stainless steel.

Spiral wound gasket as per ASME B16.20 shall match flanges to ASME B16.5 up to 24" (except 22"size) and to ASME B16.47 (Series A) for 22" and above 24" unless specifically mentioned otherwise.

3.3. Metal Ring Joint

Hardness of metallic RTJ gaskets shall not exceed the values specified below unless otherwise specified.

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Table 3-1: RTJ Hardness

Ring Gasket Material Maximum	Max. Hardness (BHN)
Soft Iron	90
Carbon steel	120
5Cr½ Mo	130
18/8 Stainless Steel	135

3.4. *Face finish of metallic RTJ gaskets shall be 32 to 63 AARH.*

Ring joints may be either oval or octagonal. The dimensions of ring joints shall be in accordance with the standard ASME B16.20, and shall be specified to match with the relevant flanges standard.

4. QUALITY CONTROL

The inspection and tests necessary to confirm that the products meet the requirements of the standards, specifications, and requisitions, shall be carried out in the MANUFACTURER's plant by personnel of the plant. These specially qualified personnel shall be independent of the production department of the plant.

Products shall be guaranteed by an inspection certificate (conformity, material, etc.) that must accompany the supply. If the Manufacturer does not have the necessary means of examination, these tests may be carried out by an Inspection agency and at a place approved by the Company.

All inspection and testing shall be carried out as per standard & the QAP provided elsewhere in the bid.

All items shall be inspected and approved by Approved Third party inspector or any other agency authorized by owner.

4.1. Testing

Test reports shall be supplied for all mandatory tests for gaskets as per the standards specified in the requisition and the QAP.

Chemical composition and hardness of RTJ gaskets shall also be furnished in the form of test reports on samples.

For Spiral wound material following shall be furnished:

Manufacturer's test certificate for filler material and spiral material as per the relevant material specifications.

Manufacturer's test certificate for raw materials and tests for compressibility/ seal-ability & recovery as per the relevant material specifications.

PMI shall be performed as per standard and QAP.

5. MANUFACTURER's DOSSIER / FINAL DOCUMENTATION

5.1. Certificate of conformity

The Manufacturer shall submit certificates of conformity to the standards specified by the requisitions for spiral-wound gaskets, and metal ring joints.

5.2. Material certificates

The Manufacturer shall submit material certificates in accordance with the requirements of the reference codes, standards and QAP.

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6. PREPARATION FOR SHIPMENT

6.1. Marking

6.2. Spiral-wound gaskets

In addition to the marking required by the standard ASME B16.20, the following information shall be marked by cold stamping on the centering ring of each spiral-wound gasket:

a. The MANUFACTURER's name and trademark
b. The diameter
c. The rating

6.3. Metal ring joints

In addition to the marking required by the standard ASME B16.20, the outside surface of each ring shall include the following information which shall be marked by cold stamping:

a. The MANUFACTURER's name and trademark
b. The diameter
c. The rating
d. The ring number, followed by the identifying reference of the material.

6.4. Color Coding

Spiral-wound gaskets shall be marked with a color code that identifies the windings and filler materials as per ASME B 16.20.

6.5. Protection

Ring joint gaskets other than those made of stainless steel shall be covered by grease impregnated protecting strips.

Small diameter gaskets shall be grouped in cardboard boxes or plastic pouches and large diameter gaskets in rigid packing cases.

6.6. Packing

The gaskets must be packed in sea-packing, which must be tight and meet the requirements of all stages of transport (rail, road, air, etc.).

The gaskets of different types and sizes shall be place in separate shipping containers.

Each container shall clearly mark with size, rating, material specification and item code.

Abbreviations:

AARH	:	Average Arithmetic Root Height
BHN	:	Brinnel Hardness Number
CS	:	Carbon Steel
MR	:	Material Requisition
PMI	:	Positive Material Identification
RTJ	:	Ring Type Joint
QAP	:	Quality Assurance Program

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BHAGYANAGAR GAS LIMITED (BGL)

COMPOSITE WORKS PACKAGE (CIVIL, MECHANICAL, INSTRUMENTATION AND ELECTRICAL WORKS) OF MOTHER STATIONS IN HYDERABAD GA

PTS – Thermoplastic Hoses

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1.0 GENERAL

BHAGYANAGAR GAS LIMITED (BGL), (hereinafter referred as Owner), has been authorised by PNGRB for setting up infrastructure and operation of City Gas Distribution Network for the Hyderabad GA. Natural gas will be transported to residential, commercial, industrial (PNG) and automobile consumers (CNG) in the city.

The present document covers the technical specifications for the procurement of "**Thermoplastic hose**"

This document shall be read in conjunction with schedule of rate (SOR), Material Requisition (MR), specification, standards, drawings and other documents forming a part of the tender document.

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 Conductive Core Thermoplastic Flexible Hoses as per relevant codes.

2.2 All codes & Standards for manufacturing, testing, inspection etc. shall be of latest edition.

3.0 CODES & STANDARDS

Sr. No.	Description
1	Hose Length: 3 meter with Breakaway coupling 3/8" ID HOSE Rated Pressure – 5000 PSI@ 70 Deg. F Min Hose end to end Connections: 3/8" OD Tube adaptor with nut & ferrule.
2	Breakaway coupling for 3/8" ID HOSE Material - SS316 Flow rate– 2000 SCFM

Hose should conform to NFPA 52, AGA1-93 and ANSI / CSA NGV 4.2-2014 / CSA 12.52-2014 and end connections shall conform to ASTM A276; ASTM A479, ASME SA479.

4.0 TECHNICAL SPECIFICATION

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

4.1 Materials

4.1.1 The core material shall be non-metallic, flexible in complete conformity with the relevant standard as mentioned above.

4.1.2 Electrical conductivity shall comply with AGA1-93

4.1.3 End connections shall be 316 stainless steel materials conforming to relevant design standard as specified above.

4.2 Design & Manufacture

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4.2.1 Hoses shall be designed in conformance with the requirements 52, AGA1-93 and ANSI / CSA NGV 4.2-2014 / CSA 12.52-2014 and other applicable codes and standards. Area classification applicable for all items shall be Class-1, Division-1, Group-D as per NEC or Zone-1 Group-HA/ HB as per IS/ IEC specification or equivalent specification. All fittings shall be designed so that all parts/ components meet the requirements for the specified area classification.

4.2.2 End connections shall be designed in conformance with the requirement of ASTM A276; ASTM A479, ASME SA479.

5.0 INSPECTION AND TESTING

The manufacturer shall submit typical type test reports for the following test carried out:

i) Hydrostatic test shall be carried out with de-ionized water. There shall be no detectable leakage at 1.5 times the rated pressure.

ii) Electrical conductivity test shall be carried out.

iii) Mechanical properties as a result of the test conducted

6.0 TEST REPORTS AND CERTIFICATES

6.1 The manufacturer shall supply material compliance certificates.

6.2 Mechanical properties test report

6.3 Hydrostatic test report

6.4 Electrical conductivity test report

6.5 Warranty certificate

7.0 MARKING, PACKING & SHIPMENT

7.1 Heat code traceability number shall be stamped or etched.

7.2 All the items shall be suitably wrapped and packaged to with stand rough handling during ocean shipment and inland journey

7.3 Item shall be properly tagged and package separately to facilitate easy identification.

7.4 Items shall be wrapped and packaged in such-a-way that they can be preserved in original as new condition.

7.5 Packing note shall carry easily identifiable name or code of the physical item

8.0 DOCUMENTATION & TRAINING

Following test certificates shall be furnished along with shipment

- Test certificate of visual, chemical, mechanical testing (incl.tensile, hardness, flaring, Eddy current and leak test)
- Manufacturers standard test report for all items
- Third party inspection report as applicable to meet the requirements of specified codes & standards as applicable
- Copy of regulatory compliance document/certification for similar product supplied earlier.
- Manufacturer Quality Control Plan and sampling plan.
- Technical descriptive catalogue of manufacturer.
- General arrangement/ assembly drawing showing all features.
- Sectional drawing showing major parts with reference number and material specification.

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- Prior to shipment, manufacturer shall submit one set of all the documents and test certificates as specified above. And one set of the same documents and certificates along with the material in addition to Manual for installation, erection, maintenance and operating instructions including a list of recommended spares.
- Vendor shall provide complete training to Owner on installation of Tubes at sites and other aspects like safety, operations & Maintenance, Repairing etc.

9.0 GUARANTEE

- Manufacturer shall guarantee that the design, materials, manufacturing and testing of Hose conform to the requirement of this specification. Manufacturer shall replace all Hoses free of costs which fail during field pressure testing or do not perform satisfactorily due to inadequate engineering, substandard material and poor workmanship at Manufacturer's end.
- The manufacturer shall guarantee against any defect, failure or malfunctioning occurring during 12 months from the date of commissioning or 24 months from the date of supply whichever is earlier.

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BHAGYANAGAR GAS LIMITED (BGL)

COMPOSITE WORKS PACKAGE (CIVIL, MECHANICAL, INSTRUMENTATION AND ELECTRICAL WORKS) OF MOTHER STATION IN HYDERABAD GA

SS TUBE LAYING & MECHANICAL WORKS

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1.0 GENERAL

BHAGYANAGAR GAS LIMITED (BGL), (hereinafter referred as Owner), has been authorised by PNGRB for setting up infrastructure and operation of City Gas Distribution Network for the GA of Haryana (Hyderabad districts). Natural gas will be transported to residential, commercial, industrial (PNG) and automobile consumers (CNG) in the city.

This document shall be read in conjunction with schedule of rate (SOR), specification, standards, drawings and other documents forming a part of the tender document.

2.0 OTHER TECHNICAL REQUIREMENTS

The Contractor shall carry out the work in accordance with Specifications, Standards and ASME B 31.3 - Process Piping / ASME B 31.8 – Gas Transmission and Distribution Piping System, Oil Industry Safety Directorate (OISD) norms.

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 contractor.

3.0 SCOPE OF WORK

The scope of work includes supply, transportation, erection / construction, testing, pre-commissioning & commissioning including final documentation for associated works.

It shall be the sole responsibility of the Contractor to interface all such works so as to make the total system operational, trouble free and satisfactory as intended to the Owner.

All such works which are not indicated here below but are otherwise required to complete the work in all respects in accordance with codes, specifications, drawings, operation & maintenance manual and other requirements shall also form part of Contractor's scope of work. All works described below shall be performed in accordance with the applicable codes, specifications, drawings and other requirements of Tender and shall be subject to review by the Owner/Owner's Representative.

This document includes the details of work tendered, detailed scope of work and scope of material supply for the execution of composite work of CNG refuelling stations.

The scope of work is broadly divided into the following.

- Scope of supply
- Laying/Shifting of minor equipments.
- Construction/Installation and Erection
- Testing, Pre- Commissioning & Commissioning.
- Project Management

3.1 Detailed Scope of Work

3.1.1 Tubing Work

3.1.1.1 Piping & Instrumentation Diagram (P&ID) for the CNG refueling stations, if required, to enable the Bidder to understand the various connection and details of tubing work involved may be handed over to successful bidder. The contractor shall carry out tubing works based on these drawings, reference specification / standards, documents etc. enclosed with this tender document and instruction of Owner / Owner's Representative and other provisions of Contract document.

3.1.1.2 The Contractor's Scope of Work for each CNG refueling station shall consist of but not limited to the following. Scope of Work indicated shall be read in conjunction with the schedule of rates, drawings, specification, standards and other documents forming a part of the Contract document.

3.1.1.3 Providing all equipment, manpower, machinery, consumables for fabrication, installation, inspection, testing and pre-commissioning and assistance during commissioning; all types of safety tools, tackles, devices and apparatus, equipment etc. including ladders and scaffolding etc. complete as required including providing of

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all types of consumables, tools, tackles and facilities for inspection and interpretation of testing results by Owner/Owner's Representative personnel.

3.1.1.4 The fronts for execution of work may not be available at one go and shall be released in batches. Contractor shall make available their team along with all tools, tackles and vehicle for movement at any time.

3.1.1.5 Furnishing and mobilizing at site(s) of all construction equipment, tools and tackles, fully equipped and fully manned with other required support facilities etc. needed for successful execution of the works within 15 days after receipt of written notice from the Owner.

3.1.1.6 Supply of all materials as indicated in scope of supply.

3.1.1.7 "Taking over" of existing facilities required to be modified/dismantling from the Owner and carrying out necessary modifications / dismantling works including handing over of dismantled items to Owner. Owner will ensure that the facilities handed over to Contractor are safe for carrying out dismantling / modification works.

3.1.1.8 The contractor shall obtain necessary approvals, hot/cold work permits, and safety permits from the owner prior to starting of any cutting / dismantling/modification works on existing facilities. The contractor shall obtain work permits from respective control room in charge for works on operational existing facilities.

3.1.1.9 Fabrication works including modification, cutting/dismantling of existing operating facilities and hook-up of facilities shall be executed in a manner to ensure complete safety of the operating system and operating personnel.

3.1.1.10 "Receiving and taking over" of Owner supplied free issue materials from the designated places of issue, transportation including loading, unloading, handling from Owner's designated places of issue to Contractor's own stock yard(s) / work site(s) / work shop(s) including arranging all necessary intermediate storage areas(s) there of as required till the permanent installation of materials.

3.1.1.11 Procurement and supply of all materials and equipment that are included in the scope of supply of Contractor, transportation of all materials/equipment from manufacturer's works including loading, unloading, handling, storing and transportation to work site(s) / work shop(s) including arranging all necessary intermediate storage area(s) there of, as required.

3.1.1.12 Fabrication and installation of all tubing systems including hook-up of tubing with compressors, stationary type cascades, mobile type cascade facilities, dispensers etc. consisting of fabrication and installation of tubes, valves, fittings, hose and hose coupling etc.

3.1.1.13 Carrying out cutting, edge preparation wherever required, fit-up, bending wherever required.

3.1.1.14 Supply, fabrication and erection of tubing supports including extension of existing sleepers/supports wherever required. Box Clamps as per DIN 3015 Part-II shall be used for clamping for SS Tubes. Contractors are required to get the clamp sample approved from Owner after award of work.

3.1.1.15 Testing, pre-commissioning and assistance during commissioning activities of tubing system of all sizes as per specifications enclosed.

3.1.1.16 Installation and commissioning assistance works of Compressors, Dispensers and Cascades (stationary as well as mobile).

3.1.1.17 Painting of all tray/tube supports and all miscellaneous items with paints suitable for normal corrosive environment shall be done wherever touch up/repair of primer is required, high build epoxy zinc phosphate primer shall be used.

3.1.1.18 Final clean up and restoration of site, facilities etc. as per the requirement of Owner / Owner's Representative.

3.1.1.19 Co-ordination as required with other Agencies/Contractor(s) till the time the commissioning operations and handling over the CNG stations are complete.

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3.1.1.20 Preparation of fabrication drawings, if required for the purpose of fabrication during execution of work.

3.1.1.21 Preparation of detailed procedures for fabrication, installation, testing and pre – commissioning. These procedures shall be submitted to Owner / Owner's Representative for review and approval.

3.1.1.22 Transportation of all surplus free issue material to Owner's designated store after completion of works.

3.1.1.23 Any other works not specified listed herein but required for satisfactory completion/ operation/safety/ statutory/ maintenance of the works in all respects within specified schedule at no extra cost to Owner.

4.0 SCOPE OF SUPPLY

4.1 Tubing

4.1.1 Contractors Scope of supply

The procurement and supply, in sequence and at the appropriate time and place, including inspection and expediting of all materials and consumables required for completion of the work as defined in this tender document except the materials specifically listed under para 4.1.1 as Owner free issue material, shall be entirely the Contractor's responsibility. The item rate quoted for the execution work shall be inclusive of supply of all these materials. All equipment, materials, components etc. shall be new and specifically purchased for this job from Owner approved vendors. Manufacturer's certificate shall be submitted for review. As a minimum, such materials to be supplied by the contractor shall include, but not limited to the following :-

4.1.1.1 All temporary materials required for filling, pressurizing and dewatering in connection with testing including tubes, flanges, fittings, gaskets, bolts, nuts, clamps, etc. required for fabrication of test headers and all consumable.

4.1.1.2 All equipment and consumables required for testing like pumps, compressors, pressure and temperature gauges, test water and corrosion inhibitors for test water for hydrostatic testing, inert gas for purging etc.

4.1.1.3 All consumable required for all types of test.

4.1.1.4 All materials including consumables required for hook-up.

4.1.1.5 All steel materials such as structural steel, reinforcement steel, shims, wedges, packing plates, pipes, perforated trays, nuts and bolts etc. for all types of supports and foundation. (pipes supplied by Owner shall not be used for fabrication of supports/saddles etc.). all nuts and bolts washers, Box Clamps as per DIN 3015 Part 2, clips etc. as required for fabrication of support and other structural works. Tube/tray supports like MS plates, GI plates, flats, pipe etc.

4.1.1.6 Clamping of perforated trays/tubes with necessary accessories like bolts, supports etc., all bolts and nuts for supports, Box Clamps as per DIN 3015 Part 2 for tubes, anchor bolts of various sizes for fixing to concrete structure etc.

4.1.1.7 All types of painting materials including primers, paints, solvents, sand blasting materials, cleaning agents, compressed air etc.

4.1.1.8 Nitrogen for purging of tubing.

4.1.1.9 All materials required for grouting and concrete works etc.

4.1.1.10 All safety tools and tackles, devices, apparatus, equipment, etc. including ladders and scaffolding etc. complete as required.

4.1.1.11 Supply of 250 X 50mm wide MS galvanized perforated tray along with coupler plate (with nuts and bolts for above trays). All materials, equipment and manpower required during commissioning of tubing system.

4.1.1.12 Supply of SS-304 tubing for Air Line of ½" OD, 1.5 mm thk. along with required fittings and valves as per specifications enclosed.

4.1.1.13 Any other material not specifically listed herein, but required for the successful completion of the work.

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4.1.2 Storage of Materials

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

4.1.2.2 The contractor shall duly protect all materials for corrosion with appropriate preservatives like primer, lacquer, coating, grease etc.

4.1.2.3 Tubes shall be stacked according to the identification marks and stacks shall be arranged on sleepers / sand bags /racks at least 300 mm above ground.

4.1.2.4 The contractor shall check that valves, fittings etc are not subjected to corrosion from hydrostatic test water remaining in the tubing. Any such condition when detected should be brought to the notice of Owner / Owner's Representative and remedial measures taken as directed. Small and medium size tube fittings shall be stored in racks constructed for this purpose inside a covered godown.

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

4.1.2.6 As far as possible materials shall be transported to the site of erection only just prior to the actual erection and shall not be left around indefinitely. Instruction of Owner / Owner's Representative shall be followed strictly in this regard.

4.1.3 Laying, Testing & Commissioning of SS tubing

4.1.3.1 SS Tubes shall be clamped to the angles, trays at every 1500 mm using Box Clamps as per DIN 3015 Part-2. The practice of flattening tubes for clamping purpose is not allowed. In case of PVC covered tubes, any exposed portion and connection shall be neatly taped to appropriate thickness.

4.1.3.2 Perforated trays/angle shall be properly supported at a regular interval of max. 1500mm, wherever insert plates are not available, supports on concrete shall be fixed with a minimum of 10mm expansion bolts (Anchor fasteners). Trays shall be laid generally as per site conditions with the approval of Owner / Owner's Representative. Angle supports shall be fabricated from 50 mm x 50 mm x 6mm MS angles as minimum with a base plate of 200mmx 200mm x 6mm thk.

4.1.3.3 Modification and rectification of cascades and emergency modification work at stations like addition of new equipment in the existing set up shall also be included in the scope of Contractor. The rate indicated per meter shall be applicable.

4.1.3.4 Horizontal and vertical tubes shall be installed using levels and plumb bobs.

4.1.3.5 Tubes shall be bent using tube benders only and no hot bending is permitted.

4.1.3.6 Tubes shall be cut using pipe cutting devices. Hot cutting is not allowed.

4.1.3.7 Minor civil works like chipping of pavement and grouting on its pavements the supports and chipping and reinstating of the pavement, removal of sand from tube/pipe trenches etc.

5.0 CONSTRUCTION/INSTALLATION AND ERECTION

Work tendered as a part of this tender document pertains to works related to CNG refueling stations in geographical area.

5.1 Work Tendered

5.1.1 Work tendered shall consist of the following:-

5.1.1.1 Laying, Installation, testing and commissioning of SS tubes, fittings, valves and hoses complete with all supports.

5.1.1.2 Loading of various equipment from designated place(s) of issue, safe transportation, unloading at various stations in specified locations, but some of these equipment will have to be unloaded on ground at specified locations like from ground level to ground level at site, from ground level to 4.5 m ht., from ground level to 6.0 m ht., from ground level to 8.0 m ht., from 4.5 m ht. to ground level, from 6.0 m ht. to ground level and from 8.0 m ht. to ground level, but some of the units such as cascades of 3000WL/4500WL (water capacity) weight 6.5T/8.0T having 5.5 M X 1.75M X 1.6M (H) approx.. dimensions may have to be erected on the roof top at 4.5m, 6.0 m and 8.0 m elevation above workshop / office area. In some cases only

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unloading of cascades shall have to be done at stores / sites. Any damage/lost/theft of owner issued materials during transportation from owner designated place to site/destination is responsibility of contractors. Contractors are required to take transit insurance/CAR policy as per requirement. Cost of purchasing of this policies shall be borne by the contractor.

5.1.1.3 The contractor shall be paid on SOR basis. Contractor shall execute the work and perform his obligations under the Contract and Owner shall pay the contractor for the measured quantity of each item of work actually carried out under the Contract.

5.1.1.4 Installation of all associated SS tubing for necessary hook-ups and modification / dismantling works wherever required.

5.1.1.5 Installation of Fittings etc. for necessary hook-up and modification works.

5.1.1.6 All associated and other mechanical works including works related to testing, commissioning assistance for SS tubing.

5.1.2 Loading, Unloading, Transportation & Erection of equipment

Following shall also constitute the Contractor's scope of work but not limited to as given herein:

5.1.2.1 Unloading of material at store/site.

5.1.2.2 Receiving of materials from store/site.

5.1.2.3 Loading of material / equipment (like AVR, UPS, Battery etc.) on a trailer / truck from stores / site. (Equipment with weight up to 200 Kg, Equipment with weight range from 200 Kg to 500 Kg)

5.1.2.4 Safe transportation to various sites.

5.1.2.5 Unloading, placement and alignment of foundation on ground above ground +4.5 / 8.0 m at roof top (Cascade only).

5.1.2.6 Installing new base frame for dispenser, making holes by drill, providing anchor fastener, grouting etc., complete as per the direction of Owner / Owner's Representative.

5.1.2.7 Isolation and dismantling of existing equipment from foundation and shifting to ground as per direction of Owner / Owner's Representative.

5.1.2.8 All equipment transported shall be securely boarded and transported without causing any damage to equipment. Any damage caused during loading, transportation & unloading shall be recoverable from the contractor.

5.1.2.9 Dismantling of SS tubes along with all accessories (all sizes).

5.1.3 Installation procedure

5.1.3.1 Tube end preparation

Cut the ends square with a hacksaw and a suitable guide. Tube cutters shall be suitable for cutting most tube materials but tend to work harden stainless steel.

Burrs must be removed inside and outside for proper entry into fittings to prevent contamination and/or restricted flow. Preferably swagelock deburring tool shall be used.

Remove all fittings, chips and grift before attachment of fittings.

5.1.3.2 Assembly

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.

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 imperfection that may exist on the outside tube surface.

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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.

Always turn the nut in prescribed amount regardless of torque required. Fitting end plugs required only 1-1/4 turn from finger tight make up in all sizes.

5.1.3.3 Remake of fittings

A disassembles 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 previous marks lining up. (A noticeable increase in mechanical resistance will be felt indicating the ferrule is being re-sprung into sealing position). Then swing the nut 1/12 turn (1/2 hex flat) past the original position.

6.0 TESTING, PRE- COMMISSIONING & COMMISSIONING

All expenses and cost for attending Tests/Inspections related to construction, bought out items etc. at laboratory or at vendors place for Owner/Owner's Representative shall be borne by the Contractor.

All work related to testing, acid cleaning, drying, pre-commissioning and commissioning of complete system shall be carried out as per specification and instruction of Owner/Owner's Representative.

Pre-Commissioning of complete system and commissioning with Nitrogen.

Assistance in Commissioning of complete system (with Compressors, Cascades and Dispensers) at operating pressure, including supply of materials (temporary, permanent or consumables), tools and tackles (including special tools & tackles) and manpower.

Contractor shall assist in commissioning the complete system. The system shall be tested with CNG in steps of 50 bar till a final pressure of 250 bar is achieved. At each increment of 50 bar, tubing shall be checked for any leakage. Contractor to supply manpower and equipment for the testing of the system. The testing may be delayed due to commissioning of the compressor, the contractor availability is required during the entire commissioning process of the station.

7.0 PROJECT MANAGEMENT

Planning, Scheduling and Monitoring of the entire project related activities.

Preparation of detailed project schedule and progress reports. Providing organization chart at construction site.

All necessary coordination and compliances as per general permissions from the authorities having jurisdiction during actual execution of work. Owner will provide general permission from authorities for construction at contractor's cost.

Co-ordinate all activities from concept to successful commissioning, with his own sub-contractors, site-workers, vendors, suppliers, Owner/Owner's Representative and Government agencies for specific clearances and approvals. Co-ordination and supervising the work of all sub-contractor(s), if any.

Quality Control of all the activities.

Attending Project Progress review meetings as per the requirements of the Owner.

8.0 SAFETY

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

Contractor shall obtain the work permit from concerned control room / authority to carry out the work at running CNG station.

Any accident causing injury to any person or damage to property or equipment shall be reported to the Owner / Owner's Representative.

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When the Owner / Owner's Representative determines that the work is being performed by the contractor in an unsafe manner, he may suspend the work until the contractor takes corrective action.

The contractor shall provide helmets and safety shoes to the workers. No worker shall be allowed without the minimum personnel protective equipments (PPE's) and safety appliances.

9.0 DOCUMENTATION

Preparation of As-built drawings / documents

Pipe books

Measurement sheets

Hydrostatic Test Reports / records

Inspection Reports

Vendor documents / records

Reconciliation statement

Project Records

Organization chart

Photographs

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ANNEXURE – I

1. EQUIPMENT WEIGHT & SIZES

Sl. No.	Equipment	Size	Weight (Approx.)
1	Cascades 3000WL/4500WL	5.5 M X 1.75M X 1.6M (H) approx.)	6.5T / 8.0T
2	Car Dispenser	-	350 Kg
3	Bus Dispenser	-	300 Kg

2. TOOL AND TACKLES REQUIRED

Sl. No.	Description	Qty in Nos.
1	Tube Bender (all sizes)	2
2	Tube Deburring Tool (Swagelok / Parker)	2
3	Tube Cutting Guide (Swagelok / Parker)	2
4	Cutting blade of 25 TPI	Lot
5	Welding Machine with DG sets	1
6	Tube Cuter (Approved Make)	2
7	Gap inspection gauges (Approved Make)	2
8	Vehicle (car / jeep) dedicated	1

The Contractor to confirm the availability of the above for acceptance of the bid.

In addition, the contractor to employ only Approved make certified fitters to carryout the tubing wok.

3. SCRAP AND EXCESS MATERIAL

Every month the Contractor shall submit an account for all the materials issued to him by the Owner in the standard Performa prescribed for this purpose by the Owner / Owner's Representative.

On completion of the work, the contractor shall submit material reconciliation statements for all the materials issued by the Owner in the standards Performa. The following scrap allowances are permissible:

Item	Unaccountable	Scrap
Tube	1%	1% (Less than 0.3m)
Valves	0%	0%
Ferrule Fittings	0%	0%

All excess materials and scrap shall be returned after duly accounting for, to the Owner's stores. Where materials are to be weighed before return, the contractor shall be responsible for making necessary arrangements for weighing etc. The contractor shall not use scrap sections obtained during the course of construction for fabrication of temporary supports or other items without prior written permission of Owner / Owner's Representative.

If the contractor fails to return the surplus material aforesaid, the Owner will charge the contractor for such unreturned material at penal rates, which will be deducted from whatever amount is due to the contractor. In case any materials issued by the Owner deteriorates during storage by the contractor, new materials will be issued to him if available at penal rates, but delay in procuring such materials will be at the contractor's account only.

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	PTS – STEEL FASTNERS	**P.019141** **G11077** **M016**

BHAGYANAGAR GAS LIMITED (BGL)

COMPOSITE WORKS PACKAGE (CIVIL, MECHANICAL, INSTRUMENTATION AND ELECTRICAL WORKS) OF MOTHER STATIONS IN HYDERABAD GA

STEEL FASTNERS

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	PTS – STEEL FASTNERS	P.019141 G11077 M016

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1. GENERAL

The process of manufacture, heat treatment, chemical & mechanical requirements and marking for all stud bolts, m/c bolts, Jack screws & nuts shall be in accordance with the codes/standards and specifications given in the requisition. The applicable identification symbol in accordance with the material specification shall be stamped on each bolt and nut. Vendor shall strictly comply with this specification & QAP and no deviations shall be permitted.

2. 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.

ASME B31.8	:	Gas Transmission and Distribution Piping Systems.
ASME B1.1	:	Unified Inch Screw Threads (UN and UNR Thread Form)
ASMEB16.5	:	Pipe Flanges and Flanged Fittings NPS ½" Through NPS 24 Metric/Inch Standard
ASME B18.2.1	:	Square and Hexagonal Bolts and Screws (Inch Series)
ASME B18.2.2	:	Square and Hexagonal Nuts (Inch Series)
ASTM A193	:	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
ASTM A194	:	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Temperature or High Pressure Service, or Both.
ASTM A307	:	Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
ASTM A320	:	Standard Specification for Alloy-Steel and SS Bolting Materials for Low-Temperature service.
ASME 18.2.1	:	Square and Hex Bolts and Screws (Inch Series)
ASME 18.2.2	:	Square and Hex Nuts (Inch Series)

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ASME B16.5 : Pipe Flanges and Flanged Fittings up to 24”

ASME B16.47 : Large Diameter Steel Flanges (NPS 26 through NPS 60)

3. SPECIFIC REQUIREMNT

3.1. All bolting shall be as per ANSI B 18.2.1 for studs, M/c bolts and jackscrews and ANSI B18.2.2 for nuts and material.

3.2. Material of Stud Bolts shall be ASTM 320 Gr. L7

3.3. Material of Nuts shall be ASTM 194 Gr. 4 /Gr. 7

3.4. Threads shall be unified (UNC for 1" dia. and 8UN for > 1" dia.) as per ANSI B1.1 with class 2A fit for studs, M/c bolts and jackscrews and class 2B fit for nuts.

3.5. Stud bolts shall be threaded full length with two heavy hexagonal nuts. Length tolerance shall be in accordance with the requirement of table D2 of Annexure-D of ANSI B 16.5.

3.6. The nuts shall be double chamfered, semi-finished, heavy hexagonal type and shall be made by the hot forged process and stamped as per respective material specification.

3.7. Heads of jackscrews and m/c bolts shall be heavy hexagonal type. Jackscrew end shall be rounded.

3.8. Each size of studs & m/c bolts with nuts and jackscrews shall be supplied in separate containers marked with size and material specifications.

3.9. All items shall be inspected and approved (stage wise) by TPIA.

3.10. The heat treatment for stud bolts & nuts shall be as per code unless mentioned otherwise.

3.11. All austenitic stainless steel bolts, nuts, screws shall be supplied in solution annealed condition unless specified otherwise in the material specification.

3.12. Any additional requirements specified in the requisition shall be fully complied with.

3.13. When specified as galvanized, the studs, M/C bolts and nuts shall be 'hot dip zinc coated’ in accordance with requirements of ‘Class C’ of ‘ASTM A153’. As an alternative, electro-galvanizing as per IS 1573, ‘Service Grade Number 2’ is also acceptable.

3.14. All Stud Bolts of Bolt diameter size 1" and above shall be provided with three nuts irrespective of whatever has been specified elsewhere in the MR.

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3.15. Each stud bolt shall be supplied with matching two nuts and two washers

3.16. Bolts/Nuts shall be protected by non-corrosive oil or grease before dispatch to prevent rusting.

4. TESTING

4.1. Test reports shall be supplied for all mandatory tests as per the relevant material specifications.

4.2. Material test certificate shall also be furnished. (Heat Analysis, Product Analysis and Mechanical Requirement)

4.3. PMI shall be performed as per the scope and procedures defined in the Specification for PMI at Vendor's Works.

4.4. Stress Rupture Test as detailed in ASTM A453 shall be carried out for all ASTM A453 bolting material irrespective of the temperature.

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PIPELINE VALVES

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ANNEX I : LOFC (LIST OF OPERATIONS OF FABRICATIONS AND CONTROLS)

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1. SCOPE

This General Technical Specification covers the supply of pipeline valves used in high pressure natural gas transport and distribution systems. It describes the general requirements, controls, tests, QA/QC, examination and final acceptance criteria which needs to be fulfilled.

This specification is general and is updated / amended by the Particular Technical Specification dedicated to the project.

2. DEFINITIONS

Engineer : The Entity of the Purchaser or the Company nominated by the Purchaser to design the natural gas transport or distribution system and to specify the equipment.

Purchaser : The Company which makes the purchase order.

Control Authority or **CA** : The Organisation put in place/requested by the Purchaser/Engineer to proceed to Quality Controls and Certification.

Manufacturer : Manufacturer who receive the purchase order

3. PRELIMINARY STATEMENT

The name of Control Organisation shall be mentioned in the purchase order.

Eventual interpretations and deviations to this specification by the Manufacturer shall be requested by writing in his offer with detailed justification and approved by the Purchaser/Engineer and the Control Authority before the eventual order to the Manufacturer. The latter is responsible and shall indemnify the Purchaser/Engineer for any damage resulting from the non-respect of this obligation.

The specifications of the steel used, the material Manufacturer and all potential subcontractors (such as forging plant, heat treatment, weld fabrication, …) will be described in the offer. After order, no change will be accepted except for justified "force majeure". In that case, the asked changes shall be supported by a technical file submitted to the Purchaser/Engineer for approval.

The Manufacturer shall provide a technical description of the manufacturing method that might influence the quality of the material.

When the order is placed, the Manufacturer shall promptly inform the Purchaser/Engineer about his subcontractor's names, addresses, phone numbers as well as sub-order numbers, extent and delivery terms. On this basis, the Manufacturer shall send a general planning including at least the raw material supply, the manufacturing stages (machining, welding, part assembly, …), testing , painting and packing/dispatching. This planning shall be updated by the Manufacturer at least every month unless otherwise provided in the purchase order. A Dispatcher/Inspector

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delegated by the Purchaser is entitled to follow, examine and verify the planning's' relevance and effectiveness.

The Purchaser keeps the right to audit the Manufacturers and subcontractor's manufacturing process and control methods. All costs form such an audit shall be borne by the Manufacturer except the wages and travel expenditures of the auditor(s) supported by the Purchaser.

The manufacturing processes and the laboratories, in which welding tests, destructive and non destructive tests are carried out, shall be approved by the Control Authority.

The Purchaser/Engineer and the Control Authority shall have, at any time, free access to all parts of the Manufacturer's facilities and to those of all his subcontractors involved in the order manufacturing. All reasonable means shall be placed at the inspector(s)'s disposal to enable him to check that the product is being manufactured in accordance with this specification. All tests and inspections required in this specification shall be carried out, prior to shipment, in the Manufacturer's plant (or subcontractor's plant) and at the Manufacturer's expenses, unless otherwise provided in the order. The Purchaser/Engineer and the Control Authority shall try not to interfere unnecessarily with other Manufacturer's works when running these tests and inspection.

A valid copy of the ISO 9001 certificate shall be included in the offer.

For any control, test or examination required under the supervision of the Control Authority (LOFC intervention points included), the latter shall be informed in writing FIFTEEN (15) working days in advance by the Manufacturer about place and time with a copy to the Purchaser/Engineer.

If manufacturing is to be carried out under LOFC concept, the Manufacturer shall send for approval a List of Operation in Manufacturing and Control to the Control Authority and Purchaser/Engineer, TEN (10) working days before manufacturing. This list shall be in conformity with the annex 1 to this document. Before starting any manufacturing, the Manufacturer shall be in possession of this approved document, filled in with all intervention points.

Material, even released by the Control Authority and in which injurious defects are found after delivery, shall be rejected. The Manufacturer shall be notified and the material replaced : all costs involved, including wages and travel expenditure of the Control Authority's representative, Purchaser and Engineer shall be borne by the Manufacturer.

An approval of documents can never be considered as an acceptance of deviations on relaxations to requirements. A deviation is only possible after specific request to the purchaser.

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4. GENERAL

- Valves are intended to be used in aboveground or underground, with cathodic protection services.

  All particular conditions for each valve are described in attached data sheet and valve list.

  All valves shall conform to API 6D spec. Whenever this specification and API 6D spec. conflict, this specification shall prevail.

  Unless otherwise specified, pipeline valves covered by this specification are suitable for use in gas transmission and distribution systems, and in accordance with ASME B31.8.

5. CODES, NORMS AND STANDARDS

Latest edition of following standards are applicable.

- ASME STANDARDS

ASME B16.5	Pipe flanges and flanged fittings
ASME B16.34	Valves- flanged and butt welding end
ASME B31.8	Gas transmission and distribution piping systems

- ASTM STANDARDS

ASTM A 53	Pipe, steel, black and hot-dipped zinc coated welded and seamless
ASTM A 105/A 105 M	Forgings, carbon steel, for piping components
ASTM A 106	Seamless carbon steel pipe for high temperature service
ASTM A 193/A 193 M	Alloy steel and stainless steel bolting materials for high temperature service
ASTM A 194/A 194 M	Carbon and alloy steel nuts for bolts for high temperature service
ASTM A 234/A 234 M	Piping, fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures
ASTM A 320/A 320 M	Alloy steel bolting materials for low temperature service

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ASTM A 333	Seamless & Steel Pipes for low temperature service
ASTM A 350/A 350 M	Forgings, carbon and low alloy steel, requiring notch toughness testing for piping components
ASTM A 370	Mechanical testing of steel products
ASTM A 381	Metal-arc-welded steel pipe for use with high-pressure transmission systems
ASTM A 420/A 420 M	Piping fittings of wrought carbon steel and alloy steel for low temperature service
ASTM A 694/A 694 M	Forgings, carbon and alloy steel, for pipe flanges, fittings, valves, and parts for high-pressure transmission service
ASTM A 707/A 707 M	Flanges, forged, carbon and alloy steel for low temperature service

- API STANDARDS

API 5L	Specification for line pipe
API 6D	Specification for pipeline valves, end closures, connectors and swivels
API 6FA	Fire test for valves
API 605	Large diameter carbon steel flanges

- MSS STANDARDS

MSS SP 6	Standard Finishes for Contact Faces of Pipe Flanges & Connecting – End Flanges of Valves and Fittings
MSS SP 25	Standard marking system for valves, fittings, flanges and unions
MSS SP 44	Steel pipeline flanges
MSS SP 54	Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components Radiographic Examination Method
MSS SP 55	Quality standard for steel castings for valves, flanges and fittings and other piping components (visual method)

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MSS SP 72	Ball valves with flanged or butt welding ends for general service
MSS SP 75	Specification for high test wrought butt welding fittings

- ASME STANDARDS

ASME	Boiler and Pressure Vessel code

- EN STANDARDS

EN 10204	Metallic products : types of inspection documents
EN 10045/1	Metallic products : Charpy impact test – test methods (V and U notches)

- ISO STANDARDS

ISO 148	Acier – Essai de résilience Charpy (entaille V)
ISO 9001 :	Quality management standard

- BRITISH STANDARDS

BS 5146	Inspection and test of valves
BS 5351	Steel ball valves for the petroleum, petrochemical and allied industries

- NACE STANDARDS

MR0175	Sulphide Stress Cracking Resistant Metallic Materials for Oilfield Equipment.

6. DESIGN AND CONSTRUCTION

6.1. RATINGS

1) The pressure temperature ratings of flanged and butt welding end valves shall be in accordance with ASME B16.34.

2) The temperature and pressure ranges of valves shall be in accordance with the indicated values on the appropriated piping specification and valve data sheet.

3) Wall thickness for parts used for the welding connection with the line pipes shall meet the following requirements :

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- The maximum allowable stress in the material of the butt weld connection for butt welding end valves shall be equal to fifty per cent of the minimum yield strength guaranteed by the specification of the steel used.

- The minimum wall thickness for butt welding connection must be greater than or equal to the largest value of either the calculated minimum thickness of butt welding connection or the nominal thickness of the pipe as indicated on data sheet.

- If the butt welding connection has a yield strength lower than the yield strength of the pipe to which it is intended to be welded, the wall thickness in each zone of the butt welding connection is at least equal to the specified pipe wall thickness times the ratio of the minimum yield strength guaranteed by the specification of the steel of the pipe and the minimum yield strength guaranteed by the specification of the steel of the butt welding connection.

- The specified pipe wall thickness and grade (with reference to the equivalent grade in API 5L spec. or ASTM spec.) with which the valve is intended to be used is specified in the data sheet/piping class.

4) The Manufacturer shall submit for approval to the Control Authority and to the Purchaser/Engineer the dimensional drawings, the calculation of the parts used for the welding connection to the pipeline and the material part list for all the types of valves. All these documents must be identified with the individual valve number according to attached valve list and shall be attached to the CMTR.

5) The design shall take into consideration performance requirements prescribed in the next paragraph.

   All valves under this specification shall be designed to withstand a field hydrostatic test pressure with non corrosive water, after installation, during 24 hours when the gate, plug, ball or piston is partially or fully open at a pressure of 1.5 times the 38°C pressure rating gauged by ASME B16.34

   During this test the closure element shall not be moved.

6.2. DESIGN

6.2.1. Face-to-face and end-to-end dimensions

Face-to-face and end-to-end dimensions for ball valves shall be in accordance with API spec. 6D.

Valves may be made to special dimension by agreement between the Manufacturer and the Purchaser.

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6.2.2. Welding ends

The connecting pipe outside diameter, wall thickness, specified minimum yield strength and material grade are mentioned in the relevant piping specification and valve data sheet.

Butt-welding ends shall be in accordance with figure 1 for wall thickness up to 20.0 mm; for thicker walls, refer to figure 2. The inside diameter at the welding end shall be equal to that of the pipe on which the valve shall be welded. If a welding end of a valve has a thickness not equal to the pipe with which it is intended to be used, the welding end preparation at the joint has to be in conformity with fig. 3.

The tolerance of the inside diameter at the bevel end shall be following :

NPS	Tolerance of inside diameter at bevel end (1) (mm)	
2" - 10"	+ 1.6	-0.4
12" - 48"	+ 2.4	-0.8

(1) Tolerance refers to variation from specified ID calculation by (OD spec. - 2t spec).
OD = outside diameter
t = wall thickness

The out-of roundness at a welding end, defined as the difference between the maximum and the minimum inside diameter at the welding pipe end shall not exceed 1% of the specified inside diameter.

The length of the butt end shall be sufficient to allow welding and heat treatment without damage of the internal parts of the valve. If Purchaser/Engineer accepts design which do not meet this requirement, than Manufacturer shall inform the Purchaser/Engineer about the precautions which needs to be fulfilled in order to guarantee that during welding of the butt welding ends no damage shall occur to the seat. These precautions shall be highlighted by the Manufacturer in the erection and installation instruction book.

6.2.3. End flanges

End flanges shall be furnished in the same class as the valve body with raised face or ring-joint face, as specified by the valve data sheet. Dimensions and tolerances (including drilling templates, flange facing, spot facing and back facing) shall conform to :

- ASME B16.5 standard for NPS 24" and smaller
- MSS SP-44 for NPS 26" to 60"
- MSS SP-6 for flange facing.

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6.2.4. Design features

All ball valves shall be full bore - to allow pigging - unless stipulated otherwise on the valve data sheet.

All trunnion mounted ball valves shall be fitted with following devices :

- Double block and bleed : design of a valve with two seating surfaces between which the cavity can be vented through a bleed connection and thus confirm the tightness of the valve, at least in closed position, when pressure is applied to any side or both sides of the valve.

- Double piston effect : when the pressure is applied to one side, let us say "upstream" side, and when upstream ball seat is leaking, transfer pressure shall have a positive shut-off effect on the downstream seat (acting, for instance, on the back face of this seat) and thus reinforcing the global tightness of the valve.

- Anti -static design : all ball valves shall be fitted with anti-static device conforming to BS 5351.

- Stem retention (anti blow-out) : In conformity with BS 5351 valve shall be designed with an anti blow-out stem so that the stem cannot be fully ejected by pressure inside the valve with the stem packing, gland retainer bolting removed.

- Secondary seat and stem sealing : all ball valves NPS 6" shall be fitted with a secondary stem sealing and all ball valves greater or equal to NPS 8" shall be fitted with a secondary seat and stem sealing. This system permits an injection of sealant and shall be fitted with an integral check valve. The number and the location of sealing points shall be on the Manufacturer's responsibility.

  Purchaser is allowed to request the check of this system design and its operation, specially for modified or new valve model.

- A drain connection shall be located at the lowest part of the body cavity.

6.2.5. Auxiliary connections

The Manufacturer shall complete the valve data sheet with the size and allowable pressure for the following auxiliary piping connections.

a) Aboveground valves

   - The drain shall be plugged.

   - The vent/bleed connection for valves NPS 6" and above shall be equipped with one block valve plus one needle valve, each with anti blow-out stem. The block valve shall be of ball type. The needle valve shall have screwed connections, shall be preferably of angular pattern and shall be fitted with a special plug at the outlet : this plug shall be designed to relieve slowly the pressure without being ejected.

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- For valve size < NPS 6", the vent/bleed connection shall be equipped with this anti blow-out, depressurising plug only.

- Each secondary stem - and each secondary seat sealing device, when required (see § 6.2.4.), shall be fitted with a check valve integrated in the body plus a sealant fitting with built-in, spring loaded ball check valve, as mentioned in the valve data sheet.

b) Underground valves

- Vent/bleed connection shall be plugged and this functionality is by passed through the drain.

- Drain shall be fitted with a normally open block valve (ball type with anti blow-out stem) at the drain tap, piped to the upper part of the extension and ended by one ball valve plus one needle valve, each with anti blow-out stem.

- The needle valve shall have screwed connections, shall be preferably of angular pattern and shall be fixed with an anti blow-out, depressurising plug, at the outlet.

- Each stem and seat sealing connection, when required (see § 6.2.4) shall have a check valve integrated in the main valve body, a block valve (ball type with anti blow-out stem) closed to the body tap, shall be piped up to the upper part of the extension and equipped with a block valve (same type) plus a sealant fitting with built-in, spring loaded check valve, as mentioned in the valve data sheet.

- Valves and tubing shall be carefully fastened to the valve body and/or extension.

Valve bodies shall have tapped holes with a minimum effective threaded engagement at least equal to the nominal thread diameter. If body wall thickness is too thin, then unthreaded side of OEP/OET (One End Plain/One End Threaded) piece of pipe of a material compatible with the body, shall be welded to the valve body with full penetration or via a boss. Anyway, weld on threads is prohibited.

Material of auxiliary connections (pipe, tube, fittings, valve, …) shall be, at the least of the same material quality as the main valve and can be in stainless steel series AISI 300.

6.2.6. Stem extension for underground valve

When a stem extension is required (see valve data sheet), the configuration and the length H shall be in accordance with this valve data sheet.

In this case and except otherwise specified in the purchase order, valves shall be fitted with drain and sealant extensions well fixed to the stem extension and clearly indicated in the as built design. The stem extension shall be fully watertight, but shall be provided with a means to prevent overpressure built up in the mechanism resulting from stem or bonnet seal leakage.

Valves, equipped with stem extension and/or actuator, shall be delivered completely equipped and mounted (in one piece).

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Underground actuated valves shall be provided with one identification plate on the valve body and one on the upper part of the extension.

6.2.7. Miscellaneous

Lifting lugs are required on all valves NPS 6" and larger. The lifting lugs shall be stamped with the safe working load. Number of lugs shall be sufficient for safe handling on site. Valve support : All valves greater than NPS 24" shall be equipped with supports to permit the installation of the valve in horizontal position directly on the floor. These supports shall be directly welded or fitted on the body of the valve.

6.2.8. Design review

The Manufacturer shall submit for approval to the Engineer/Purchaser and Control Authority the calculation for all bonnet, cover and body bolting for pressure retaining parts conforming to ASME B16.34.

6.3. OPERATION

6.3.1. Valve shall be operated by a hand-wheel, wrench, manual key or actuator.

Manual override devices shall be provided on all valves. Hand-wheels of electric actuators, shall be normally disengaged and shall automatically disengage when the actuator is operated.

6.3.2. The length of the wrench or diameter of the hand-wheel for direct or gear operated valves shall (after opening and closing a new valve at last three times) be such that a force not exceeding 350 N shall be required to operate the ball from either the open or closed position under the maximum differential pressure recommended by the Manufacturer.

For valves without stem extension equipped with a hand-wheel in vertical position, the maximum radius of the hand-wheel is equal to the distance between the centre line of the pipe and the centre of the hand-wheel minus 120 mm. In this case no extruding lugs on hand-wheel are permitted, and provision for by-pass valve shall be kept.

6.3.3. Hand-wheel shall be marked to indicate the direction of closing.

6.3.4. Hand-wheels and wrenches shall be fitted in such a way that whilst held securely they can be removed and replaced where necessary.

6.3.5. All ball valves shall be provided with a mark on the stem to show the position of the ball in order to enable a good regulation of the actuator without seeing the ball. Exception can be made for valves with gear boxes for underground service.

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6.3.6. Ball manual direct operated valves shall be fitted out with fully open and fully closed stops. These stops shall be well fixed to the body of the valve in order to withstand many extreme opening and closing actions. These stops shall be easily removable. Ball gear operated valves shall be fitted out with fully open and fully closed stops shall be adjusted and fixed on the gear box.

6.3.7. The Manufacturer shall advise the maximum operating torque or force which can be sustained without causing permanent damage anywhere in the drive train from the actuator to the obturator. The Manufacturer shall also provide the torque graph : torque value in function of opening angle of the ball and pressure.

Deflection in the extended drive train must be limited so that the closing position contact reflects exactly the real position of the obturator.

6.3.8. Maximum rated differential pressure (MRDP)

The MRDP is the maximum difference between the valve upstream and downstream pressure at which the obturator (closure member) may be operated (opening). The Manufacturer shall specify this value and shall mark it on the valve name plate.

For the specification of different types of actuator refer to the concerned GTS/740/403.

7. MATERIALS

7.1. STEEL USED

The steel used in the valve Manufacturing shall be selected by the Manufacturer and filled in data sheet form

This list shall be submitted for approval to the purchaser/Engineer at the time of the offer. This list shall be added to the CMTR.

7.2. PRESSURE RETAINING PARTS

For pressure retaining parts the following requirements must be fulfilled

7.2.1. Bodies, including end flanges and welding ends (other than for field welding), bonnet and covers of valves shall be made in material conforming to API 6D spec. (or another material specification accepted by the Purchaser/Engineer) and be furnished with certificates EN 10204-3.1. B stating the quality, the mechanical properties (yield strength, tensile strength, percent elongation, impact test value at the temperature specified under per Section 8.4.2), the chemical analysis, the manufacturing process and the marking (e.g. the heat number) of the steel. These certificates shall be added to the CMTR.

For the valves with butt welding end, for the part on which the line pipe shall be welded, see paragraph 7.2.4. and 8.4.

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7.2.2. Notch toughness properties

The impact test temperature conditions and temperature are defined under Section 8.4.2.

7.2.3. The carbon content of parts involved in welding operation (except for those parts which shall be used for the welding connection with the line pipes) shall be restricted as follows :

- maximum percentage of carbon : 0.230
- $C + \frac{Mn}{6} \leq 0.41$

7.2.4. For parts used for the welding connection with the line pipes the following supplementary requirements must be fulfilled :

- The chemical composition of the steel meets the requirements of table 1. The choice and use of alloying elements made from high strength low alloy steels to give the tensile properties prescribed in table 2 shall be made by the Manufacturer and included and reported to identify the type of steel.
- For each heat, the Manufacturer shall analyse the following elements : C, Mn, Si, P, S, Nb, V, Cr, Mo, Ni and Cu.
- The carbon equivalent shall be computed by the following equation :

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

and shall not exceed 0.45.

- The steel used shall be fully killed, fine grain practice.
- The steel used shall be suitable for field welding to pipes, flanges or fittings manufactured under ASTM A53, A105, A106, A234, A333, A350, A381, A420, A694, A707 or API 5L, 605 or MSS SP-44, SP-72, SP-75, EN10208-2.
- The steel used has tensile properties conforming to requirements prescribed in table 2 and capable of meeting the valve design.
- The ratio of yield strength to tensile strength shall not exceed 0.85.
- Mechanical tests as prescribed in section 8.4. shall be performed after final heat treatment.

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7.3. BONNET, COVER AND BODY BOLTING

Bonnet flange cover, and body bolting shall be conform to ASTM A320 Gr L7 or L7M or ASTM A193 grade B7 or B7M. Nuts shall be conform to ASTM A194 Gr 7 or 7M or 2H. For NPS greater than 4", they must be supplied with certificates EN 10204-3.1.C. and for NPS 4" and smaller with certificates EN 10204.3.1.B. These certificates shall be added to CMTR.

Bolt design shall be done to withstand safety all stresses occurring under operating conditions, calculations shall be submitted for approval.

Materials shall be compatible in order to avoid galvanic corrosion and shall not be susceptible to hydrogen embrittlement or stress corrosion cracking. Manufacturer must take into account that the materials shall be eventually cathodic protected.

7.4. NON-METALLIC PARTS

Non-metallic parts and elements, which usually include such items as packing, injectable material and lubricants, shall be suitable for the service and must be defined in the offer.

7.5. OTHER PARTS

Metal parts, which usually include such items as yokes, yoke nuts, stems, glands, gland bushing, gates, balls, plugs, discs, pistons, hand-wheel, gearing and motor drive attachments, shall be of material suitable for the service and must be defined in the offer.

7.6. SOUR GAS SERVICE

When sour gas service or NACE is specified, all process wetted, pressure containing parts and bolting shall meet the requirements of NACE MR0175.

8. FABRICATION AND TEST

Prior to manufacturing a meeting shall be organised between Manufacturer, Purchasing agent, Engineer and Control Authority.

8.1. WELDING FABRICATION

1) Welds and repair welds shall be performed according to written procedures. The welding procedure must be submitted for approval to the Control Authority before any fabrication and/or repair.

2) Only welders and welder operators who are qualified shall be used in production.

3) The joints shall be furnished in accordance with the requirements of Section VIII of ASME Boiler and Pressure Vessel Code - Division 1.

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4) The machine welding shall be done by an electric process, preferably by submerged arc.

5) Repair by welding is prohibited on forged material.

8.2. WELDING PROCEDURES

8.2.1. All welds, repair welds and repair by welding shall be performed according to written procedures. These welding procedures shall be qualified according to the requirements of the ASME Boiler and Pressure Vessel Code, Section IX.

The welding procedure tests are required on material which is on the high side of the chemistry specification.

The Manufacturer shall maintain a weld record of the procedure and performance test results.

For the tensile test, the rupture of the specimen must take place in the unaffected parent material.

The welding procedure qualification must include an impact test set in the weld and in the HAZ with requirements of paragraph 8.4.2. and a macrographic examination described in paragraph 8.2.2. These tests shall be performed after eventual final heat treatment. If weld thickness is higher than 25 mm, even covered by the PQR, additional impact test shall be performed on the test specimens taken in weld thickness layers.

8.2.2. Macrographic examination : the etched surface of the macro test specimen viewed macroscopically must display the image of a well performed welded joint with sufficient penetration, free from linear defects and important inclusions. In case of doubt, the etched surface must be examined microscopically and additional macroscopic examinations of other areas may be required.

The macrographic examination will include hardness measurements in the weld and the HAZ. The hardness will not exceed the values measured on the parent metal by more than 80 points for the welds and 100 point for HAZ, with an absolute maximum of 350HV10.

The acceptance of inclusions can be decided upon with the NDE of the welded plates (see paragraph 8.5.).

8.2.3. Additional requirements for "Sour Gas". Qualified welding procedure shall guarantee a good geometry without stress concentration and shall be realised according to NACE MR 0175 (max. 1% Ni in welding consumables).

On the macro, series of hardness tests shall be performed in the base metal, weld and Heat affected zone; results shall be maximum 248HV10.

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8.3. HEAT TREATMENT

8.3.1. After hot working and before re-heating for normalising heat treatment, forging or casting shall be allowed to cool substantially below the transformation range. All forging or casting shall be heat treated by normalising. Normalising shall be carried out in such a way that the base material acquires a fine grained perlitic structure.

8.3.2. Heat treatment of welds : the rules of ASME VIII Div. 1 are applicable. If a required treatment is not feasible (seat damage, etc, …), special agreement must be obtained from Purchaser/Engineer and Control Authority ACA, after the Manufacturer has proved good quality of welds.

8.3.3. The Manufacturer shall include in the CMTR data of this heat treatment.

8.4. MECHANICAL TESTS ON THE PARTS USED FOR WELDING CONNECTION WITH THE LINE PIPES

The following mechanical tests shall be performed on these parts after final heat treatment under the supervision of the Control Authority's delegate and the certificates shall be added to the CMTR.

Test specimens may only be cut after a marking transfer by the Control Authority.

8.4.1. Tensile testing

Requirements :

The material shall be in conformity with table 2. The ratio of yield strength to tensile strength shall not exceed 0.85.

Test specimen :

The test specimen represents any part of the same shape, the same heat of steel and the same heat treatment lot.

Number of test : one

Test location and orientation :

The test specimen shall be orientated transversally to direction of lamination and if this orientation is not feasible, it shall be orientated longitudinally. For castings only one orientation is applicable.

Test method :

Testing shall be performed in accordance with ASTM A370 standard rectangular plate type 1 1/2" wide (fig. 4 - A370) or standard round (fig. 5 or fig. 6 - A370).

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Yield strength shall be determined either by the 0.2 % offset or the 0.5 % extension under load (EUL) method. If another material are accepted by the Purchaser, the test method will be as specified in the material specification.

8.4.2. Impact test

Requirements :

The standard impact test temperature is -20°C, except if otherwise stated in the "Material Requisition" or particular Technical Specification. The average value of a set of 3 test specimens shall be equal to 35 J/cm². The minimum value per test specimen shall be equal to 35 J/cm² but this value may drop to 28 J/cm² for only one test specimen per series.

- Test specimen :

  The test specimen represents any part of the same shape, the same heat of steel and the same heat treatment lot.

- Number of tests :

  2 test sets (3 test specimens constitute one test set). For castings only 1 test set.

- Test location and orientation :

  1 set shall be orientated longitudinally and another one transversally. For castings only one orientation is applicable.

- Test method :

  The notched bar impact test shall be performed in accordance with ISO 148 or A370-Charpy V - Notch.

  If the wall thickness of these parts or the coupon does not enable machining of full size specimens, the largest possible size must be used but not less than (10 x 5) mm. The axis of the notch shall be orientated through the wall thickness of these parts. If the weld thickness is > 25 mm, several specimen sets shall be taken in the weld thickness with min one (1) set per 12.5 mm of thickness, the specimen sets shall be selected in agreement with the Purchaser/Engineer and Authorised Control Authority.

8.5. NON DESTRUCTIVE EXAMINATION (NDE)

The following NDE will be performed after the final heat treatment and before coating.

8.5.1. List of NDE

- All butt welds shall be examined by a radiographic examination. If the thickness exceeds 15 mm or if the radiographic examination is not feasible than welds are only examined by ultrasonic examination to the largest extent possible.

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The radiographic examination shall be executed in accordance with ASME Boiler and Pressure Vessel Code, section V, art. 2 - using fine grain film and lead screens.

- Butt welding ends on cast bodies shall be examined before fabrication welding end, by radiography in accordance to MSS-SP-54 and over a width of 70 mm.
- 25 mm of base material at each side of each weld and each weld shall be 100 % ultrasonically examined.

  The ultrasonic examination shall be executed in accordance with ASME Boiler and Pressure Vessel Code, section 5, art. 5.
- Body for all valves NPS 6" and greater shall be tested by magnetic particle examination in conformity with ASME Boiler and Pressure Vessel Code, section V, art. 7.
  - All valves shall be visually examined.
  - All valves shall be dimensionally examined.
  - For butt welding end valves after machining, the finished bevel end pipe used for field welding shall be submitted to the following tests :
    - Magnetic (ASME V Art. 7) or liquid penetrant (ASME V Art. 6).
    - Ultrasonic inspection (ASME V Art. 5) or radiographic examination (ASME V Art. 2)on 25 mm of base material.
    - Visual and dimensional examination.
  - If any repair by welding is performed, the concerned parts shall be completely re-examined.

8.5.2. Additional NDE requirement for "SOUR Gas"

A series of hardness test on surfaces in contact with the fluid shall be performed to NACE MR 0175. Results shall be 22 HRC or 248 HV 10 max.

8.5.3. Acceptance criteria of the different NDE

- Radiographic examination :

  ASME Boiler and Pressure Vessel Code, section VIII, division 1, UW 51 for forged steel

  ASME Boiler and Pressure Vessel Code, section VIII, division 1, appendix 7 for casted steel. The control will done on width of 70mm with.

  On the first 40mm A1,B1,C1 acceptable, D, E, F and G are rejected.

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Between 40mm and 70mm, A2, B3, C3 acceptables; D, E, F, G are rejected.

- Ultrasonic inspection of weldings and HAZ:

  ASME Boiler and Pressure Vessel Code, section VIII, division 1, Appendix 12.

- Magnetic particle inspection of the body:

  ASME Boiler and Pressure Vessel Code, section VIII, division 1, Appendix 6.

  For casted pieces refer to Appendix 7.

- Visual examination

  MSS-SP-55.

- Magnetic particle or liquid penetrant of the finished bevel:

  The following defects are unacceptable :

  - Defects extending into the bevel provided the lamination is parallel to the surface and has a transverse dimension exceeding 6.35 mm.
  - All defects not parallel to the surface extending into the bevel.

All the NDE (except radiographic examination) shall be performed under the supervision of the control authority's delegate and the certificates shall be added to the CMTR.

8.6. PRESSURE TESTING

8.6.1. General requirements

- Each valve shall be tested by the Manufacturer under the supervision of the Control Authority after final completion of all welding and all heat treatment operations.
- Hydrostatic and air seat test shall be performed after an acceptable shell test.
- Fluid for shell and hydrostatic seat tests shall be liquid as water (which may contain a corrosion inhibitor), kerosene, or other fluid with a viscosity not greater than that of water. Temperature of the test fluid shall not exceed 50°C.
- Valves shall be substantially relieved of air when tested with liquid.
- Valves shall be shell tested prior to painting.
- Valve test fixture loads applied to valve ends shall be limited to those required to effectively seal the valve ends.
- Pressure testing certificates shall be included in the CMTR.

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- Drain, the sealant and the bleed valve shall be included in all pressure tests.
- If any supplementary welding, repair by welding or treatment are performed, valve shall be completely re-tested.

8.6.2. Shell test

- Each valve shall be given a shell test at the gauge pressure not less than 1.5 times the 38°C rating gauged by ASME B16.34, rounded off to the next higher 1 bar increment.
- Shell test shall be conducted with the valve in a partially open position and with the valve ends closed.
- *Drain lines and valves*

  Shall be either included in the hydrostatic shell test, or tested separately.
- Duration of the shell test

  NPS up to 18" shall not be less than 15 minutes.

  NPS 20" and larger shall not be less than 30 minutes.
- Visual leakage or harmful inelastic deformation are not accepted.

8.6.3. Hydrostatic seat test

- Each valve shall be given a hydrostatic seat test at the gauge pressure not less than 1.1 times the 38°C rating gauged by ASME B16.34, rounded off to the next higher 1 bar increment.
- Seat closure testing shall be performed with seat surfaces free of sealant, grease or other foreign material that aids in sealing except as provided hereafter :
  - When necessary to prevent damage during valve actuation, a light oil of viscosity not greater than that of kerosene may be applied to sealing surface.
  - When valve primary design is based on the presence of a sealant material (lubricated plug valve), the sealant material may be in place.
- For valve of the double seating type such as gate, plug and ball valve, the test pressure shall be applied successively to each end of the closed valve and leakage to opposite end checked. Provision shall be taken before, for de energising the self relieving pressure system.
  - For soft seated valves there shall be no visible leakage - for metal seated valves the leakage rate shall not exceed 0.006 ml per minute and per mm of nominal pipe size (ND).

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- For double block and bleed valve the following tests shall be performed :

  Close valve, open body vent, apply seat test pressure to both ends of the valve.

  Close valve, open body vent, apply seat test pressure to one end of the valve, release pressure and repeat test for the other end of the valve.

- For double piston effect valve the following test shall be performed :

  Release pressure, close valve, open body vent, apply seat test pressure through the body vent.

- For other valve type, the test pressure shall be applied across the closure member in the direction producing the most adverse seating conditions. For example, a globe valve shall be tested with pressure under the disc. A check valve, globe valve or other valve type designed, sold and marked as a one-way valve, requires a closure test only in the appropriate direction.

- The duration of the hydrostatic seat test shall not be less than 5 minutes for each end.

- Visual leakage or harmful inelastic deformation are not accepted.

8.6.4. External leak testing

Under the supervision of the Control Authority's delegate, the Manufacturer shall check the external leak tightness of body, stem and all external taps. This shall be done with soap suds at an inner pressure of 6 bar. For underground valves, this test shall include piping, fittings and valves of the auxiliary lines for drain, vent/bleed and sealant connections.

8.6.5. Air seat test

- Each valve shall be given an air seat test at 6 bar.

- This test shall be performed in the same manner as hydrostatic seat test.

- The duration of this test shall not be less than 5 minutes for each end.

- No signs of leakage are accepted.

8.6.6. Procedure

Procedure of all pressure tests shall be included in the offer.

8.6.7. After tests

After test, any auxiliary connections shall not be removed, and auxiliary piping shall be cleaned and dried, especially the sealant piping.

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8.7. OPERATIONAL TORQUE TEST

For valves operated with an actuator the Manufacturer shall perform an operational torque test at full rated differential pressure and at ambient temperature. The procedure must be included in the offer. The certificates shall be included in the CMTR.

8.8. FIRE TEST

The Manufacturer shall supply valves qualified by fire testing as specified in API 6FA and this certificate shall be added to the CMTR.

8.9. ANTI-STATIC DEVICE TESTING

If requested in the purchase order, all ball valves shall be submitted of to an anti-static electricity testing in accordance with BS 5146 and this certificate shall be added to the CMTR.

8.10. VISUAL AND DIMENSIONAL EXAMINATION

All valves shall be visually and dimensionally examined, according to API 1104 and MSS-SP-55.

9. MARKING

9.1.1. All valves supplied under this specification shall be clearly identified on the body, on the identification plate and on the valve flange edge.

9.1.2. Body markings

The following markings shall be cast, stamped, forged or engraved on the body of the valve :

c) Manufacturer's name or trademark.

Individual tag number according to attached valves list.

The monogram of the Control Authority. This marking shall only be applied after complete approval of the CMTR.

Flow direction on unidirectional valve.

9.1.3. Permanently attached identification plate markings

On minimum the following markings shall be shown on permanently attached identification plates :

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a) Manufacturer's name or trademark.

b) Individual valve fabrication number (serial number).

c) Individual tag number.

d) The maximum operating pressure;

e) The min and maximum operating temperatures

f) Body material designation (conforming MSS SP-25).

g) Rating designation (conforming ASME B16.34).

h) Valve trim identification (conforming MSS SP-25).

i) Nominal valve size.

j) Monogram of the Control Authority.

10. INSPECTION

10.1. INFORMATION

The Manufacturer shall inform the Control Authority min. five (5) working days in advance of any intervention required by this specification and shall send a copy of it to the Purchaser/Engineer (by fax).

10.2. DOCUMENTS

Before starting any fabrication, the Manufacturer shall submit for approval to the Control Authority and the Purchaser/Engineer the following documents :

- Detailed fabrication drawing and calculations.
- Fabrication and control procedure.
- Qualified welding procedures;
- Welders performances qualifications;
- NDT procedures;
- List of Operations in Fabrication and Control (LOFC) in accordance with annex 1.

Each company dealing in the order by fabrication and/or control shall implement a LOFC for all operations and interventions performed in its organisation. They shall also be responsible for the implementation of the same by their subcontractors.

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10.3. CERTIFIED MATERIAL TEST REPORT

A Certified Material Test Report (CMTR) shall be furnished listing as built drawings and calculations, the LOFC (see paragraph 10.2.), the base material certificate, the chemical check analysis of the welding ends. The certificate of the heat treatment, the mechanical test, the non-destructive examination, the pressure testing, the operational torque test, the quality release note (see paragraph 10.4.) and any special test required by the purchase order. The valve individual number (see paragraph 9.1.2.) must be indicated in the CMTR to permit the correct traceability of each valve. The Manufacturer shall furnish one copy of the CMTR to the Control Authority's delegate and one original and one copy to the Purchaser/Engineer.

10.4. QRN

After final approval of valves and the acceptance of the CMTR, the control authority's delegate shall furnish to the Purchaser/Engineer and to the Manufacturer a Quality Release Note (QRN). The Manufacturer shall deliver one copy of the QRN with the valves and one copy shall be included in the CMTR (see paragraph 10.3.).

10.5. REPAIR

Defects in material may only be repaired provided written acceptance by the contracting parties and the Control Authority has first been obtained.

This written acceptance must be given case per case. Defective material, that cannot be satisfactory repaired or repaired without written approval shall be definitively rejected.

10.6. REJECTION

Each valve in which injurious defects are found after delivery shall be rejected. The Manufacturer shall be notified. In this case, the valve shall be replaced immediately. All the costs involved, including wages and travel expenses of the Control Authority's delegate shall be borne by the Manufacturer.

11. PAINTING AND COATING

The surface of the valve will be shot-blasted SA 2 1/2 (Swedish standard SIS 055900). Before painting, the valve shall be cleaned from grease and dirt. The painting shall consist of a primer coating (30 - 40 µm) and a finish coating (30 - 40 µm).

The nature of the products shall be specified in the offer and shall guarantee a corrosion protection for a storage period in a shop for at least one year.

Painting in accordance with Purchaser/Engineer's specifications.

Painting and coating procedures shall be submitted for approval before manufacturing to the authorized Control authority and to the purchaser / engineer.

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For underground valves the Manufacturer shall propose an adequate protection at the time of offer. This adequate protection shall be in accordance with the Purchaser/Engineer's specification.

TABLE 1

CHEMICAL COMPOSITION FOR WELDING END OF VALVES

Maximum limit of chemical elements which may be used in material under this standard.

	% Maximum
C	0.230
Mn	1.60
Si	0.50
P	0.030
S	0.025
Nb	0.080
V	0.120
Mo	0.250
N_t	0.0150

Alternate alloy elements may be used but they shall be discussed with the user prior to delivery of the material. This table is not intended to represent the composition of any heat of steel, but merely to record the maximum permissible amounts of one element. The combination of elements of any heat must conform to the carbon equivalent, subsection 3.2.4.3.

For each heat the Manufacturer shall analyse the following elements : C,

Mn, Si, P, S, Nb, V, Cr, Mo, Ni and Cu.

The intentional addition of elements other than those specified is not permitted unless agreed upon by the Purchaser.

In any case, for unintentional additions, the following limitations shall be respected :

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Cr ≤ 0.15 % Mo ≤ 0.05 % Cu ≤ 0.20 %

Ni ≤ 0.30 % Co ≤ 0.01 % Al ≤ 0.07 %

The content of N total (N_t) may be up to 0.0150 % and Must be guaranteed by the Manufacturer. If the Manufacturer cannot give any guaranty of N content, he shall analyse this element.

The total content for Nb + V will be limited to 0.150 %.

In grades X42 through X60 for each reduction of 0.01 % below the maximum carbon content, an increase of 0.05 % manganese above the specified maximum is permissible, up to a maximum of 1.70 %.

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TABLE 2

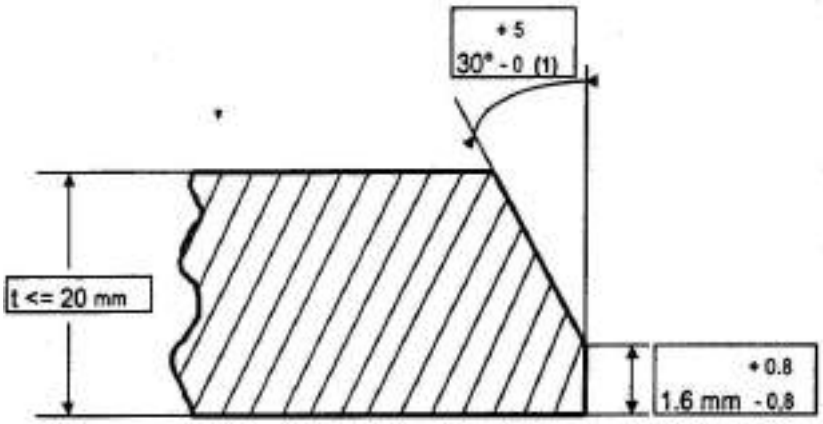
TENSILE REQUIREMENTS OF THE WELDING END OF VALVES

CLASS SYMBOL	FIELD STRENGTH (min)		TENSILE STRENGTH (min)		ELONGATION in 2" min. %
	KSI	MPa	KSI	MPa	
B	35	241	60	413	25
X42	42	289	60	413	25
X46	46	317	63	434	25
X52	52	358	66	455	25
X60	60	413	75	517	20

The ratio of effective yield strength to effective tensile strength of the steel shall not exceed 0.85.

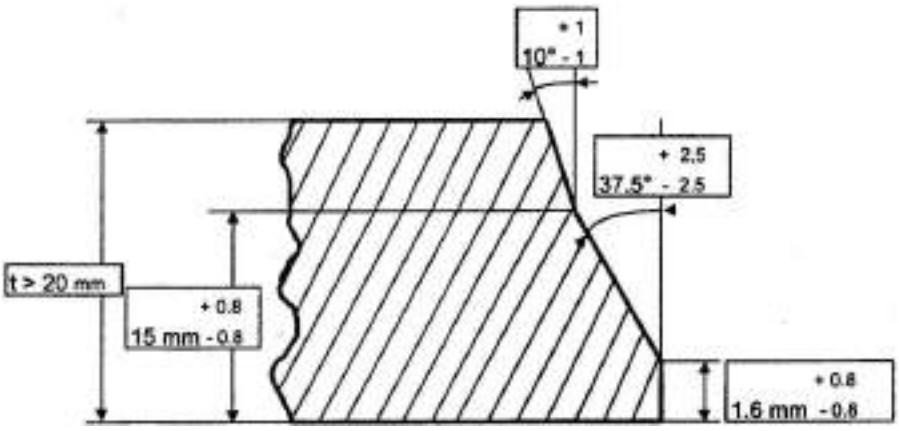
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Figure 1



(1) : welding end, size 24" and smaller may be furnished with 37.5° +- 2.5 bevel at manufacturer option.

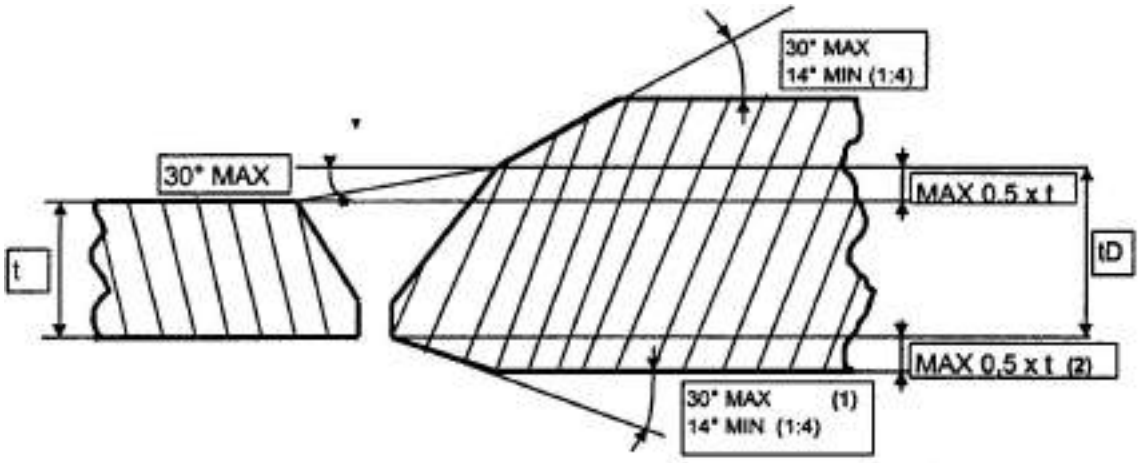
Figure 2



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Figure 3

ACCEPTABLE DESIGN FOR UNEQUAL WALL THICKNESS AT WELDING END OF VALVE



Notes

(1) No minimum when materials joined have equal yield strength.

(2) Dimension to be limited to a minimum.

When the minimum specified yield strengths of the sections to be joined are unequal :

- the deposited weld metal shall have mechanical properties at least equal to those of the section of the higher strength.
- tD shall be equal to at least t times the ratio of min. specified yield strength of pipe by those of welding end of valve.
- $tD \geq tx \dfrac{\text{Min. Yield strength guaranteed by the s tan dard of the steel of the pipe}}{\text{Min. yield strength guaranteed by the s tan dard of the steel of the welding end of the valve}}$

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ANNEX 1

LOFC (LIST OF OPERATIONS OF FABRICATIONS AND CONTROLS)

Each LOFC must contain the following information as a minimum (all clearly marked and separated) :

k) Company name and references relating to the order.

l) All technical and other information required in order to define the items covered.

The area of application will be limited to that item or those considered as in fabrication and control.

m) A numerical sequence of operations with description will be built-up in a logical way of work progress.

- The first operation will be the control of the incoming material(s) and documents.
- The last operation will be the control of the CMTR.

The following operations have to be included (not limited to) :

- Each fabrication step.
- Each step which calls for own quality control (eventually QA).
- Each applicable examination as part of this specification.
- Document controls - stamping and final documentation.

n) Each operation will be followed by the applicable specification or procedure number (with the latest revision).

o) Columns to be provided for possible interventions of :

- the Manufacturer's fabrication control,
- the Manufacturer's quality control (eventually QA),
- Control Authority,
- the Purchaser/Engineer,

and place of intervention if not by the Manufacturer.

The interventions will be indicated per operation with H or W and/or R.

H = hold point
No further steps may be undertaken before the intervention of the appointed responsible takes place.

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W = witness point
The appointed responsible has to be notified of the operation in advance, but production will continue whether the intervention took place or not.

R = point for which a control report or a recording has to be made.

The Manufacturer will fill in his own H, W and R points. The Control Authority and the Purchaser/Engineer will do the same in their designated columns, but this will not implicate a relaxation or wearing of the requirements of the Manufacturer's controls.

Each intervention has to be signed and dated by the person acting as controller. Only the original documents will be presented for this purpose.

p) One column to be provided for report or record numbers (points marked R) and one for the review of these documents by the Control Authority.

q) Two extra columns may give reference to a non-conformity report if any and to the resolution given to it.

Completion of the LOFC does not automatically give rise to a release of the material or it must be stipulated otherwise in the contract.

* * *

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	PIPING SPECIFICATION	P.019141 G 11076 M001 (3C1)
		SHEET 1 OF 6

BASIC PIPING SPECIFICATION DATAS		MAXIMUM DESIGN CONDITIONS			
		TEMPERATURE ° C		PRESSURE bar g	
PRIMARY FLANGE RATING	300#-RF	CARBON STEEL	- 20 to 65	NG	49.00
				AG	49.00
BASIC MATERIAL	CARBON STEEL				
CORROSION ALLOWACE	1.6 mm				
X-RAYS	100%				
SIZE RANGE	1/2"-16"				
CODE	ANSI B 31.8				
FLUIDS					

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			PIPING SPECIFICATIONS				**SPECIFICATION NO P.019141 G 11076 M001 (3C1)** **SHEET 2 OF 6**
ITEM	**SHORT CODE**	**SIZE FROM-THRU**	**END CONNECTION**	**RATING AND/OR SCHED.**	**DIMENSION STANDARD**	**MATERIAL**	**REMARKS**
PIPES	**P**	1/2" - 1 1/2"	PE-SEAMLESS	SCH 80	ANSI B36.10	ASTM A 106 Gr. B	SEAMLESS
		2" - 3"	BE-ANSI B16.25	SCH 80	ANSI B36.10	ASTM A 106 Gr. B	SEAMLESS
		4" - 8"	BE-ANSI B16.25	6.4 mm	API 5L	API 5L X 52	HFW / SMLS
		10" - 12"	BE-ANSI B16.25	6.4 mm	API 5L	API 5L X 56	HFW / SMLS/ LSAW
		16"	BE-ANSI B16.25	7.1 mm	API 5L	API 5L X 56	HFW / SMLS/ LSAW
ELBOWS 90 LR	**E**	1/2" - 1 1/2"	SW	CLASS 3000	ASME B16.11	ASTM A105	SEAMLESS
		2"-3"	BE-ASME B16.25	SCH 80	ASME B16.9	ASTM A234 Gr. WPB	SEAMLESS
		4" - 8"	BW - ANSI B16.25	SEE PIPE	ANSI B16.9	API 5L X 52 or ASTM A860 WPHY 52	
		10" - 16"				API 5L X 56 or ASTM A860 WPHY 60	
ELBOWS 45 LR	**E45**	1/2" - 1 1/2"	SW - ASME B16.25	CLASS 3000	ASME B16.11	ASTM A105	SEAMLESS
		2"-3"	BE-ASME B16.25	SCH 80	ASME B16.9	ASTM A234 Gr. WPB	SEAMLESS
		4" - 8"	BW - ANSI B16.25	SEE PIPE	ANSI B16.9	API 5L X 52 or ASTM A860 WPHY 52	
		10" - 16"				API 5L X 56 or ASTM A860 WPHY 60	
REDUCERS CONCENTRIC	**RCO**	1/2" - 1 1/2"	SW - ASME B16.25	CLASS 3000	ASME B16.11	ASTM A105	SEAMLESS
		2"-3"	BE-ASME B16.25	SCH 80	ASME B16.9	ASTM A234 Gr. WPB	SEAMLESS
		4" - 8"	BW - ANSI B16.25	SEE PIPE	ANSI B16.9	API 5L X 52 or ASTM A860 WPHY 52	
		10" - 16"				API 5L X 56 or ASTM A860 WPHY 60	
REDUCERS ECCENTRIC	**REC**	1/2" - 1 1/2"	SW - ASME B16.25	CLASS 3000	ASME B16.11	ASTM A105	SEAMLESS
		2"-3"	BE-ASME B16.25	SCH 80	ASME B16.9	ASTM A234 Gr. WPB	SEAMLESS
		4" - 8"	BW - ANSI B16.25	SEE PIPE	ANSI B16.9	API 5L X 52 or ASTM A860 WPHY 52	
		10" - 16"				API 5L X 56 or ASTM A860 WPHY 60	
TEES EQUAL	**T**	1/2" - 1 1/2"	SW - ASME B16.25	CLASS 3000	ASME B16.11	ASTM A105	SEAMLESS
		2"-3"	BE-ASME B16.25	SCH 80	ASME B16.9	ASTM A234 Gr. WPB	SEAMLESS
		4" - 8"	BW - ANSI B16.25	SEE PIPE	ANSI B16.9	API 5L X 52 or ASTM A860 WPHY 52	
		10" - 16"				API 5L X 56 or ASTM A860 WPHY 60	
TEES RED	**TR**	1/2" - 1 1/2"	SW - ASME B16.25	CLASS 3000	ASME B16.11	ASTM A105	SEAMLESS For Branch Size, Please refer to the Chart given in Sheet 6 of this Document.
		2"-3"	BE-ASME B16.25	SCH 80	ASME B16.9	ASTM A234 Gr. WPB	
		4" - 8"	BW - ANSI B16.25	SEE PIPE	ANSI B16.9	API 5L X 52 or ASTM A860 WPHY 52	
		10" - 16"				API 5L X 56 or ASTM A860 WPHY 60	
SOCKOLETS	**SOL**	1/2" - 1 1/2"	SW - ANSI B16.25	CLASS 3000	MSS-SP-97	ASTM A 105	
THREADOLETS	**TOL**	1/2" - 1 1/2"	THREADED AS PER ASME B 1.1	CLASS 3000	MSS-SP-97	ASTM A 105	Threadolet shall only be used for Temperature measuring equipments
WELDOLETS	**WEL**	2"-8"	BW - ANSI B16.25	STD	MSS-SP-97	ASTM A 105	
CAPS	**CAP**	1/2"- 1 1/2"	SW	SEE PIPE	ANSI B16.9	ASTM A 105	SEAMLESS
		2"	BE-ASME B16.25	SCH 80	ASME B16.9	ASTM A234 Gr. WPB	
		4" - 8"	BW - ANSI B16.25	SEE PIPE	ANSI B16.9	API 5L X 52 or ASTM A860 WPHY 52	
		10" - 18"				API 5L X 56 or ASTM A860 WPHY 60	
NIPPLES	**NBEP**	1/2" - 1.1/2"	BOTH ENDS PLAIN	80	ANSI B36.10	ASTM A 106 Gr. B	SEAMLESS-LG=100mm
	NOET	1/2" - 1.1/2"	ONE END THRD-MNPT	80	ANSI B36.10	ASTM A 106 Gr. B	SEAMLESS-LG=100mm
	NBET	1/2" - 1.1/2"	BOTH ENDS THRD-MNPT	80	ANSI B36.10	ASTM A 106 Gr. B	SEAMLESS-LG=100mm
FULL COUPLINGS THRD	**CF**	1/2" - 1.1/2"	FNPT ANSI B1-20-1	3000#	ANSI B16.11	ASTM A 105	SEAMLESS
CAPS THRD	**C2**	1/2" - 1.1/2"	FNPT ANSI B1-20-1	3000#	ANSI B16.11	ASTM A 105	SEAMLESS
PLUGS THRD	**PL**	1/2" - 1.1/2"	MNPT ANSI B1-20-1	3000#	ANSI B16.11	ASTM A 105	SEAMLESS

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			PIPING SPECIFICATIONS				**SPECIFICATION NO P.019141 G 11076 M001 (3C1)**
							SHEET 3 OF 6
ITEM	**SHORT CODE**	**SIZE FROM-THRU**	**END CONNECTION**	**RATING AND/OR SCHED.**	**DIMENSION STANDARD**	**MATERIAL**	**REMARKS**
WN FLANGES	**FLG**	1/2" - 1 1/2"	SW	300# SWRF, TO MATCH SCH 80 PIPE	ASME B16.5	ASTM A105	SERRATED FINISH
		2"	BW - ASME B16.25	300# WNRF, TO MATCH SCH STD PIPE	ASME B16.5	ASTM A105	
		4" - 8"	BW - ASME B16.25	300# WNRF, TO MATCH SCH STD PIPE	ASME B16.5	ASTM A 694 F 52	
		10" - 16"	BW - ASME B16.25	300# WNRF, TO MATCH SCH STD PIPE	ASME B16.5	ASTM A 694 F 60	
ORIFICE FLANGES	**FRO**	1/2" - 1 1/2"	SW	300# SWRF, TO MATCH SCH 80 PIPE	ASME B16.36	ASTM A105	SERRATED FINISH
		2"	BW - ASME B16.25	300# WNRF, TO MATCH SCH STD PIPE	ASME B16.36	ASTM A105	
		4" - 8"	BW - ASME B16.25	300# WNRF, TO MATCH SCH STD PIPE	ASME B16.36	ASTM A 694 F 52	
		10" - 16"	BW - ASME B16.25		ASME B16.36	ASTM A 694 F 60	
BLIND FLANGE	**FBL**	1" - 16"	FLGD	300# RF	ANSI B16.5	ASTM A 105	SERRATED FINISH
SPECTACLE BLINDS	**SPB**	1" - 16"		300# RF	ASME B16.48	ASTM A 105	
RESTRICTION ORIFICES	**ROF**	All Size		300# RF	ASME B16.36	ASTM A 105	
BOLT	**BOL**	All Sizes	-	-	ASME / B16.5 / ASME B 18.2.1	ASTM A193 Gr. B7 (HOT DIP GALVANISED, 80 - 100 MICRON)	THREADS AS PER ASME B1.1
NUT	**NUT**	All Sizes	-	-	ASME B 18.2.2	ASTM A194 GR 2H (HOT DIP GALVANISED, 80 - 100 MICRON)	THREADS AS PER ASME B1.1
GASKET SPIRAL WOUND	**GSK**	All Sizes	-	300# RF	ASME B 16.20	3.2MM Thick Spiral Wound 316L with CS Outer ring and 316L inner ring and graphite filler.	

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			PIPING SPECIFICATIONS				**SPECIFICATION NO P.019141 G 11076 M001 (3C1)** SHEET 4 OF 6
ITEM	**SHORT CODE**	**SIZE FROM-THRU**	**END CONNECTION**	**RATING AND/OR SCHED.**	**DIMENSION STANDARD**	**MATERIAL**	**REMARKS**
BALL VALVE (See Note 4)	**VBA**	1/2" - 1 1/2"	SW	800#	ASME B16.10 ISO EN 17292	BODY : ASTM A105 BALL : ASTM A182 GR.F316 SEAT : RPTFE	WRENCH OPERATED. ANTI-STATIC FIRE SAFE
		2" - 4"	FLGD RF:ASME B16.5 or BW :ASME B16.25	300 #	ASME B16.10 API-6D	BODY : ASTM A216 GR WCB BALL : ASTM A182 Gr. F316 SEAT : AISI4140+ 75 microns ENP / AIS410	WRENCH OPERATED. ANTI-STATIC FIRE SAFE
		6" - 16"	FLGD RF:ASME B16.5 or BW :ASME B16.25	300#	ASME B16.10 API-6D	BODY : ASTM A216 GR WCB BALL : ASTM A182 Gr. F316 SEAT : AISI4140+ 75 microns ENP / AIS410	ANTI-STATIC FIRE SAFE GEAR OPERATED - MANUAL / ACTUATED - AS INDICATED IN DATA SHEET
GLOBE VALVE	**VGL**	1/2" - 1 1/2"	SW: ASME B16.25	800#	ASME B16.10 ISO 15761	BODY : ASTM A 105 DISC / RING : 13% CR. / SS304L STEM : 13% CR. STEEL (NO CASTING)	HANDWHEEL
		2" - 4"	FLGD RF:ASME B16.5 or BW: ASME B16.25	300#	ASME B16.10 BS 1873	BODY : ASTM A216 GR WCB DISC / RING : 13% CR. / SS304L STEM : 13% CR. STEEL (NO CASTING)	HANDWHEEL
		6" - 16"	FLGD RF:ASME B16.5 or BW: ASME B16.25	300#	ASME B16.10 BS 1873	BODY : ASTM A216 GR WCB DISC / RING : 13% CR. / SS304L STEM : 13% CR. STEEL (NO CASTING)	HANDWHEEL
SWING CHECK VALVE	**VCH**	1/2" - 11/2""	SW: ASME B16.25	800#	ASME B16.10	BODY : ASTM A 105 DISC / RING : 13% CR. / SS304L HINGE PIN : 13% CR. STEEL (NO CASTING)	
		2 1/2" - 16"	FLGD RF:ASME B16.5 or BW: ASME B16.25	300#	ASME B16.10 API-6D	BODY : ASTM A216 GR WCB DISC / RING : 13% CR. / SS304L HINGE PIN : 13% CR. STEEL (NO CASTING)	

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	PIPING SPECIFICATIONS	SPECIFICATION NO P.019141 G 11076 M001 (3C1) SHEET 5 OF 6

REDUCERS CHART

SMALL SIZE

LARGE SIZE

	1/2"	3/4"	1"	1.1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"
1/2"															
3/4"	X														
1"	X	X													
1.1/2"	X	X	X												
2"		X	X	X											
3"				X	X										
4"				X	X	X									
6"						X	X								
8"							X	X							
10"							X	X	X						
12"								X	X	X					
14"								X	X	X	X				
16"									X	X	X	X			
18"										X	X	X	X		
20"											X	X	X	X	

LEGEND
X : CONCENTRIC AND ECCENTRIC REDUCERS- BW

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	PIPING SPECIFICATIONS	SPECIFICATION NO P-PP01-G-11076-N001 (JCT) SHEET 6 OF 6

BRANCH CHART

BRANCH SIZE

HEADER SIZE	1/2"	3/4"	1"	1.1/2"	2"	2.1/2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"
1/2"	T															
3/4"	TR	T														
1"	TR	TR	T													
1.1/2"	TR	TR	TR	T												
2"	SOL	TR	TR	TR	T											
2..1/2"	SOL	SOL	TR	TR	TR	T										
3"	SOL	SOL	SOL	TR	TR	TR	T									
4"	SOL	SOL	SOL	TR	TR	TR	TR	T								
6"	SOL	SOL	SOL	SOL	WOL	TR	TR	TR	T							
8"	SOL	SOL	SOL	SOL	WOL	WOL	WOL	TR	TR	T						
10"	SOL	SOL	SOL	SOL	WOL	WOL	WOL	TR	TR	TR	T					
12"	SOL	SOL	SOL	SOL	WOL	WOL	WOL	WOL	TR	TR	TR	T				
14"	SOL	SOL	SOL	SOL	WOL	WOL	WOL	WOL	TR	TR	TR	TR	T			
16"	SOL	SOL	SOL	SOL	WOL	WOL	WOL	WOL	TR	TR	TR	TR	TR	T		
18"	SOL	SOL	SOL	SOL	WOL	WOL	WOL	WOL	WOL	TR	TR	TR	TR	TR	T	
20"	SOL	SOL	SOL	SOL	WOL	WOL	WOL	WOL	WOL	TR	TR	TR	TR	TR	TR	T

LEGEND

T : TEE EQUAL-BW

TR : REDUCING TEE-BW

WOL : WELDOLET- BW

SOL : SOCKOLET-SW

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BHAGYANAGAR GAS LIMITED (BGL)

CNG STATION WORKS

SS TUBE LAYING & MECHANICAL WORKS

AT VARIOUS LOCATIONS

TECHNICAL SPECIFICATION FOR SS TUBES, SS VALVES & SS FITTINGS FOR INSTRUMENTS AIR LINE

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SPECIFICATION FOR INSTRUMENT VALVES AND MANIFOLDS 23

INSTALLATION, TESTING AND CALIBRATION OF ISTRUMENTATION AND CONTROL SYSTEM

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1.0 SCOPE

1.1 The purpose of this specification is to define the general requirements for the installation, installation materials, testing and calibration of instruments and control system.

1.2 The work shall be carried out in accordance with the codes, standards and recommended practice listed in this specification and in accordance with local Statutory regulations'.

1.3 For installation of instruments and control system, of the new material where quality is of the prescribed standards and which is in every way fit for its intended purpose shall be used.

1.4 Unless otherwise specified all the materials shall be indicated in this specification except where it is not compatible with fluids being handled. In such cases the selection of the material shall be approved by Owner/PMC.

1.5 Only the best trade practices shall be used. All the work shall be carried out in a neat, workman like manner and to the satisfaction of Owner/PMC.

2.0 STANDARDS OF MATERIALS

2.1 Instrument process piping / tubing up to and including the first block valve and `in-line' instrument equipment shall conform to the line class or vessel rating concerned instrument piping or tubing after the first lock valve may use alternate materials consistent with service conditions. In general, they shall conform to the following specification as a minimum.

2.1.1 Stainless tubes shall be fully annealed and cold drawn seam less as per ASTM A 269 TP304 with size 1/2"OD x 0.083" WT (wall thickness).

2.1.2 Monel tubing shall be fully annealed seamless as per ASTM B165 with size 1/2" OD x 0.35"WT.

2.1.3 Carbon steel pipe shall be 1/2" seamless and shall be as per ASTM A106 Gr B min of SCH 80 & dimensions as per ANSI B36.10.

2.1.5 Instrument air supply piping from the main instrument air header shall be galvanised heavy class pipes to IS 1239.

2.2 Individual pneumatic signal and air supply tubing shall conform to the following specifications:

2.2.1 Stainless tubes shall be used in general and shall be fully annealed and cold drawn seamless as per ASTM A269 TP 304 with 6mmOD x 1mmWT.

2.2.2 Copper tubing where specified shall be seamless 6mmOD x 1.0mmWT soft annealed as per ASTM 868.74a cd No. 122 (DHP) sheathed with PVC 1.0mm thick coloured Black.

2.3 All fittings shall be as a minimum of 100 rating except for tube fittings. The fittings shall have threading as per B2.1 and socket weld connections as per B 16.11. These shall conform to the following specifications in general.

2.3.1 Tube fittings shall be flare type compression fittings Swagelok or equivalents make double ferrule and pressure seat type.

All tube fittings in impulse lines shall be rated to 5000 PSIG at 38 degree C.

2.3.2 Carbon steel pipe fittings shall be forged as per ASTM A105 stainless steel pipe fittings shall be as per ASTM –182 Grf 316L

2.4 Valve shall have normally Globe body and shall be fabricated out of Bar-stock and rated to min. of 1500. These shall be screwed bonnet type with 13% GSS trim and plug shall be integral with the stem. Face to face dimensions shall be approx. 80mm. End connections shall be socket weld to ANSI 16.11 and threaded to B2.1

2.5 Multibore tubing shall have a maximum 19 single polyethylene tubes, 6mmOD x 1mm numbered for easy identification. The bundle shall be marked with inner and outer fire resistance PVC sheath. They shall carry a pair of telephone wire 0.6mm diameter flexible.

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2.6 Single pair and multi pair extension cables for Thermocouples shall be matched and calibrated in accordance with ISA MC 96.1. Conductor size shall be AWG for single pair and 20 A for Multipair.

The cable shall be armoured, each twisted pair shall be individually shielded with aluminium Mylar tape and a tinned copper drain wire. The wires and the cable shall be colour coded as per ISA recommended practices.

2.7 Instrument Electrical cables shall conform to the following specificationsZ:

2.7.1 Instrument electronic signal cables single pair/ Multipair shall have copper conductor, twisted in pair and individually shielded with Aluminium Mylar tape with drain wire. In multipair cables, each pair shall be armoured with inner and cut PVC sheath. Minimum conductor size shall be 1.5 mm2.

2.7.2 Control Cables for control signal, alarms actuating devices and solenoid valves of the interlock and shutdown valves shall generally be 1.5 mm2 copper conductors armoured with inner and cut PVC sheath.

2.7.3 All power supply cables shall have copper/Aluminium conductor depending upon the conductor size. The cables shall be armoured with inner and cut PVC sheath. The cables shall be sized adequately. Minimum conductor size shall be 2.5 mm2.

2.7.4 2-core armoured cable shall be used for illuminator on level gauges.

2.7.5 The material and construction of all electrical cables shall conform to IS- 1554 Part I or appropriate equivalent code and standard

3.0 INSTALLATION OF INSTRUMENTS

3.1 Instrument Mounting

3.1.1 No instrument shall be installed in such a way that it bends for support on the impulse piping or electrical connection on it.

3.1.2 Pressure gauges and temperature indicator shall normally be mounted directly on line. However direct on line mounting shall be avoided where vibrations are likely to be present.

3.1.3 Local mounted instruments shall be mounted on brackets, panels or placed on a suitable pedestal. Transmitters shall be mounted on 2” pipe supports where practical. Instruments to be mounted on steel columns, masonary structure etc. These shall not be mounted on heating equipments, pipelines and structures.

3.1.4 Blind transmitters shall be mounted at 130mm above graded platform. Local controllers, indicating transmitters and indicating instruments shall be mounted at approximately 1500 mm.

3.1.5 All the instruments shall be accessible from grade, ladder or platform etc. Pressures gauges and other local indicating instruments shall be readable from grade or operating level and if used for manual control shall be visible from the related valve.

All the instruments shall be located such that they don’t impede the process operation.

3.1.6 Local mounted instruments which are not available in weather proof housing shall be mounted inside a weather proof case.

3.1.7 Items such as pilot valves, solenoid valves etc. shall be located local to its point of application or near to the device being actuated by them.

3.1.8 For blind transmitters output meters shall be mounted on instrument supports.

3.1.9 Filter regulators shall be mounted on the instrument supports below pneumatic transmitter or on the control valve yoke.

3.1.10 Instruments or instrument lines shall not be supported on hand rails, in general.

3.1.11 The use of process piping to support instrument lines shall be avoided as far as possible.

3.1.12 The instrument impulse piping shall be kept as short as possible.

3.1.13 Instruments and impulse lines shall be protected against mechanical damage.

3.1.14 In case of capillary tube instruments, capillary tube is to be supported and protected against mechanical damage.

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3.1.15 Orifice meters shall not be installed on the top of orifice fittings. On horizontal lines orifice pressure taps shall be located as follows

a) On top for air and gas service

b) Horizontal for liquid and condensable vapour service.

3.2 Instrument Piping & Tubing.

3.2.1 Impulse Piping/tubing

3.2.1.1 The primary instrument block valves for all instruments shall be as per piping specifications.

3.2.1.2 3- Valve manifold in general shall be integral type. For pressure gauges, 2-valve manifolds shall also be acceptable instead of isolation valve, drain valve and pipe fittings.

3.2.1.3 Differential or static pressure sensing lines shall not exceed 6 mtrs. (20 feet) in general for direct connected or locally mounted instruments.

3.2.1.4 All impulse lines shall be run with a slope not less than 1 in 12 except where otherwise specified. Direction of slope is to be downward from the process for liquid service and upward from the process for gas service.

3.2.1.5 Tubing shall be joined by compression fittings.

3.2.1.6 Piping shall be joined by pipe fittings/flanges as per the piping specifications.

3.2.1.7 All instruments pipes and tubes shall run in horizontal and vertical planes only and shall run with minimum number of changes in direction, consistent with good engineering practices and neat appearance.

3.2.1.8 Tubing shall be bent with correct size tube bender as far as possible to avoid use of fittings. Hot bending shall be totally avoided.

Tube cutter shall always be used to cut tubing. The use of short lengths of tubing in long runs shall be avoided in order to avoid the fittings.

3.2.1.9 All tubing shall run in such a manner as to give the maximum protection against mechanical damage. Tubing runs shall be grouped together and clamped.

3.2.1.10 Tubing shall be arranged so that the unions can be tightened without distorting lines.

3.2.1.11 Instrument tubing or piping shall not run on trays intended for cables and shall not share the same transit.

3.2.1.12 No pipe or tube shall be left with mechanical strain on them.

3.2.1.13 A mechanical ferrule seater shall be used on tubing for 140 kg/cm^2 (2000 psi) or more.

3.2.1.14 Pipe bushings shall not be used.

3.2.1.15 Pipe plugs shall be fabricated out of bar stock and shall have hex-head.

3.2.2 Air/Signal Tubing

3.2.2.1 Signal Transmission tubes shall be laid on perforated trays prefabricated out of min 2.5 mm. thick steel plates. The width of the tray shall be selected as per the number of tubes to be laid.

3.2.2.2 Where tubing is run in permanent enclosures, it should be ensured that entry and exit of such enclosures is clean and smooth.

3.2.2.3 Tubing run in permanent enclosures shall not have joints, except at special junctions boxes provided for this purpose.

3.2.2.4 Where permanent enclosures are left with space for instrument tubing to be laid at some later date, a galvanised pull wire of adequate size shall be left in the tray.

3.2.2.5 Where the length of transmission tubing exceeds 60 mtrs (200ft) necessity of installing signal booster relays shall be considered.

3.2.2.6 In case of `Skidded' equipment or vessels with instrumentation, where off- skid alarms shutdown or control functions are provided the signal tubes shall be terminated on the control bulk head near the skid boundary.

3.2.3 All threaded pipe joints shall be joined after applying Teflon tape. It should be applied in a manner

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to ensure that the tape does not spill over the end of the male fitting. No other pipe joining compound shall be used except on high temperature service where graphite sealing compounds shall be used.

3.2.4 All reasonable precautions shall be taken to prevent foreign materials entering pipe lines or tubing before and during erection.

3.2.5 Pipes and tubes installed but not connected, shall have the ends clad in approved fashion to prevent the entry of foreign material. For a period upto one week adhesive tape may be used, for longer periods, caps or plugs shall be used.

3.2.6 Piping/Tubing supports

3.2.6.1 Piping and tubing shall be adequately supported and fixed at a distance not exceeding that in the following table:

Table - 1

Single tubing/Piping	Max. distance between supports
3/8" OD or less	Continuous
1/2" to 3/4" Nom. size	2 meters (6ft.)
3/4" to 1" Nom. size	3 meters (9ft.)
Multitube bundle	3 meters (9ft)

3.2.6.2 All field mounted instrument air tubing shall be supported with galvanised steel angles or channels of minimum 1/8" thickness fabricated to present neat appearance.

3.2.6.3 All instruments tubing supports shall be galvanised prior to installation

3.2.6.4 Trays shall be properly supported either from any rigid steel structure or concrete member. In case of non-availability of above, a suitable support shall be fabricated.

3.3 Instrument Air Supply Distribution

3.3.1 Piping material for instrument main and branched air headers upto the isolation valve at each take-off from main or branch header shall conform to piping specification.

3.3.2 The air header size shall be established in accordance with the table below, unless otherwise specified, for a header pressure of 4 to 8.5 kg/cm^2

Table – 2

number of users	Nominal pipe size Max.
upto 5	1/2"
upto 10	3/4"
upto 25	1"
upto 80	1-
1/2" upto 150	2"
upto 500	3"

3.2.3 All take off for branch lines are to be from the top of the main header with block valves equal in size to the branch line. All low point shall have a 1/2" valve installed as a drain and blow down point.

3.3.4 A minimum size of ½" pipe shall be run to the instrument with a ½" valve for each user. Tubing from the isolation valve to the instrument shall be 6.0 mm.

3.2.5 Union shall be provided at convenient location in the air header.

3.3.6 Filter regulator shall be provided for individual field mounted consumer and shall be complete with an output gauge.

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3.3.7 In case of skid mounted equipment or vessels which incorporate instrumentation requiring pneumatic supply, on skid supply piping shall terminate at the skid boundary location and size of the supply connections shall be noted on the vendor approval drawings.

3.4 Installation of multitude and Multicore cables.

3.4.1 Multicore/ Multitube cables shall generally be installed on trays or ducts and properly clamped. At bends minimum radius shall be maintained as per cable manufacturer's standards

3.4.2 All cables shall be rigidly supported on structural steel and masonary. Drilling of steel member should normally be avoided. However, if the drilling of steel must be resorted to, it must be drilled where minimum of weakening of structure will result cables shall be support at every 500 mm. At every vertical drop these shall be clamped at more frequent intervals max of 300 mm.

3.4.3 Directly buried cables shall be laid underground in excavated cable trenches. Trenches shall have sufficient depth and width to accommodate all cables correctly spaced and arranged with a view of heat dissipation and economy of design construction of trenches laying of cables and filling up of trenches shall be as per relevant standard.

3.4.4 Each underground cable shall be provided with identifying tag of load securely fastened every 30 M of its underground length with at least one tag at each end before the cable enters the ground. Before cables are placed, the trench bottom shall be filled with a layer of sand. The cables shall be covered with 150 mm of sand on the top of the largest dia. cable tube and sand shall be lightly pressed. A protective covering of 75 mm thick second class red bricks shall be laid flat and the balance portion of the trench shall be filled with soil, compacted and levelled.

3.4.5 At each road crossing and other places where cables enter pipe sleeves, adequate bed of sand shall be given so that the cables don't slack and get damaged by pipe ends after back filling.

3.4.6 At the entry into concrete blocks loops shall be provided at either end to prevent any damage to cable.

3.4.7 The cable entry to control room shall be suitably filled and sealed after laying of cables so as to achieve a positive sealing against the entry of gas/water.

3.4.8 All wiring, tubing, cables, Junctions boxes and auxiliary equivalent shall be suitably identified as per applicable codes and practices. All piping and tubing shall be tagged with slip-on or clip on wire marker at both ends.

3.4.9 Cables jointing are not permitted. Cables shall be cut after the exact site measurements at the cable drums shall be so selected before cutting the lengths as to avoid any unnecessary wastage.

3.4.10 Low signal cables like alarms, analysers cables, special cables for turbine meter, thermocouple compensating cables etc. shall be layed separated from power supply cables in ducts/trenches/trays.

3.4.11 Electric signal lines for electronic transmitters to receive and to final control element shall be continuously shielded with the shield grounded at the same point as the signal circuit generally at the control instrument.

3.4.12 Separate junction boxes shall be used for intrinsically sage cables.

3.4.13 Different intrinsically safe system e.g., systems having different rounds shall not be run in the same multicore cable, in general.

3.4.14

Recommended minimum separation distance between twisted pair signal leads and AC Power Lines

Power Cable	Minimum Distance to AC

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Voltage (Volts)	Current (Am)	Signal Lead in (cm)
0 to 125	0 to 10	12" (30)
125 to 250	0 to 50	15" (38)
250 to 440	0 to 200	18" (46)
5KV & Up	200 Amp. & Up	24" (61)

Different intrinsically safe circuits e.g., circuits having different voltage levels, of the same intrinsically safe system shall not be run in the same cable unless each conductor insulation is at least 0.25mm or no hazard can result from interconnection.

3.4.15 Separation between power cables and signal cables shall be as per API 550 Part I Section VII. Cable in intrinsically safe circuits shall preferably be not run in the same tray where-- on intrinsically safe circuits cables are being run. If these are being run in the same tray, a metallic earthed separately shall be provided.

3.4.16 For temperature controllers, single pair thermocouple extension cable or cable for resistance thermometer shall be layed directly from the element to the transducer in the control room without intermediate terminal blocks.

3.4.17 In case of skid mounted equipment or equipment which incorporates skid instrumentation like alarms, shutdown or control function shall terminate signals or control junction box near skid boundary for connection of off skid equipment.

3.4.18 No wire shall be terminated or left with mechanical strain within any conductor.

3.4.19 Splices shall be made only at terminals, in instruments or approval equipment/ junction boxes using lugs and screwed connections. No intermediate splices shall be made in cable trays or in conduct. Number of junction boxes in any cable path shall be limited to only one.

3.5 Installation of Zener barriers

3.5.1 Zener barriers shall be installed in the circuit to make the system intrinsically safe provided:

a) There is no energy storage system in excess to the minimum permitted by the barrier design on the hazardous side of the barrier. The same shall be met by taking intrinsically safe transmitters and selecting the cable electrical parameters like inductance L/R ratio & capacitance in accordance with the maximum parameters given in barrier specifications.

b) No power source exceeding the voltage rating of Zener barrier shall be connected on safe side of the Zener barrier.

c) No outside power source including other intrinsically safe circuits shall be connected to the hazardous side of the barrier

3.5.2 Zener barriers shall be located as close as possible to the field wiring entry point in the control room.

3.5.3 Single barrier are bolted directly to copper bus bar and multiple barriers on the barrier mounting plates. Copper bus or barriers mounting plates shall be isolated from the panel frame.

3.5.4 The signal ground system for intrinsically safe system shall be separate from power ground system and shall be connected to the signal ground reference point. The maximum resistance allocable between the farthest point on intrinsically safe barrier ground bus and signal ground reference point shall be less than 1 ohm.

3.5.5 Field wires shall directly terminate at the barriers and not through intermediate terminals.

3.6 Installation of Analyser / Gas Chromatograph

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3.6.1 Installation of all analyser shall be in general, as per APIP 550 Part II.

3.6.2 The analyser housing at its installation shall meet all safety requirements as per classifications.

3.6.3 Sampled process fluid, if not returned to the process shall be disposed to a safe location. Piping shall be provided so that vapours can be vented to a safe location and liquids shall be drained in a clean and orderly fashion to a safe place. Toxic vapours shall not be vented to atmosphere.

3.6.4 Analyser shall be located as near to the sampling point as possible.

3.6.5 Analyser equipment must be protected from the following:

a) Hot equipment

b) Severe ambient temperature changes

c) Shock

d) Mechanical damage

e) Vibration

3.6.6 If a separate vent for the analyser is used, the location of that vent shall be in area of minimum air Turbulence. If the vents of different analysers are vented into a common vent, a back pressure regulator shall be used.

3.6.7 Vent piping shall be designed to prevent condensate from accumulation in low point and obstruct a free vent flow.

3.7 Ducts, Trays and Supports

3.7.1 Main cable duct shall be of bottom open type with flat/angle --- construction with side sheet and top cover of 3.2 mm thickness.

3.7.2 The ducts and trays shall be properly supported at regular intervals. Wherever insert plates are not available, support on concrete structure or ceiling shall be fixed with a minimum of 10 mm expansion bolts Angle supports for ducts shall be fabricated from minimum of 40 mm angle.

3.7.3 All supports shall be neatly cut with hacksaw only and not with gas cutting. Free ends of angle supports shall not have sharp ends and shall be properly rounded off.

3.7.4 Ducts and supports shall be painted with one coat of Red oxide Zinc chromate primer conforming to IS-2074 after cleaning to remove scale and then painted with 2 coats of final enamel paint as given below:

a) Duct - Dark admirately Grey as per IS0632.

b) Supports - Black.

3.8 Instrument Steam Tracing

3.8.1 Steam for Tracking of instruments shall be taken from main steam header take of valve through carbon steel pipes supported at regular intervals.

3.8.2 Steam tracing around individual instrument shall be by copper tube of 1/8" diameter.

3.8.3 Piping or tubing for steam tracing shall be installed in such a way as to avoid condensate pockets.

3.8.4 After steam tracing, the line is connected to drain funnel through steam trap.

3.9 Identification of Lines and Instruments

3.9.1 All site mounted instruments, junction boxes, air headers, tubing and wiring terminations shall be labelled or tagged.

3.9.2 Instruments shall be furnished with stainless steel name tags containing Tag no., manufacturer's name, and model no. serial number. This tag number shall be approximately 3"x1" size and shall be attached to the

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instruments with -- gauge stainless steel wire.

3.9.3 Unused cable entries in junction boxes and field instruments are to be plugged.

4.0 TESTING

4.1 Instrument Impulse Piping/Tubing

4.1.1 All process impulse lines shall be disconnected both from the instrument and vessel/piping end and flushed with water.

4.1.2 After thorough flushing the impulse line shall be isolated from the instruments and pressurised hydraulically to 1.5 times the maximum working pressure corrected for ambient temperature. They shall then be isolated from the pressure source and the pressure reading on a test pressure gauge shall not fall at a rate exceeding one psig/hour.

In case no isolation valve is provided near the instrument, impulse piping/tubing shall be pressurised along with the instrument to the maximum pressure of scale in case of pressure transmitter and max. Operating pressure in case of differential pressure instrument with equalising valve open

4.1.3 In special conditions where hydro- testing is not permissible due to service requirements, testing shall be carried out by using compressed air/nitrogen.

4.1.4 The external displacer type instruments and cage type level switches shall be tested to 1.5 times the operating pressure using air/nitrogen after thorough flushing.

4.2 Instrument Air Lines/Signal Tubing

4.2.1 Instrument air lines/signal tubing shall not be hydrostatically tested.

4.2.2 Instrument air tubing shall be disconnected upstream of all filter regulators and blown down to remove water, slag and mill scale, from lines at 7.0 kg/cm ^{2} G for fifteen minutes.

Air filter shall be taken in line and tubing shall be disconnected at instrument end, and blown for 3 minutes to remove traces of dirt.

4.2.3 Testing of instrument air shall be carried out with instrument air at 7 kg/cm^{2}G upto the upstream of the filter regulator after thorough flushing. All lines shall be checked with soap solution and bubbler unit for possible leak at joints.

4.2.4 All signal tubing shall be checked with 1.5 kg/cm^2 after proper flushing. After pressuring, source shall be cut off and rate of fall in pressure shall be less than IPSL for each 100 feet of tubing for a test period of 2 minutes as per instrument society of American RP 7.1 `Pneumatic Control Circuit Pressure Test'

4.3 Cables

4.3.1 All wiring shall be checked to ensure that it is correctly connected and properly grounded.

4.3.2 All cables shall be checked for continuity proper connection and insulation testing.

Insulation test shall be carried out on all wiring with a certified magger after disconnecting the cables at both ends.

4.4 All the results of the above mentioned testing shall be recorded and submitted for check.

4.5 All the in line instruments like orifice plates, turbine meters, Rotameters, Target meters, vortex meters, control valves, safety valves etc. shall be removed and spool pieces shall be provided prior to the flushing of the lines.

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5.0 CALIBRATION OF INSTRUMENTS

5.1 All instruments shall be calibrated strictly as per manufacturer's instructions prior to the installation. In addition to calibration of instruments, setting of safety devices like process switches, safety valves etc. and simulation testing of all interlock and shutdown system shall be carried out.

5.2 In general, all tests shall simulate, as closely as possible, design process condition by the use of manometers, potentiometers, deadweight testers, test pressure gauges etc. Pour point calibration shall refer to the input signal to an instrument equivalent to 0, 25, 50, 75,100% of instrument range upscale (rising) and 75, 50, 25, 0% of instrument (downscale) (falling).

All instruments unless otherwise noted shall be calibrated in upscale and downscale direction and if necessary, adjusted until their accuracies conform to those limits state by the manufacturer.

Upon completion of these tests, the instruments shall be drained, completely.

5.3 Temperature Instruments

5.3.1 Temperature Gauges Filled type and Bi metallic dial type Thermometers shall be four point bench checked for proper operation and calibration using a temperature bath prior to installation.

5.3.2 Temperature Elements and Temperature Transmitters.

Temperature Elements and Transmitter shall be four point bench calibrated using a temperature bath precision meter or precision gauge prior to installation.

5.4 Pressure Instruments

5.4.1 Pressure Gauges

5.4.1.1 Direct connected bourdon type pressure gauges shall be dead weight tested or tested against a test gauges prior to installation.

5.4.1.2 Receiver type pressure gauges shall be four points calibrated using a precision gauge and precision air regulator.

5.4.1.3 Pressure and Differential Pressure Transmitters.

Pressure and differential pressure transmitters shall be four points calibrated using a hydraulic or dead weight tester or a precision pneumatic calibrator prior to the installation. A precision output meter or gauge shall be used to monitor the output.

5.5.1 Orifice plates shall be checked visually for the name plate and for an upstream sharp edge. Bore dia. shall be checked for compliance with the specification.

5.5.2 Differential pressure type of flow instruments shall be four points calibrated using precision pneumatic calibrator or a manometer and precision regulator. A precision output meter or gauge shall be used to monitor the output of the transmitter.

5.5.3 a) Rotameters shall be installed as received. A check shall be made to confirm that shipping stops have been removed and float has been installed.

b) Where rotameters have transmitting mechanism, the float shall be raised and lowered mechanically and output shall be checked. Vendor calibration data/ curve shall be checked.

C) A check shall be conducted with plumb for a vertical installation

5.5.4 Turbine meters, Annubar, positive displacement meters, vortex meter, ultrasonic flow meter, etc. shall be installed as received.

5.5.5 Target meters shall be checked for calibration using calibration weights. Output shall be monitored using precision output meter.

5.6 Level Instruments

5.6.1 Level Gauge Glasses

Gauge glasses shall be installed as received installation of illuminators, frost protectors and other

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accessories shall be checked.

5.6.2 Displacer Type, Level Transmitter

- Displacer type level transmitter shall be checked by raising and lowering mechanically the displacement and checking the pilot or transmitter action. Check transmitter with out put gauge or meter for smooth and full output change.
- A check shall be conducted with plumb for a vertical installation.

5.6.3 Differential pressure type level transmitter Differential pressure type level transmitter shall be calibrated with pneumatic calibrator at four points prior to installation. A precision meter or gauge shall be used to monitor the output of the transmitter.

5.6.4 Tank level gauges

a) Tank level gauges shall be checked by raising and lowering mechanically the displacer and checking the indicator on the gauge board.

b) Check for proper liquid seal prior to installation in case of liquid seal tank gauges.

c) In case of servo type gauges, the displacer is hoisted from the tank into the calibration chamber.

5.7 Control Valves, shutdown valves and self actuated valves

5.7.1 All diaphragm and piston operated control valve shall be stroked pneumatically using a pressure regulator and pressure gauge against the spring range specified on the name plate of the valve.

5.7.2 Mechanical seating and travel of the valve stem shall be checked against the side indicator and the name plate

5.7.3 Valve positioned shall be calibrated with the control valve in accordance with the name plate data and specifications with the help of pneumatic calibrator or gauge with precision regulator. Zero position or fully close position of the valve shall be a live zero i.e., the plug shall be just off the seat at the minimum setting.

5.7.4 Volume bottles, where used shall be checked for proper filling. The signal line shall be bled to zero pressure and failure action shall be confirmed.

5.7.5 Control valve accessories such as handwheels, boosters, relays etc. shall be checked operationally. Declutch able handwheel shall be operable both with and without an air signal to the diaphragm.

5.7.6 Self actuated control valves shall be installed as received, checking inlet and outlet points and name plate data. Regulators with external pressure connections shall be inspected for proper installation.

5.7.7 Butterfly shall be checked carefully to see that the vane moves freely into the upstream and down stream piping. Proper vane movement to stroke shall be confirmed.

5.7.8 All control valves and regulators shall be removed from the line prior to flushing and during hydro testing.

5.8 Safety Relief Valves

5.8.1 Safety relief valves shall be installed as received after carefully checking the name plate data. Pilots, if used, shall be checked carefully for installation on the proper safety valve.

5.8.2 Valves, which are installed in such a manner as to permit on line testing, shall be pressure tested after installation to determine proper operation and setting. Compressed air or nitrogen shall be used for testing of safety relief valves.

5.9 Switches

5.9.1 Level Switches shall be actuated mechanically for switch operation but shall not be calibrated for level setting.

5.9.2 Pressure switches shall be calibrated using hydorlic or dead weight tester or precision air regulator

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and gauge. The setting/trip point shall be checked using a continuity tester.

5.9.3 Temperature switches shall be calibrated using a temperature both prior to installation and set to the required alarm/ trip point using a continuity tester.

5.10 Receiver Instruments

5.10.1 Receiver Indicator/Recorders

5.10.1.1 Pneumatic indicators/ Recorders shall be calibrated using pneumatic calibrator/ precision pressure regulator and gauge.

5.10.1.2 Electronics indicators/ Recorders shall be calibrated using a current generator and a precision meter.

5.10.1.3 Chart drive assembly shall be checked for proper operation.

5.10.2 Controllers

5.10.2.1 Proper balancing of the controller shall be checked as per the manufacturers catalogues

5.10.2.2 Controllers shall be checked for manual and Auto operation and Transfer. The transfer from manual to Auto and vice versa shall be bumpless and smooth.

5.10.3.1 Manual loader station Output of the manual loader shall be checked with a precision meter.

5.10.4.1 Multipoint Temperature Recorders Each point shall be calibrated using a temperature simulator/ decade box for RTD / voltage generator and precision meter for the thermocouples.

5.10.4.2 Point synchronisation shall be checked.

5.10.5 Pneumatic receiver switches shall be calibrated using precision air regulator and gauge. The setting/alarm/trip point shall be checked using continuity tester.

5.10.6 Trip Amplifiers Trip amplifiers shall be calibrated using a temperature simulators or voltage generator and precision meter for thermocouple or Resistance box for RTD's. The required setting/ alarm point/ trip point shall be checked using a continuity tester.

5.10.7 Receiver Switch module Receiver switch modules shall be calibrated using a current source and a precision meter. The required setting/alarm/trip point shall be checked using a continuity tester.

5.10.8 Alarm and Annunciator system

5.10.8.1 Alarm and annunciator system shall be checked for visual and audio alarm operation using dummy signals. Full alarm sequence of each alarm point shall be checked.

5.10.8.2 Each point shall be checked for proper engraving.

5.10.9 Shutdown System

5.10.9.1 Operation of final actuating elements shall be checked for proper operation using dummy signals.

5.10.9.2 All timers, push buttons and switches shall also be checked for their proper operation.

5.11 Analytical Instruments

5.11.1 Check the full analyser system including sample handling system for leakage.

5.11.2 Check the full sample handling system for its proper operation. Calibrate and check completely all analysers using zero and span samples as per vendor catalogues.

5.10.4.1 Multipoint Temperature Recorders

Each point shall be calibrated using a temperature simulator/ decade box for RTD / voltage generator and precision meter for the thermocouples.

5.10.4.2 Point synchronisation shall be checked

5.10.5 Pneumatic receiver switches shall be calibrated using precision air regulator and gauge. The setting/alarm/trip

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point shall be checked using continuity tester.

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5.11.2 Check the full sample handling system for its proper operation. Calibrate and check completely all analysers using zero and span samples as per vendor catalogues.

5.12 Flow computer / Volume corrector

5.12.1 Corrected flow values shall be checked for various D.C. inputs and pressure and temperature variations for upscale and downscale ranges.

5.13 The list of test and calibration instruments with traceability certificates shall be submitted to MECON for approval before carrying out the tests / calibration of instruments at site.

5.14 The formats / description of tests / calibration of all instruments shall be submitted to MECON for approval.

5.15 Daily / weekly reports shall be submitted during execution of work at site

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SPECIFICATION

FOR INSTRUMENT TUBING

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C O N T E N T S

1.0 GENERAL

2.0 CONSTRUCTION

3.0 TESTING

4.0 SHIPPING

5.0 REJECTION

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1.0 GENERAL

1.1 Scope

1.1 This standard specifications, together with the data sheets attached herewith, covers the requirements for the design, materials, testing and shipping of Instrument Tubing which includes the following types:-

a) SS tubes

b) Copper tubes

1.1.2 The related standards referred to herein and mentioned below shall be of the latest edition prior to the date of Purchaser's enquiry:

ASTM A 269	-	Specification for seamless and welded ferritic stainless steel tubing for general services.
ASTM B 251	-	Specification for general requirements for wrought seamless copper and copper alloy tube.
ASTM B 251M	-	Specification for general requirements for wrought seamless copper and copper alloy tube (Metric)
ASTM B 68	-	Specification for seamless copper tube, bright annealed.
ASTM B 68M	-	Specification for seamless copper tube, bright annealed. (Metric)

1.1.3 In the event of any conflict between these specifications, data sheets, related standards, codes, etc., the vendor shall refer the matter to the purchaser for clarifications and only after obtaining the same shall proceed with the manufacture of the items in question.

1.2 Bids

1.2.1 Vendor's quotation shall include a detailed specification sheet for each type of tube which shall provide the following information:

a) All the details regarding the type, construction, materials etc. of the items.

b) Overall dimensions in mm.

1.2.2 All the units of measurement and material specifications for various parts in the vendor's specification sheets shall be to same standards as in purchaser's data sheets.

1.2.3 Vendor shall attach a list of items, type wise, summing up all the deviations from this specification and purchaser's data sheets if there are any. Also vendor shall provide reasons for these deviations.

1.2.4 Vendor shall enclose catalogues giving detailed technical specifications a nd other information for each type of tube in the bid

1.2.5 Vendor's quotation, catalogues, drawings etc. shall be in English language.

1.3 Drawings, Data and Certification

Detailed drawings, data, catalogues and manuals etc. required from the vendor are indicated by the purchaser in vendor data requirement sheets. The required number of reproducible and prints shall be despatched to the address mentioned, adhering to the time limits indicated.

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2.0 CONSTRUCTION

2.1 Stainless Steel Tubes

2.1.1 SS tubes of the tubes shall be Rockwell RB 70-70. Tubes shall be free from scratches and to be suitable for bending.

2.1.3 Tube wall thickness shall be 0.083" for 1/2" OD.

2.1.4 Maximum working pressure shall be 153.0 kg/cm^2 at 38° C for 1/2" OD Tube, unless otherwise specified and 80.0 kg/cm^2 at 38° C for 6mm OD tube.

2.1.5 Tubes shall be supplied in minimum length of 6 metres without brazing in between.

2.1.6 Dimensional tolerances shall be as per ASTM A 269.

2.1.7 The following shall be marked on the tube:

a) Name of manufacturer

b) Type and material grade of tube

c) Tube O.D. and wall thickness

2.2 Copper Tubes

2.2.1 **Copper Tubes (PVC Jacket)**

2.2.1.1 The tube shall be soft annealed copper with 6mm OD and a wall thickness o 1.0 mm as per ASTM B 68M Copper No.C12200.

2.2.1.2 The tube shall be jacketed with black PVC. The jacket thickness shall be 1.6mm. The PVC jacket shall confirm to ASTM D-1047.

2.2.1.3 The tube ends shall be plugged prior to transportation.

2.2.1.4 The tube shall be of continuous length without any brazing in between for 100 metres length.

2.2.1.5 Minimum length of single tube shall be 100 metres.

2.2.1.6 The dimensional tolerances shall be as per ASTM B 251M

2.2.2 **Bare Copper Tubes (For Steam Tracing)**

2.2.2.1 The tube shall be soft annealed copper with 3/8" OD or 6mm OD with a wall thickness of 1.0 mm as per ASTM B68 copper No.C12200.

2.2.2.2 The tube ends shall be plugged prior to transportation.

2.2.2.3 The tube shall be of continuous length without any brazing in between for 100 metres length.

2.2.2.4 Minimum length of tube shall be 100 metres.

2.2.2.5 The dimensional tolerances shall be as per ASTM B 251.

3.0 TESTING

3.1 The following tests shall be done for SS tubes.

a) Hardness test

b) Hydrostatic test at 153.0 kg/cm^2 at 38° C for 1/2" tube and at 80.0 kg/cm^2 at 38°C for 6mm tube, unless otherwise specified.

3.2 PVC jacketed copper tubes shall be tested at 7.0kg/cm^{2}g with dry air for leak check.

3.3 Bare copper tubes shall be hydrostatically tested at 80.0 kg/cm^{2}g at 38°C.

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3.4 Final test before delivery shall include ball test to ensure clear opening of the tube for copper tubes. The O.D of the ball shall be minimum 1mm for 6mm O.D tube and 2mm for 3/8" tube.

4.0 SHIPPING

4.1 The tubes shall be plugged at both ends to avoid entry of foreign matter. The tubes shall be packed carefully so as to avoid damage during transport.

5.0 REJECTION

Vendor shall make his offer in detail, with respect to every item of the purchaser's specifications. Any offer not conforming to this shall be summarily rejected

SPECIFICATION

FOR INSTRUMENT TUBE FITTINGS

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CONTENTS

1.0 GENERAL

2.0 CONSTRUCTION

3.0 TESTING

4.0 SHIPPING

5.0 REJECTION

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1.0 GENERAL

1.1 Scope

1.1.1 This standard specifications, together with the data sheets attached herewith, covers the requirements for the design, materials, testing and shipping of instrument tube fittings which includes the following types:-

a) SS compression fittings (SS tube)

b) Brass compression fittings (copper tube)

1.1.2 The related standards referred to herein and mentioned below shall be of the latest edition prior to the date of Purchase's enquiry:

ANSI B 2.1	-	Pipe Threads
B16.11	-	Forged steelfittings-socket welding and threaded.
IS:319	-	Specification for free cutting brass bars, rods and sections.
ISA RP 42.1	-	Nomenclature for instrument tubing - fittings.

1.1.3 In the event of any conflict between these specifications, data sheets, related standards, codes etc., the vendor shall refer the matter to the purchaser for clarifications and only after obtaining the same shall proceed with the manufacture of the items in question.

1.2 Bids

1.2.1 Vendor's quotation shall include a detailed specification sheet for each type of tube fittings which shall provide the following information:

a) All the details regarding the type, construction, materials, etc. of the items.

b) Overall dimensions in mm.

1.2.2 All the units of measurement and material specifications for various parts in the vendor's specification sheets shall be to same standards as in purchaser's data sheets.

1.2.3 Vendor shall attach a list of items, typewise, summing up all the deviations from this specification and purchaser's data sheets if there are any. Also vendor shall provide reasons for these deviations.

1.2.4 Vendor shall enclose catalogues giving detailed technical specifications and other information for each type of fitting in the bid.

1.2.5 Vendor's quotation, catalogues, drawings, etc. shall be in English language.

1.3 Drawings, Data and Certification

Detailed drawings, data, catalogues and manuals etc., required from the vendor are indicated by the purchaser in vendor data requirement sheets. The required number of reproducibles and points shall be despatched to the address mentioned, adhering to the time limits indicated.

2.0 CONSTRUCTION

2.1 SS Tube fittings:

2.1.1 Nomenclature of all tube fittings shall be as per ISA RP 42.1.

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2.1.2 Fittings shall be flareless compression type and of three piece construction with ferrule, nut and body suitable for use on SS tubes conforming to ASTM A 269 TP304, hardness not exceeding RB80.

2.1.3 All parts shall be of SS 316.

2.1.4 Hardness of the ferrules shall be in the range of RB 85-90 so as to ensure a minimum hardness difference of 5 to 10 between tube and fittings, for better sealing.

2.1.5 Nuts and ferrules of particular size shall be interchangeable for each type.

2.1.6 Spanner hold shall be metric.

2.1.7 Threaded ends of fittings shall be NPT as per ANSI B 2.1.

2.1.8 Copper Tube Fittings

2.2.1 Nomenclature of all tube fittings shall be as per ISA 42.1.

2.2.2 Fittings shall be of flareless compression type and of three-piece construction consisting of ferrule, n u t and body suitable for use on copper tubes conforming to ASTM B 68/B 68M hardnesss not exceeding RB 50.

2.2.3 All parts shall be manufactured from Brass as per IS 319 barstock and Nickel plated.

2.2.4 For better grip, vendor shall maintain hardness difference between tube & ferrule and indicate the same along with the offer.

2.2.5 Nuts & ferrules of particular size shall be interchangeable for each type.

2.2.6 Threaded ends of fittings shall be NPT as per ANSI B 2.1.

2.2.7 Spanner hold shall be metric.

2.2.8 Vendor shall ensure that the ferrules and nuts supplied for fittings shall be suitable for sample tube which shall be supplied during manufacture.

3.0 TESTING

3.1 Random samples of SS tube fittings shall be hydrostatically tested as follows:-

For 6 mm fittings at 80.0 kg/cm^2, 1/2" fittings at 153.0 kg/cm^2 at 38°c unless otherwise specified.

3.2 Random samples of brass compression fittings shall be hydrostatically tested as follows:-

For 1/4" fittings, at 10 kg./cm^2, 3/8" at 80.0 Kg/cm^2 and all at 38°C.

4.0 SHIPPING

4.1 All thread/ends shall be protected with plastic caps to prevent damage/entry of foreign matter.

5.0 REJECTION

Vendor shall make his offer in detail, with respect to every item of the purchaser's specifications. Any offer not conforming to this shall be summarily rejected

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SPECIFICATION

FOR INSTRUMENT VALVES AND MANIFOLDS

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C O N T E N T S

1.0 GENERAL

2.0 CONSTRUCTION

3.0 TESTING

4.0 SHIPPING

5.0 REJECTION

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1.0 GENERAL

1.1 Scope

1.1.1 This standard specifications, together with the data sheets attached herewith, covers the requirements for the design, materials, testing and shipping of Instrument Valves & Manifolds which includes the following types:-

a) Miniature instrument valves

b) Instrument valve manifolds

c) Instrument air valves

1.1.2 The related standards referred to herein and mentioned below shall be of the latest edition prior to the date of Purchaser's enquiry:

ANSI B 2.1 - Pipe threads

ANSI B 16.11 - Forged steel fittings-socket welding and threaded.

1.1.3 In the event of any conflict between these specifications, data sheets related standards, codes etc, the vendor shall refer the matter to the purchaser for clarifications and only after obtaining the same shall proceed with the manufacture of the items in question.

1.2 Bids

1.2.1 Vendor's quotation shall include a detailed specification sheet for each type of Valves & Manifolds which shall provide the following information:

a) All the details regarding the type, construction, materials etc. of the items.

b) Overall dimensions in mm.

1.2.2 All the units of measurement and material specifications for various parts in the vendor's specification sheets shall be to same standards as in purchaser's data sheets.

1.2.3 Vendor shall attach a list of items, typewise, summing up all the deviations from this specification and purchaser's data sheets if there are any. Also vendor shall provide reasons for these in the bid.

1.2.4 Vendor's quotation, catalogues, drawings etc. shall be in English language.

1.3 Drawing, Data & Certification

Detailed drawings, data, catalogues and manual etc. required from the vendor are indicated by the purchaser in vendor data requirement sheets. The required number o f reproducible and prints shall be despatched to the address mentioned, adhering to the time limits indicated.

2.0 CONSTRUCTION

2.1 Instrument Valves (Miniature)

2.1.1 The instrument valves shall be globe pattern-needle valves forged/ bar stock with inside screwed bonnet.

2.1.2 Body and trim material shall be 304 SS unless otherwise specified.

2.1.3 The valve body rating shall be 3000 lbs unless specified in piping material specification which shall govern in case it is specified

2.1.4 The end connection shall be 1/2" NPTF to ANSI B2.1.

2.1.5 The packing material shall be teflon unless otherwise specified.

2.1.6 The hand wheel material shall be carbon steel zinc plated.

2.1.7 Flow direction shall be marked on the body.

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2.1.8 The valve dimension shall be as follows:

a) End to end dimensions 76 mm (approximately).

b) Height in fully open condition - 135mm maximum.

2.2 VALVE MANIFOLDS

2.2.1 3-Valve & 5-Valve manifolds:

2.2.1.1 3-Valve manifold shall be designed for direct coupling to differential pressure transmitters having 2 bolt flanges with 54 mm (2-1/8") centre to centre connections and 41.3 mm (1-5/8") bolt to bolt distance. The manifold shall contain two main block valves and an equalizing by-pass valve. The valves shall be needle valves. They shall use self aligning 316SS ball seats.

2.2.1.2 5-Valve manifold shall contain two main line block valves and a combination double block and bleed for the bypass line.

2.2.1.3 The manifold shall be suitable for mounting directly on the station (2" pipe).

2.2.1.4 All bonnets shall have teflon packing unless otherwise specified.

2.2.1.5 The material of construction shall be 316 SS unless otherwise specified.

2.2.1.6 The material of construction shall be 316SS unless otherwise specified.

2.2.1.7 The flanges shall be integral part of the block.

2.2.1.8 The process connection shall be 1/2" NPTF to ANSI B2.1

2.2.1.9 The manifolds shall be supplied alongwith mounting accessories. The bolts and nuts shall be alloy steel as per ASTM A 193 Gr B ASTM A 194 GR 2H respectively. Rings shall be teflon and other accessories shall be cadmium plated.

2.2.1.10 Vendor shall furnish the material certificate for body.

2.2.2 3 Way 2 Valve Manifold for pressure gauges.

2.2.2.1 The manifold shall be designed for use with pressure gauges.

2.2.2.2 The valve shall be a ball valve.

2.2.2.3 The body shall be either straight or angle as specified in data sheets.

2.2.2.4 The body and trim material shall be 316SS, packing material shall be teflon unless otherwise specified.

2.2.2.5 The inlet connection shall be 3/4" plain end (female) for socket weld as per ANSI B 16.11.

2.2.2.6 The gauge connections shall be with union nut & tail piece threaded 1/2" NPT (F).

2.2.2.7 The drain connection shall 1/2"NPTF.

2.3 Instrument Air Isolation Valves

2.3.1 The valves shall be full bore ball valves.

2.3.2 Body material shall be Nickel or Cadmium plated carbon steel.

2.3.3 Trim material shall be 316SS.

2.3.4 The end connection shall be 1/2" NPTF to ANSI B2.1 unless otherwise specified.

2.3.5 The packing material shall be teflon.

2.3.6 The handle/wrench material shall be cadmium or nickel plated carbon steel.

2.3.7 The valve body rating shall be ANSI 800 lb

2.3.8 End to end dimensions shall be 70mm (approximately).

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3.0 TESTING

3.1 The instrument valves (miniature) shall be hydrostatically tested at 200kg/cm^{2} g at 38°C.

3.2 All manifolds (3 valves, 5 valves and 3 ways, 2 valves) shall be hydrostatically tested at 200 kg/cm2 at 38C.

3.3 The instrument air valves shall be hydrostatically tested at 15.0 kg/cm^{2}g at 38°C and at 10.5 kg/cm^{2}g with dry air.

4.0 SHIPPING

4.1 All threads/ends shall be protected with plastic caps to prevent damage/entry of foreign matter.

5.0 REJECTION

Vendor shall make his offer in detail, with respect to every item of the purchaser's specifications. Any offer not conforming to this shall be summarily rejected.

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BHAGYANAGAR GAS LIMITED City Gas Distribution project	MANUAL BALL VALVES ABOVEGROUND SERVICES SIZE - 2" AND ABOVE DATA SHEET	DATA SHEET No. P.019141 G11087 M001 (VBA-3C1) Page 1 of 2

I. PROCESS DATA :

- PIPE CLASS	:	3C1	-	CORROSION ALLOWANCE	:	1.6 mm
- FLUID	:	Natural Gas				
- FLUID SYMBOL	:	NG				
- OPERATING CONDITION						
TEMPERATURE (°C)	:	10 - 50				
PRESSURE (Barg)	:	19 - 45				
- DESIGN CONDITION						
TEMPERATURE (°C)	:	0 - 65				
PRESSURE (Barg)	:	49				

II. VALVE DATA :

- APPLICABLE SPECIFICATION	:	PTS - Pipeline valves
- CONSTRUCTION DESIGN	:	API 6D
- PIPE CLASS	:	3C1
- RATING	:	300#
- VALVE BORE	:	Full Bore
- TYPE	:	2" - 4" - FLOATING BALL 6" & ABOVE - TRUNNION MOUNTED - DOUBLE BLOCK AND BLEED
- END CONNECTION	:	BW/Flange End
- BODY MATERIAL	:	ASTM A 216 GR. WCB / ASTM A 234 GR. WPB
- BALL MATERIAL	:	(ASTM A 216 GR. WCB / ASTM A 234 GR. WPB) + MINIMUM 75 MICRONS ENP
- BODY SEAT RINGS	:	AISI 4140 + MINIMUM 75 MICRONS ENP COATING / AISI 410
- SEAT SEAL	:	VITON / DEVLON
- STEM	:	AISI 4140 + MINIMUM 75 MICRONS ENP COATING / AISI 410
- STEM SEALS	:	VITON / PTFE
- STUD BOLTS/NUTS	:	ASTM A 193 Gr. B7 / ASTM A 194 GR. 2H
- PRIMARY SEAT	:	METAL TO METAL
- SECONDARY SEAT	:	DEVLON / RPTFE or Equivalent
- FIRE SAFE	:	YES (Bidder to submit documentry proof)
- ANTISTATIC	:	YES
- ANTI-BLOW OUT	:	YES
- EXTENSION STEM	:	NO
- PUPS (Applicable only for BW end)		
LENGTH	:	Min. 150 mm for size upto 8" & Minimum 250 mm for size greater than 10"
MATERIAL OF CONSTRUCTION	:	for 2" TO 8" size - API 5L GR.-X52 PSL2 for 10" TO 16" size - API 5L GR.-X56 PSL2
THICKNESS	:	See PMS
- **PAINTING (Refer Annexure II of PTS)**		
Surface preparation	:	SA 2.5

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Primer	:	30 - 40 µm	See Para.11 of PTS- PIPELINE VALVES & Painting System & Colour Code for Final Layer (P.019141 G11077 M005 & P.019141 G11077 M012)
Finish	:	30 - 40 µm	
Final Paint DFT	:	300 µm (min.)	
- **INSULATION**	:	NO	

12.08.2021	0	AHR	SSA	SSM	ISSUED FOR PROCUREMENT	
DATE	REV	PREP	CHK	APP	DESCRIPTION	

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BHAGYANAGAR GAS LIMITED City Gas Distribution Project	MANUAL BALL VALVES ABOVEGROUND SERVICES SIZE - BELOW 2" DATA SHEET	DATA SHEET No. P.019141 G 11087 M003 (VBA-3C1) Page 1 of 2

I *GENERAL*

- VALVE MANUFACTURER	-
- ACTUATOR MANUFACTURER	NA

II *VALVE DESIGN CONDITIONS*

- CORROSSION ALLOWANCE	1.6 mm
- SERVICE	Gas
- DESIGN PRESSURE (Barg)	49
- TEMPERATURE (°C)	0 to 65

III. *CONNECTING PIPE DETAILS*

- MATERIAL	See PMS
- DIAMETER (OD)	See PMS
- THICKNESS	See PMS

IV. *VALVE CONSTRUCTION DESIGN :*

- APPLICABLE SPECIFICATION	PTS - Pipeline valves
- CONSTRUCTION DESIGN	ISO EN 17292
- PIPE CLASS	3C1
- RATING	800 #
- INSTALLATION	ABOVE GROUND
- VALVE BORE	AS per M.R.
- VALVE BODY	FULLY WELDED / BOLTED
- TYPE	FLOATING BALL
- VALVE OPERATION	WRENCHED OPERATED
- END CONNECTION	SW,
- FACE FINISH (Flanged End)	125 AARH

V *VALVE MATERIAL SPECIFICATION*

PART DESCRIPTION

- BODY
- BALL
- SEAT
- STEM
- GASKET & PACKING
- TRIM
- LENGTH OF EXTENSION STEM

- PUPS (Applicable only for BW end)		As per MR
Length	:	100 MM
Material of Construction	:	ASTM A 106
Thickness	:	SCH. 80
- PAINTING		
Surface preparation	:	SA 2.5
Primer	:	Type of Paint, Total DFT shall be as per paint system no. chosen from Table 5, ISO 12944-5 for highly corrosive environment, Final Shade shall be as per Painting Specification no. P.019141G11077 M012
Finish	:	
Final Paint DFT	:	300 µm (min.)
- INSULATION		NO

DATE	REV	PREP BY	CHECK BY	APPR BY	DESCRIPTION

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Rev-0						

SPECIFIED MATERIAL	**OFFERED MATERIAL**
ASTM A 105	*
ASTM A182 GR.F316	*
RPTFE WITH SECONDARY METAL TO METAL	*
ASTM A182 GR.F316	*
GRAPHITE	*
ASTM A 182 F6	*
Not Applicable	

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BHAGYANAGAR GAS LIMITED City Gas Distribution Project in UP & UK Cluster GA's	MANUAL BALL VALVES ABOVEGROUND SERVICES SIZE - BELOW 2" DATA SHEET	DATA SHEET No. P.019141 G 11087 M003 (VBA-3C1) Page 2 of 2

VI TEST

- HYDROSTATIC SHELL TEST :					
Test pressure	:	1.5 x Design Pressure	Test Medium :	Water	
Test Duration	:	15 mins.			
- HYDROSTATIC SEAT TEST :					
Test pressure	:	1.1 x Design Pressure	Test Medium :	Water	
Test Duration	:	5 mins.			
- PNEUMATIC SEAT TEST :					
Test pressure	:	6 barg	Test Medium :	Air	
Test Duration	:	5 mins.			
- FUNCTIONAL TEST :	:	3 Opening / Closing			
Test pressure	:	Atmospheric & Maximum differential pressure			
- EXTERNAL LEAK TEST	:	at inner pressure of 6 barg with soap suds to check external leak of Body, Stem and all external taps.			
- TORQUE TEST	:	Yes			
- ANTISTATIC TEST	:	BS 5146			
- VISUAL AND DIMENSIONAL EXAMINATION TEST:	:	MSS-SP-55 / API 1104			
- FIRE TEST	:	API 6FA			

IV QUALITY CONTROL	:	See quality control table for valves
- **MATERIAL CERTIFICATES**	:	ALL PRESSURE RETAINING AND PRESSURE CONTROLLING PARTS OF VALVES SHALL BE SUPPLIED WITH EN 10204 - 3.1 CERTIFICATES.
- **ALL TEST CERTIFICATES**	:	TEST CERTIFICATES INCLUDING, FIRE SAFE, ANTISTATIC, PHYSICAL IMPACT, CHEMICAL, PAINTING ETC.

NOTES:-

1 Unless otherwise stated, all tests will be witnessed by the purchaser/control authority.

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BHAGYANAGAR GAS LIMITED City Gas Distribution project IN HYDERABAD GA	MANUAL GLOBE VALVES ABOVEGROUND SERVICE SIZE 2" AND ABOVE DATA SHEET	DATA SHEET NO. P.019141 G11087 M002A (VGA-3C1) Page 1 of 2

I. PROCESS DATA

- PIPE CLASS	:	3C1	- CORROSION ALLOWANCE	:	1.6 mm
- FLUID	:	Natural Gas			
- Fluid Symbol	:	NG			
- OPERATING CONDITIONS					
Pressure (barg)	:	15-35			
Temperature (°C)	:	10 - 50			
- DESIGN CONDITIONS					
Pressure (barg)	:	49			
Temperature (°C)	:	0 to 65			

II. VALVE DATA

- CONSTRUCTION DESIGN	:	BS 1873
- TYPE	:	HIGH RESISTANCE TO VIBRATIONS AND HIGH DIFFERENTIAL PRESSURE
	:	BILINEAR OR EQUAL %
	:	Uni-Directional
	:	GLAND TYPE-BOLTED BONNET-NON ROTATING STEM
PATTERN	:	STRAIGHT THROUGH GLOBE
- END CONNECTION	:	Refer MR
- FACE TO FACE	:	ANSI B16.10
- BODY MATERIAL	:	ASTM A 216 GR. WCB / ASTM A 234 GR. WPB
- DISC MATERIAL	:	13% CR. STEEL / SS304L
- SEAT	:	13% CR. STEEL / SS304L
- TRIM	:	13% CR. STEEL / SS304L
- STEM	:	13% CR. STEEL / SS304L
- GASKET	:	GRAPHITE
- PACKING	:	GRAPHITE
- OPERATOR	:	HANDWHEEL OPERATED
- **PAINTING**		
Surface preparation	:	SA 2.5
Primer	:	Type of Paint, Total DFT shall be as per paint system no. chosen from Table 5, ISO 12944-5 for highly corrosive
Finish	:	environment, Final Shade shall be as per Painting Specification no. P.019141G11077 M012
Final Paint DFT	:	300 µm (min.)
- INSULATION	:	No

DATE	REV	PREPARED BY	CHECKED BY	APPROVED BY	DESCRIPTION
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BHAGYANAGAR GAS LIMITED City Gas Distribution project	MANUAL GLOBE VALVES ABOVEGROUND SERVICE SIZE LESS THAN 2" DATA SHEET	DATA SHEET NO. P.019141 G11087 M002 (VGA-3C1) Page 1 of 2

I. PROCESS DATA

- PIPE CLASS	:	3C1	- CORROSION ALLOWANCE	:	1.6 mm
- FLUID	:	Natural Gas			
- Fluid Symbol	:	NG			
- OPERATING CONDITIONS					
Pressure (barg)	:	15-35			
Temperature (°C)	:	10 - 50			
- DESIGN CONDITIONS					
Pressure (barg)	:	49			
Temperature (°C)	:	0 to 65			

II. VALVE DATA

- CONSTRUCTION DESIGN	:	ISO 15761
- TYPE	:	HIGH RESISTANCE TO VIBRATIONS AND HIGH DIFFERENTIAL PRESSURE
	:	BILINEAR OR EQUAL %
	:	Uni-Directional
	:	GLAND TYPE-BOLTED BONNET-NON ROTATING STEM
PATTERN	:	STRAIGHT THROUGH GLOBE
- END CONNECTION	:	SW
- FACE TO FACE	:	ANSI B16.10
- BODY MATERIAL	:	ASTM A 105
- DISC MATERIAL	:	13% CR. STEEL/ SS304L
- SEAT	:	13% CR. STEEL/ SS304L
- TRIM	:	13% CR. STEEL/ SS304L
- STEM	:	13% CR. STEEL/ SS304L
- GASKET	:	GRAPHITE
- PACKING	:	GRAPHITE
- OPERATOR	:	HANDWHEEL OPERATED
- **PAINTING**		
Surface preparation	:	SA 2.5
Primer	:	Type of Paint, Total DFT shall be as per paint system no. chosen from Table 5, ISO 12944-5 for highly corrosive
Finish	:	environment, Final Shade shall be as per Painting Specification no. P.019141G11077 M012
Final Paint DFT	:	300 µm (min.)
- INSULATION	:	No

DATE	REV	PREPARED BY	CHECKED BY	APPROVED BY	DESCRIPTION
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BHAGYANAGAR GAS LIMITED City Gas Distribution project UP & UK Cluster GA's	MANUAL GLOBE VALVES ABOVEGROUND SERVICE SIZE LESS THAN 2" DATA SHEET	DATA SHEET NO. P.019141 G11087 M002 (VGA-3C1) Page 2 of 2

III. VALVE INSPECTION AND TESTING

- SHELL TEST	:	SEE API 598 / BS 6755
- BACKSEAT TEST	:	SEE API 598 / BS 6755
- LOW -PRESSURE CLOSURE TEST	:	SEE API 598 / BS 6755
- HIGH-PRESSURE CLOSURE TEST	:	SEE API 598 / BS 6755
- VISUAL EXAMINATION OF CASTINGS	:	SEE API 598 / BS 6755
- HIGH-PRESSURE PNEUMATIC SHELL TEST	:	SEE API 598 / BS 6755

NOTE : Unless otherwise stated, all tests will be witnessed by the purchaser.

IV. QUALITY CONTROL (See Quality Control Table for CS valves)

- MATERIAL CERTIFICATES	ALL PRESSURE RETAINING AND PRESSURE CONTROLLING PARTS OF VALVES SHALL BE SUPPLIED WITH EN 10204 - 3.1 CERTIFICATES.
- ALL NECESSARY CERTIFICATES	TEST CERTIFICATES INCLUDING, FIRE SAFE, ANTISTATIC, PHYSICAL IMPACT, CHEMICAL, PAINTING ETC.

19.07.2022	0	AHR	SSA	SSM	Issued for Tender	
DATE	**REV**	**PREPARED BY**	**CHECKED BY**	**APPROVED BY**	**DESCRIPTION**	

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PRESSURE RELIEF VALVE

UNITS: Flow<-> Liquid- m*3/hr Gas- Sm*3/hr Steam- kg/hr Pressure-> kg/cm*2 G Temperature<-> oC Level/Length<-> mm

General	1	Tag No.	Quantity	*	*
	2	Line No.	Schedule	*	*
	3	Vessel No.		*	
	4	Safety / Relief		Safety relief	
Valve	5	Full Nozzle Full Lift/Mod. Nozzle		Full nozzle full lift	
	6	Bonnet type		Closed	
	7	Conv./Bellows/Pilot Operated		Conventional	
	8	Inlet Conn.	Size & Rating	*	
	9		Facing & Finish	*	
	10	Outlet Conn.	Size & Rating	*	
	11		Facing & Finish	*	
	12	Cap Over Adj. Bolt		Yes	
	13		Screwed / Bolted	Bolted	
	14	Lifting Gear - Type			
	15	Test Gag		Yes	
	16				
	17				
Material	18	Body and Bonnet		A351 CF8M	
	19	Nozzle and Disc		SS316	
	20	Spring		SS304	
	21	Bellows		--	
	22				
	23				
	24	Resilient Seat Seal		--	
Options	25				
	26				
Basis	27	Code		API	
	28				
	29				
Service conditions	30	Fluid	State	Natural Gas	Gas
	31	Corrosive Constituent			
	32	Required Flow Capacity			
	33	Mol.Wt.	S.G. at Rel. Temp		
	34	Oper. Pressure	Normal		
	35	Oper. Temp.	Rel. Temp.		
	36	Valve Discharges to		Atmosphere	
	37	Back Press.	Const. Or Variable	Variable	
	38	Set Pressure			
	39	Cold Bend Test Pressure			
	40	% Over Pressure	% Blow Down	21%	
	41	Cp/Cv	Compressibility Factor		
	42	Viscosity @ Rel. Temp.	mPas(cP)		
	43	Vess. Wall Temp.	Surf.Area-m2		
	44				
Orifice	45	Calculated Area cm2		*	
	46	Sel. Area cm2	Orifice Design	*	*
	47	No. of Valves Reqd. for capacity		*	
	48	Tota Area - cm2		*	
	49	Actual Flow Capacity		*	
	50				
	51	Model No.		*	
	52	IBR Certification		No	
	53				
	54				

NOTES:

'*' : Venodr to furnish

☐ DEVIATION ☐ NO DEVIATION VENDOR'S SIGNATURE WITH SEAL

Document No.	P.019141 G11087 M003					
Sheet 1 of 1	CLIENT:					
	PROJECT: City Gas Distribution project					
		0	12.08.2021	AHR	SHD	SSM
	VENDOR:	REV.	DATE	PREP	CHKD	APPD

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QUALITY ASSURANCE PLAN
BALL VALVES
SIZE BELOW 2 INCH

QAP No. : P.019141 G11013 M002	
Date: 27.09.2024	Revision: 0
Prepared : AML	
Checked : GGA	
Approved : SSM	

Sl. Nos.	ACTIVITY	GTS / PTS chap.	Applied standard e/o Procedure	Acceptance criteria	Document type	Scope of Inspection: Manufacturer	Scope of Inspection: TPIA (By Manufacturer / Contractor)	Scope of Inspection: Control Authority
1	**CONTROL BEFORE MANUFACTURING**							
	- list of operation in manufacturing and control	3		specification		Perform	review point	review point
	- material part list	6.1.		specification		Perform	review point	review point
	- dimensional drawings	6.1.		specification		Perform	review point	review point
	- calculation butt welding ends	6.1. / 6.2.2.		specification		Perform	review point	review point
	- calculation of body bolting, Bonnet, Cover (For Pressure Retaining Parts)	6.2.8.	ASME B16.34	specification,		Perform	review point	review point
	- Fixation of Operation Methodology	6.3	Relavant Standard	specification, Data Sheet		Perform	review point	review point
	- qualified welding procedures/welders performances qualification record	8.1, 8.2, 10.2		specification		Perform	review point	review point
	- heat treatment procedure	8.3		specification		Perform	review point	review point
	- non destructive testing procedures	8.5		specification		Perform	review point	review point
	- pressure test procedure	8.6.6		specification		Perform	review point	review point
	- painting procedure	11		specification		Perform	review point	review point
2	**CONTROL ON RECEIPT OF MATERIAL**							
2A	**Valve BODY:**	7	ISO EN 17292 / Relavant Standard					
	Casting/Forging			GTS / PTS	certif. 3.1	Perform	review point	review point
	Chemical Testing, **Carbon Equivalent**			GTS / PTS	certif. 3.1	Perform	review point	review point
	Heat Treatment							
	Mechanical tests (YS, TS, % EL, Ys / TS ratio, Micro / Macro, hardness etc) (Remark : marking transfer by TPIA)			GTS / PTS	certif. 3.1	Perform	review point	review point
	Charpy-test at 0°C and as per Material requirement 2 test sets (1 long./1 trans) (Remark : marking transfer by TPIA)			- **At 0°C Minimum Average Absorbed Energy** shall be SMYS (Mpa)/10, with a minimum of 27 J, for the transerve direction. - **At 0°C Minimum Individual Energy value** shall not be less than 80 % of the Minimum required average value, for the transerve direction.	certif. 3.1	Perform	review point	review point
	UT of Forging Body (100%)	-	ASME B 16.34	ASME B 16.34, App IV	certif. 3.1	Perform	review point	review point
	Radiography Test of Casting Body (100%)	-	ASME B 16.34	ASME B 16.34	certif. 3.1	Perform	review point	review point
	Wet magnetic Particle Examination (100% External & accessible Internal)	-	ASME B 16.34	ASME B 16.34	certif. 3.1	Perform	review point	review point

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	FLANGES:							
	Chemical Testing, **Carbon Equivalent**			GTS / PTS	certif. 3.1	Perform	review point	review point
	Heat Treatment		Relavant Standard	GTS / PTS	certif. 3.1	Perform	review point	review point
	Mechanical tests (YS, TS, % EL, Ys / TS ratio, Micro / Macro, hardness etc) (Remark : marking transfer by TPIA)		ASTM A370	GTS / PTS City Gas Distribution	certif. 3.1	Perform	review point	review point

QUALITY ASSURANCE PLAN
BALL VALVES
SIZE BELOW 2 INCH

QAP No. : P.019141 G11013 M002	
Date: 27.09.2024	Revision: 0
Prepared : AML	
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Approved : SSM	

Sl. Nos.	ACTIVITY	GTS / PTS chap.	Applied standard e/o Procedure	Acceptance criteria	Document type	Scope of Inspection: Manufacturer	Scope of Inspection: TPIA (By Manufacturer / Contractor)	Scope of Inspection: Control Authority
2B	Charpy-test at 0°C and as per Material requirement 2 test sets (1 long./1 trans.) (Remark : marking transfer by TPIA)	-	ASTM A370	- **At 0°C Minimum Average Absorbed Energy** shall be SMYS (Mpa)/10, with a minimum of 27 J, for the transerve direction. - **At 0°C Minimum Individual Energy value** shall not be less than 80 % of the Minimum required average value, for the transerve direction.	certif. 3.1	Perform	review point	review point
	UT of Forging Body (100%)	-	ASME B 16.34	ASME B 16.34, App IV	certif. 3.1	Perform	review point	review point
	Wet magnetic Particle Examination (100% External & accessible Internal)		ASME B 16.34	ASME B 16.34	certif. 3.1	Perform	review point	review point
2C	**LATERAL CONNECTIONS:**	7					review point	
	Chemical Testing, **Carbon Equivalent**			GTS / PTS	certif. 3.1	Perform	review point	review point
	Mechanical tests (YS, TS, % EL, Ys / TS ratio, Micro / Macro, hardness etc) (Remark : marking transfer by TPIA)		ASTM A370	GTS / PTS	certif. 3.1	Perform	review point	review point
	Charpy-test at 0°C and as per Material requirement 2 test sets (1 long./1 trans.) (Remark : marking transfer by TPIA)		ASTM A370	- **At 0°C Minimum Average Absorbed Energy** shall be SMYS (Mpa)/10, with a minimum of 27 J, for the transerve direction. - **At 0°C Minimum Individual Energy value** shall not be less than 80 % of the Minimum required average value, for the transerve direction.	certif. 3.1	Perform	review point	review point
	UT of Forging Body (100%)	-	ASME B 16.34	ASME B 16.34, App IV	certif. 3.1	Perform	review point	review point
	Radiography Test of Casting Body (100%)	-	ASME B 16.34	ASME B 16.34	certif. 3.1	Perform	review point	review point
	Wet magnetic Particle Examination (100% External & accessible Internal)	-	ASME B 16.34	ASME B 16.34	certif. 3.1	Perform	review point	review point
	EXTENSION PIPE PIECES AS PER DATA SHEET						review point	

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	Chemical Test, Carbon Equivalent						review point	
	Mechanical tests (Remark : marking transfer by TPIA)		ASTM A370	GTS / PTS	certif. 3.1	Perform	review point	review point
2D	Charpy-test at 0°C and as per Material requirement 2 test sets (1 long./1 trans.) (Remark : marking transfer by TPIA)	7	ASTM A370	- at **0°C, for Base** - 40J/cm²(Avg.), 32J/cm²(Ind.), - at **0°C, for Weld/HAZ** - 27J/cm²(Avg.), 22J/cm²(Ind.)	certif. 3.1	Perform	review point	review point
	BALL / OBTURATOR (Note -7):							
	Chemical Testing, **Carbon Equivalent**			GTS / PTS	certif. 3.1	Perform	review point	review point

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	QUALITY ASSURANCE PLAN **BALL VALVES** **SIZE BELOW 2 INCH**	QAP No. : P.019141 G11013 M002 Date: 27.09.2024 Revision: 0 Prepared : AML Checked : GGA Approved : SSM

Sl. Nos.	ACTIVITY	GTS / PTS chap.	Applied standard e/o Procedure	Acceptance criteria	Document type	Scope of Inspection		
						Manufacturer	TPIA (By Manufacturer / Contractor)	Control Authority
2E	- Mechanical tests (YS, TS, % EL, Ys / TS ratio, Micro / Macro, hardness of Base ENP Coating etc) (Remark : marking transfer by TPIA)	7	Relavant Standard	GTS / PTS	certif. 3.1	Perform	review point	review point

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QUALITY ASSURANCE PLAN
BALL VALVES
SIZE BELOW 2 INCH

QAP No. : P.019141 G11013 M002	
Date: 27.09.2024	Revision: 0
Prepared : AML	
Checked : GGA	
Approved : SSM	

Sl. Nos.	ACTIVITY	GTS / PTS chap.	Applied standard e/o Procedure	Acceptance criteria	Document type	Scope of Inspection		
						Manufacturer	TPIA (By Manufacturer / Contractor)	Control Authority
	UT of Forging Body (100%) OR		ASME B 16.34	ASME B 16.34, App IV	certif. 3.1	Perform	review point	review point
	Radiography Test of Casting Body (100%)		ASME B 16.34	ASME B 16.34	certif. 3.1	Perform	review point	review point
2F	**SEAT:**	7		GTS / PTS	certif. 3.1	Perform	review point	review point
	- Mechanical tests (YS, TS, % EL, Ys / TS ratio, Micro / Macro, hardness etc) (Remark : marking transfer by TPIA), - Chemical tests, Carbon equivalent		Relavant Standard	GTS / PTS				
	Wet magnetic Particle Examination (All accessible area)	-	ASME B 16.34	ASME B 16.34	certif. 3.1	Perform	review point	review point
2G	**STEM:**	7						
	-Chemical Testing, **Carbon equivalent**			GTS / PTS	certif. 3.1	Perform	review point	review point
	-Mechanical tests (YS, TS, % EL, Ys / TS ratio, Micro / Macro, hardness of Base and ENP coating etc) (Remark : marking transfer by TPIA)		ASTM A370	GTS / PTS	certif. 3.1	Perform	review point	review point
	UT of Forging Body (100%)	-	ASME B 16.34	ASME B 16.34, App IV	certif. 3.1	Perform	review point	review point
	Wet magnetic Particle Examination (All accessible area)	-	ASME B 16.34	ASME B 16.34	certif. 3.1	Perform	review point	review point
2H	**STUDS/NUTS (With Xylan Coating)**	7		GTS / PTS				
	-Chemical Testing, **Carbon Equivalent**			GTS / PTS	certif. 3.1	Perform	review point	review point
	- Mechanical tests (YS, TS, % EL, Ys / TS ratio, Micro / Macro, hardness etc) (Remark : marking transfer by TPIA)		ASTM A370	GTS / PTS	certif. 3.1	Perform	review point	review point
2I	**VENT/BLEED PLUG:**	7		GTS / PTS	certif. 3.1	Perform	review point	review point
	- 'Chemical test,"Mechanical tests		Relavant Standard	GTS / PTS				
2J	**DRAIN: OPEN BLOCK VALVE AT DRAIN TAP:**	7		GTS / PTS	certif. 3.1	Perform	review point	review point
	- 'Chemical test, mechanical tests		Relavant Standard	GTS / PTS				
2K	**DRAIN: UPPER BALL VALVE & NEEDLE VALVE:**	7		GTS / PTS	certif. 3.1	Perform	review point	review point
	- 'Chemical Test, Mechanical tests		Relavant Standard	GTS / PTS				

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2L	**STEM & SEAT SEALING CONNECTION :**	7		GTS / PTS	certif. 3.1	Perform	review point	review point
	- Chemical Test, Mechanical tests		Relavant Standard	GTS / PTS				
2M	**OTHER VALVE PARTS INCLUDING PIPE PUP PIECE**	7		GTS / PTS	certif. 3.1	Perform	review point	review point
	- Mechanical and Chemical tests		Relavant Standard	GTS / PTS				
				GTS / PTS				

QUALITY ASSURANCE PLAN
BALL VALVES
SIZE BELOW 2 INCH

QAP No. : P.019141 G11013 M002	
Date: 27.09.2024	Revision: 0
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Sl. Nos.	ACTIVITY	GTS / PTS chap.	Applied standard e/o Procedure	Acceptance criteria	Document type	Scope of Inspection		
						Manufacturer	TPIA (By Manufacturer / Contractor)	Control Authority
3	**FABRICATION AND TESTS**							
3.1	**Welds and repair welds shall be performed according to written qualified procedures**	8.1 - 8.2	ASME IX + spec. / API 6D + GTS / PTS	ASME IX + spec.	Welding Procedure Specification (WPS)	Perform	review point	review & approval point
3.1.1	Heat treatment fully welded valve and test pieces	8.3	ASME VIII Div.1 / API 6D + GTS / PTS	ASME VIII Div.1	review CTT/TT curves	Perform	review report	review report
3.1.2	Mechanical tests (Remark : marking transfer by TPIA)	8.4.1	ASTM A370	GTS / PTS	certif. 3.1	Perform	review point	review report
3.1.3	Charpy-test at 0°C and as per Material requirement 2 test sets (1 long./1 trans.) (Remark : marking transfer by TPIA)	8.4.2	ASTM A370	- **At 0°C Minimum Average Absorbed Energy** shall be SMYS (Mpa)/10, with a minimum of 27 J, for the transerve direction. - **At 0°C Minimum Individual Energy value** shall not be less than 80 % of the Minimum required average value, for the transerve direction.	certif. 3.1	Perform	review point	review report
3.3	(if feasable) RT on butt welds	8.5.1	ASME SECT V art. 2 / API 6D + GTS / PTS	ASME SECT. VIII, div.1, UW 51.	(RT-Test report)	Perform	review point	review point
	(if not feasable & thk. > 15mm) UT on butt welds	8.5.1	ASME SECT V art. 5 / API 6D + GTS / PTS	ASME SECT. VIII, div.1, App.12	UT-Test report	Perform	review point	review point
3.4	Butt welding ends on cast bodies shall be examined before fabrication welding end by radiography (Over a width of 70mm)(not applicable for forged bodies)	8.5.1	ASME SECT V art. 2 / API 6D + GTS / PTS	MSS-SP-55	(RT-Test report)	Perform	review point	review point
3.5	UT on 25 mm of base mat. (at each side) and each weld(100%)	8.5.1	ASME SECT V art. 5 / API 6D + GTS / PTS	ASME SECT. VIII, dic.1, App.12	UT-Test report	Perform	review point	review point
3.6	Magnetic Particule Examination on valve body 10 % valves < 6" 100% valves ≥ 6"	8.5.1	ASME SECT V art. 7 / API 6D + GTS / PTS	ASME SECT. VIII App.6	MPE-Test report	Perform	review point	review point

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3.7	Visual examination	8.5.1	Sec 8 proc.7 / API 6D + GTS / PTS	MSS-SP-55	report	Perform	review point	review point
3.8	Dimensional examination	8.5.1	Sec 8 proc.24 / API 6D + GTS / PTS	DWG **	report	Perform	review point	review point
4	**Finished bevel end pipe used for field welding :**							
4.1	Magnetic Particle Examination / Liquid Penetrant Examination	8.5.1	ASME SECT V art. 7 ASME SECT V art. 6 / API 6D + GTS / PTS	unacceptable defects : defects not parallel to the surface extending into the bevel + defect extending into the bevel provided the lamination is parallel to the surface and has a transverse dimension exceeding 6.35 mm	MPE/ LPE-Test report	Perform	review point	review point
4.2	UT inspection on 50 mm of base material	8.5.1	ASME SECT V art. 5 / API 6D + GTS / PTS	ASME SECT. VIII, div.1, App.12	UT-Test report	Perform	review point	review point
4.3	RT inspection on 50 mm of base material	8.5.1	ASME SECT V art. 5 / API 6D + GTS / PTS	ASME SECT. VIII, div.1, App.12	UT-Test report	Perform	review point	review point
4.4	Visual and dimensional examination	8.5.1	Sec 8 proc.7 / API 6D + GTS / PTS	MSS-SP-55 +DWG**	report	Perform	review point	review point
5	**FINAL INSPECTION TEST**							

QUALITY ASSURANCE PLAN
BALL VALVES
SIZE BELOW 2 INCH

QAP No. : P.019141 G11013 M002	
Date: 27.09.2024	Revision: 0
Prepared : AML	
Checked : GGA	
Approved : SSM	

Sl. Nos.	ACTIVITY	GTS / PTS chap.	Applied standard e/o Procedure	Acceptance criteria	Document type	Scope of Inspection: Manufacturer	Scope of Inspection: TPIA (By Manufacturer / Contractor)	Scope of Inspection: Control Authority
5.1	Hydrostatic Shell Test	8.6.2	API 6D + GTS / PTS	@ 1.5 x Design Pr., 30 Min(NPS>18") / 15 Min(NPS<16").	certif. 3.1	Perform	review point	witness point
5.2	Hydrostatic Seat Test	8.6.3	API 6D + GTS / PTS	@ 1.1 x Design Pr., 5 Min.	certif. 3.1	Perform	review point	witness point
5.3	Pneumatic Test (with nitrogen) (Shell & Seat)	8.6.5	GTS / PTS	@ 95 barg for 5 min.	certif. 3.1	Perform	review point	witness point
5.4	External leak testing (with Soup suds)	8.6.4	GTS / PTS	@ 6 bar	certif. 3.1	Perform	review point	witness point
5.5	Air seat test	8.6.5	GTS / PTS	@ 7 bar, 5 Min.	certif. 3.1	Perform	review point	witness point
5.7	Functional Test (10 Opening / Closing with Operator mounted on the valve at 95 barg)	x	API 6D/API 598 + GTS / PTS	API 6D/ API 599	certif. 3.1	Perform	review point	witness point
5.8	Antistatic Test	x	BS 5351 + GTS / PTS	BS 5351 + specification	certif. 3.1	Perform	review point	witness point
5.9	Operational torque Test	8.7	API 6D		report	Perform	review point	witness point
5.10	Fire Safe Test	8.8	API 6FA	API6FA	report	Perform	review point	review report
5.11	Visual examination	8.10	Sec 8 proc.7 / API 6D + GTS / PTS	MSS-SP-55 / GTS / PTS	report	Perform	review point	review report
5.12	Dimensional examination	8.10	Sec 8 proc.24 / API 6D + GTS / PTS	DWG **	report	Perform	review point	review report
6	Marking	9	section 9 of specification / API 6D + GTS / PTS	section 9 specification	report	Perform	review point	review report

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6.1	Inspector's stamp		9.1.2	section 9 of specification / API 6D + GTS / PTS	section 9 specification			review point	review report
7	Painting And Coating		11	SIS055900	SA2.5, Cl.11 of Specification	report	Perform	review point	review report
8	Control of all certificates & Final Certificate		10	section 10 of specification	section 10 of specification	certif. 3.1	Perform	review point	review report
LEGENDS:									
	RT: Radiographic test	**PT:**Liquid penetrant test		**MT**: Magnetic particle test	**TPIA**: Third Party Inspection Agency; .	**Control Authority :** Owner / Owner's representatives			
	P: Performed	**R:**Review		**W**: Witness	**RW:** Random Witness				
	Hold point = No further steps may be undertaken before the intervention of the appointed responsible takes place.								
	Witness point = The appointed responsible has to be notified of the operation in advance, but production will continue whether the intervention took place or not.								

Note:

1. The above testing and acceptance critera are minimum requirements, however, equipment supplier shall ensure and that the product also comply to the additional requirements as per Technical specifications and data sheets.
2. The supplier shall submit their own detailed QAP prepared on the basis of the above for approval of Owner/Owner's representative.
3. Supplier shall submit Calibration certificates of all Instruments/Equipment to be used for Inspection and Testing to TPIA with relavant procedures and updated standards for TPIA reveiew/Approval.
4. TPIA along with Owner/Owner representative shall review/approve all the documents related to QAP/Quality manuals/Drawings etc.submitted by supplier.
5. For All Forging Materials, The Specimen Shall Be Taken From The Integral Part of The Forging.
6. Heat treatment start and stop temperature chart shall be witnessed & signed by TPIA. Power failure log book / sheet shall be maintained
7. TPIA shall ensure that Ball and Stem are Electroless Nickel Plated (ENP) with minimum thickness of 75 microns as per data sheet requirement.
8. Contractor in coordination with Supplier/Sub vendor shall issue detailed Production and Inspection schedule indicating the dates and the locations to facilitate Owner/Owner's representative and TPIA to organise Inspection.
9. Certification requirements shall comply with European Standard EN 10204 (latest edition)
10. In case of conflict between purchase specification, contract documents and QAP, more stringent conditions shall be applicable.

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QUALITY ASSURANCE PLAN
BALL VALVES
SIZE 2 INCH AND ABOVE

QAP No. :	P.019141 G11013 M002
Date: 26.09.2024	Revision: 0
Prepared :	AML
Checked :	GGA
Approved :	SSM

Sl. Nos.	ACTIVITY	GTS / PTS chap.	Applied standard e/o Procedure	Acceptance criteria	Document type	Scope of Inspection: Manufacturer	Scope of Inspection: TPIA (By Manufacturer / Contractor)	Scope of Inspection: Control Authority
1	**CONTROL BEFORE MANUFACTURING**							
	- list of operation in manufacturing and control	3		specification		Perform	review point	review point
	- material part list	6.1.		specification		Perform	review point	review point
	- dimensional drawings	6.1.		specification		Perform	review point	review point
	- calculation butt welding ends	6.1. / 6.2.2.		specification		Perform	review point	review point
	- calculation of body bolting, Bonnet, Cover (For Pressure Retaining Parts)	6.2.8.	ASME B16.34	specification,		Perform	review point	review point
	- Fixation of Operation Methodology	6.3	Relavant Standard	specification, Data Sheet		Perform	review point	review point
	- qualified welding procedures/welders performances qualification record	8.1, 8.2, 10.2		specification		Perform	review point	review point
	- heat treatment procedure	8.3		specification		Perform	review point	review point
	- non destructive testing procedures	8.5		specification		Perform	review point	review point
	- pressure test procedure	8.6.6		specification		Perform	review point	review point
	- painting procedure	11		specification		Perform	review point	review point
2	**CONTROL ON RECEIPT OF MATERIAL**							
2A	**Valve BODY:**	7	API 6D / Relavant Standard					
	Casting/Forging			GTS / PTS	certif. 3.2	Perform	witness point	review point
	Chemical Testing, **Carbon Equivalent**			GTS / PTS	certif. 3.2	Perform	witness point	review point
	Heat Treatment							
	Mechanical tests (YS, TS, % EL, Ys / TS ratio, Micro / Macro, hardness etc) (Remark : marking transfer by TPIA)			GTS / PTS	certif. 3.2	Perform	witness point	review point
	Charpy-test at 0°C and as per Material requirement 2 test sets (1 long./1 trans) (Remark : marking transfer by TPIA)			- **At 0°C Minimum Average Absorbed Energy** shall be SMYS (Mpa)/10, with a minimum of 27 J, for the transerve direction. - **At 0°C Minimum Individual Energy value** shall not be less than 80 % of the Minimum required average value, for the transerve direction.	certif. 3.2	Perform	witness point	review point
	UT of Forging Body (100%)	-	ASME B 16.34	ASME B 16.34, App IV	certif. 3.2	Perform	witness point	review point
	Radiography Test of Casting Body (100%)	-	ASME B 16.34	ASME B 16.34	certif. 3.2	Perform	witness point	review point
	Wet magnetic Particle Examination (100% External & accessible Internal)	-	ASME B 16.34	ASME B 16.34	certif. 3.2	Perform	witness point	review point

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	FLANGES:							
	Chemical Testing, **Carbon Equivalent**			GTS / PTS	certif. 3.2	Perform	witness point	review point
	Heat Treatment		Relavant Standard	GTS / PTS	certif. 3.2	Perform	witness point	review point
	Mechanical tests (YS, TS, % EL, Ys / TS ratio, Micro / Macro, hardness etc) (Remark : marking transfer by TPIA)		ASTM A370	GTS / PTS City Gas Distribution	certif. 3.2	Perform	witness point	review point

	QUALITY ASSURANCE PLAN **BALL VALVES** **SIZE 2 INCH AND ABOVE**	QAP No. : P.019141 G11013 M002		
		Date: 26.09.2024	Revision: 0	
		Prepared : AML		
		Checked : GGA		
		Approved : SSM		

Sl. Nos.	ACTIVITY	GTS / PTS chap.	Applied standard e/o Procedure	Acceptance criteria	Document type	Scope of Inspection: Manufacturer	Scope of Inspection: TPIA (By Manufacturer / Contractor)	Scope of Inspection: Control Authority
2B	Charpy-test at 0°C and as per Material requirement 2 test sets (1 long./1 trans.) (Remark : marking transfer by TPIA)	-	ASTM A370	- **At 0°C Minimum Average Absorbed Energy** shall be SMYS (Mpa)/10, with a minimum of 27 J, for the transerve direction. - **At 0°C Minimum Individual Energy value** shall not be less than 80 % of the Minimum required average value, for the transerve direction.	certif. 3.2	Perform	witness point	review point
	UT of Forging Body (100%)	-	ASME B 16.34	ASME B 16.34, App IV	certif. 3.2	Perform	witness point	review point
	Wet magnetic Particle Examination (100% External & accessible Internal)		ASME B 16.34	ASME B 16.34	certif. 3.2	Perform	witness point	review point
2C	**LATERAL CONNECTIONS:**	7						
	Chemical Testing, **Carbon Equivalent**			GTS / PTS	certif. 3.2	Perform	witness point	review point
	Mechanical tests (YS, TS, % EL, Ys / TS ratio, Micro / Macro, hardness etc) (Remark : marking transfer by TPIA)		ASTM A370	GTS / PTS	certif. 3.2	Perform	witness point	review point
	Charpy-test at 0°C and as per Material requirement 2 test sets (1 long./1 trans.) (Remark : marking transfer by TPIA)		ASTM A370	- **At 0°C Minimum Average Absorbed Energy** shall be SMYS (Mpa)/10, with a minimum of 27 J, for the transerve direction. - **At 0°C Minimum Individual Energy value** shall not be less than 80 % of the Minimum required average value, for the transerve direction.	certif. 3.2	Perform	witness point	review point
	UT of Forging Body (100%)	-	ASME B 16.34	ASME B 16.34, App IV	certif. 3.2	Perform	witness point	review point
	Radiography Test of Casting Body (100%)	-	ASME B 16.34	ASME B 16.34	certif. 3.2	Perform	review point	review point
	Wet magnetic Particle Examination (100% External & accessible Internal)	-	ASME B 16.34	ASME B 16.34	certif. 3.2	Perform	witness point	review point
	EXTENSION PIPE PIECES AS PER DATA SHEET						witness point	

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	Chemical Test, Carbon Equivalent			GTS / PTS	certif. 3.2	Perform	witness point	review point
	Mechanical tests (Remark : marking transfer by TPIA)		ASTM A370				witness point	
2D	Charpy-test at 0°C and as per Material requirement 2 test sets (1 long./1 trans.) (Remark : marking transfer by TPIA)	7	ASTM A370	- at **0°C, for Base** - 40J/cm²(Avg.), 32J/cm²(Ind.), - at **0°C, for Weld/HAZ** - 27J/cm²(Avg.), 22J/cm²(Ind.)	certif. 3.2	Perform	witness point	review point
	BALL / OBTURATOR (Note -7):							
	Chemical Testing, **Carbon Equivalent**			GTS / PTS	certif. 3.2	Perform	witness point	review point

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	QUALITY ASSURANCE PLAN **BALL VALVES** **SIZE 2 INCH AND ABOVE**	QAP No. : P.019141 G11013 M002 Date: 26.09.2024 Revision: 0 Prepared : AML Checked : GGA Approved : SSM

Sl. Nos.	ACTIVITY	GTS / PTS chap.	Applied standard e/o Procedure	Acceptance criteria	Document type	Scope of Inspection		
						Manufacturer	TPIA (By Manufacturer / Contractor)	Control Authority
2E	- Mechanical tests (YS, TS, % EL, Ys / TS ratio, Micro / Macro, hardness of Base ENP Coating etc) (Remark : marking transfer by TPIA)	7	Relavant Standard	GTS / PTS	certif. 3.2	Perform	witness point	review point

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QUALITY ASSURANCE PLAN
BALL VALVES
SIZE 2 INCH AND ABOVE

QAP No. : P.019141 G11013 M002	
Date: 26.09.2024	Revision: 0
Prepared : AML	
Checked : GGA	
Approved : SSM	

Sl. Nos.	ACTIVITY	GTS / PTS chap.	Applied standard e/o Procedure	Acceptance criteria	Document type	Scope of Inspection		
						Manufacturer	TPIA (By Manufacturer / Contractor)	Control Authority
	UT of Forging Body (100%) OR		ASME B 16.34	ASME B 16.34, App IV	certif. 3.2	Perform	witness point	review point
	Radiography Test of Casting Body (100%)		ASME B 16.34	ASME B 16.34	certif. 3.2	Perform	review point	review point
2F	**SEAT:**	7		GTS / PTS	certif. 3.2	Perform	Mechanical-witness point Chemical-review point	review point
	- Mechanical tests (YS, TS, % EL, Ys / TS ratio, Micro / Macro, hardness etc) (Remark : marking transfer by TPIA), - Chemical tests, Carbon equivalent		Relavant Standard	GTS / PTS				
	Wet magnetic Particle Examination (All accessible area)	-	ASME B 16.34	ASME B 16.34	certif. 3.2	Perform	witness point	review point
2G	**STEM:**	7						
	-Chemical Testing, **Carbon equivalent**			GTS / PTS	certif. 3.1	Perform	review point	review point
	-Mechanical tests (YS, TS, % EL, Ys / TS ratio, Micro / Macro, hardness of Base and ENP coating etc) (Remark : marking transfer by TPIA)		ASTM A370	GTS / PTS	certif. 3.2	Perform	witness point	review point
	UT of Forging Body (100%)	-	ASME B 16.34	ASME B 16.34, App IV	certif. 3.2	Perform	witness point	review point
	Wet magnetic Particle Examination (All accessible area)	-	ASME B 16.34	ASME B 16.34	certif. 3.2	Perform	witness point	review point
2H	**STUDS/NUTS (With Xylan Coating)**	7		GTS / PTS				
	-Chemical Testing, **Carbon Equivalent**			GTS / PTS	certif. 3.1	Perform	review point	review point
	- Mechanical tests (YS, TS, % EL, Ys / TS ratio, Micro / Macro, hardness etc) (Remark : marking transfer by TPIA)		ASTM A370	GTS / PTS	certif. 3.2	Perform	witness point	review point
2I	**VENT/BLEED PLUG:**	7		GTS / PTS	certif. 3.1	Perform	review point	review point
	- 'Chemical test,"Mechanical tests		Relavant Standard	GTS / PTS				
2J	**DRAIN: OPEN BLOCK VALVE AT DRAIN TAP:**	7		GTS / PTS	certif. 3.1	Perform	review point	review point
	- 'Chemical test, mechanical tests		Relavant Standard	GTS / PTS				
2K	**DRAIN: UPPER BALL VALVE & NEEDLE VALVE:**	7		GTS / PTS	certif. 3.1	Perform	review point	review point
	- 'Chemical Test, Mechanical tests		Relavant Standard	GTS / PTS				
2L	**STEM & SEAT SEALING CONNECTION :**	7		GTS / PTS	certif. 3.1	Perform	review point	review point
	- Chemical Test, Mechanical tests		Relavant Standard	GTS / PTS				
2M	**OTHER VALVE PARTS INCLUDING PIPE PUP PIECE**	7		GTS / PTS	certif. 3.1	Perform	review point	review point
	- Mechanical and Chemical tests		Relavant Standard	GTS / PTS				
				GTS / PTS				

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QUALITY ASSURANCE PLAN BALL VALVES
SIZE 2 INCH AND ABOVE

QAP No. : P.019141 G11013 M002	
Date: 26.09.2024	Revision: 0
Prepared : AML	
Checked : GGA	
Approved : SSM	

Sl. Nos.	ACTIVITY	GTS / PTS chap.	Applied standard e/o Procedure	Acceptance criteria	Document type	Scope of Inspection		
						Manufacturer	TPIA (By Manufacturer / Contractor)	Control Authority
3	**FABRICATION AND TESTS**							
3.1	**Welds and repair welds shall be performed according to written qualified procedures**	8.1 - 8.2	ASME IX + spec. / API 6D + GTS / PTS	ASME IX + spec.	Welding Procedure Specification (WPS)	Perform	witness point (For new proposed WPS) Review(For already qaulified)	review & approval point
3.1.1	Heat treatment fully welded valve and test pieces	8.3	ASME VIII Div.1 / API 6D + GTS / PTS	ASME VIII Div.1	review CTT/TT curves	Perform	review report	review report
3.1.2	Mechanical tests (Remark : marking transfer by TPIA)	8.4.1	ASTM A370	GTS / PTS	certif. 3.2	Perform	witness point	review report
3.1.3	Charpy-test at 0°C and as per Material requirement 2 test sets (1 long./1 trans.) (Remark : marking transfer by TPIA)	8.4.2	ASTM A370	- **At 0°C Minimum Average Absorbed Energy** shall be SMYS (Mpa)/10, with a minimum of 27 J, for the transerve direction. - **At 0°C Minimum Individual Energy value** shall not be less than 80 % of the Minimum required average value, for the transerve direction.	certif. 3.2	Perform	witness point	review report
3.3	(if feasable) RT on butt welds	8.5.1	ASME SECT V art. 2 / API 6D + GTS / PTS	ASME SECT. VIII, div.1, UW 51.	(RT-Test report)	Perform	review point	review point
	(if not feasable & thk. > 15mm) UT on butt welds	8.5.1	ASME SECT V art. 5 / API 6D + GTS / PTS	ASME SECT. VIII, div.1, App.12	UT-Test report	Perform	witness point	review point
3.4	Butt welding ends on cast bodies shall be examined before fabrication welding end by radiography (Over a width of 70mm)(not applicable for forged bodies)	8.5.1	ASME SECT V art. 2 / API 6D + GTS / PTS	MSS-SP-55	(RT-Test report)	Perform	witness point	review point
3.5	UT on 25 mm of base mat. (at each side) and each weld(100%)	8.5.1	ASME SECT V art. 5 / API 6D + GTS / PTS	ASME SECT. VIII, dic.1, App.12	UT-Test report	Perform	witness point	review point
3.6	Magnetic Particule Examination on valve body 10 % valves < 6" 100% valves ≥ 6"	8.5.1	ASME SECT V art. 7 / API 6D + GTS / PTS	ASME SECT. VIII App.6	MPE-Test report	Perform	witness point	review point
3.7	Visual examination	8.5.1	Sec 8 proc.7 / API 6D + GTS / PTS	MSS-SP-55	report	Perform	witness point	review point
3.8	Dimensional examination	8.5.1	Sec 8 proc.24 / API 6D + GTS / PTS	DWG **	report	Perform	witness point	review point
4	**Finished bevel end pipe used for field welding :**							
4.1	Magnetic Particle Examination / Liquid Penetrant Examination	8.5.1	ASME SECT V art. 7 ASME SECT V art. 6 / API 6D + GTS / PTS	unacceptable defects : defects not parallel to the surface extending into the bevel + defect extending into the bevel provided the lamination is parallel to the surface and has a transverse dimension exceeding 6.35 mm	MPE/ LPE-Test report	Perform	witness point	review point
4.2	UT inspection on 50 mm of base material	8.5.1	ASME SECT V art. 5 / API 6D + GTS / PTS	ASME SECT. VIII, div.1, App.12	UT-Test report	Perform	witness point	review point
4.3	RT inspection on 50 mm of base material	8.5.1	ASME SECT V art. 5 / API 6D + GTS / PTS	ASME SECT. VIII, div.1, App.12	UT-Test report	Perform	Review point	review point

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4.4	Visual and dimensional examination	8.5.1	Sec 8 proc.7 / API 6D + GTS / PTS	MSS-SP-55 +DWG**	report	Perform	witness point	review point
5	**FINAL INSPECTION TEST**			City Gas Distribution				

QUALITY ASSURANCE PLAN
BALL VALVES
SIZE 2 INCH AND ABOVE

QAP No. : P.019141 G11013 M002	
Date: 26.09.2024	Revision: 0
Prepared : AML	
Checked : GGA	
Approved : SSM	

		GTS / PTS				Scope of Inspection

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Sl. Nos.	ACTIVITY	chap.	Applied standard e/o Procedure	Acceptance criteria	Document type	Manufacturer	TPIA (By Manufacturer / Contractor)	Control Authority
5.1	Hydrostatic Shell Test	8.6.2	API 6D + GTS / PTS	@ 1.5 x Design Pr., 30 Min(NPS>18") / 15 Min(NPS<16").	certif. 3.2	Perform	witness point	witness point
5.2	Hydrostatic Seat Test	8.6.3	API 6D + GTS / PTS	@ 1.1 x Design Pr., 5 Min.	certif. 3.2	Perform	witness point	witness point
5.3	Pneumatic Test (with nitrogen) (Shell & Seat)	8.6.5	GTS / PTS	@ 95 barg for 5 min.	certif. 3.2	Perform	witness point	witness point
5.4	External leak testing (with Soup suds)	8.6.4	GTS / PTS	@ 6 bar	certif. 3.2	Perform	witness point	witness point
5.5	Air seat test	8.6.5	GTS / PTS	@ 7 bar, 5 Min.	certif. 3.2	Perform	witness point	witness point
5.6	Double Block and Bleed Test	x	API 6D/API 598 + GTS / PTS	API 6D/ API 598	certif. 3.2	Perform	witness point	witness point
5.7	Functional Test (10 Opening / Closing with Operator mounted on the valve at 95 barg)	x	API 6D/API 598 + GTS / PTS	API 6D/ API 599	certif. 3.2	Perform	witness point	witness point
5.8	Antistatic Test	x	BS 5351 + GTS / PTS	BS 5351 + specification	certif. 3.2	Perform	witness point	witness point
5.9	Operational torque Test	8.7	API 6D		report	Perform	witness point	witness point
5.10	Fire Safe Test	8.8	API 6FA	API6FA	report	Perform	review report	review report
5.11	Visual examination	8.10	Sec 8 proc.7 / API 6D + GTS / PTS	MSS-SP-55 / GTS / PTS	report	Perform	witness point	review report
5.12	Dimensional examination	8.10	Sec 8 proc.24 / API 6D + GTS / PTS	DWG **	report	Perform	witness point	review report
6	Marking	9	section 9 of specification / API 6D + GTS / PTS	section 9 specification	report	Perform	witness point	review report
6.1	Inspector's stamp	9.1.2	section 9 of specification / API 6D + GTS / PTS	section 9 specification			hold point	review report
7	Painting And Coating	11	SIS055900	SA2.5, Cl.11 of Specification	report	Perform	witness point	review report
8	Control of all certificates & Final Certificate	10	section 10 of specification	section 10 of specification	certif. 3.2	Perform	hold point	review report

LEGENDS:

RT: Radiographic test | **PT:**Liquid penetrant test | **MT**: Magnetic particle test | **TPIA**: Third Party Inspection Agency; . | **Control Authority :** Owner / Owner's representatives

P: Performed | **R:**Review | **W**: Witness | **RW:** Random Witness

Hold point = No further steps may be undertaken before the intervention of the appointed responsible takes place.

Witness point = The appointed responsible has to be notified of the operation in advance, but production will continue whether the intervention took place or not.

Note:

1. The above testing and acceptance critera are minimum requirements, however, equipment supplier shall ensure and that the product also comply to the additional requirements as per Technical specifications and data sheets.
2. The supplier shall submit their own detailed QAP prepared on the basis of the above for approval of Owner/Owner's representative.
3. Supplier shall submit Calibration certificates of all Instruments/Equipment to be used for Inspection and Testing to TPIA with relavant procedures and updated standards for TPIA reveiew/Approval.
4. TPIA will have Right to Inspect minimum 10% of all manufacturing activities on each day or as specified above.
5. TPIA along with Owner/Owner representative shall review/approve all the documents related to QAP/Quality manuals/Drawings etc.submitted by supplier.
6. For All Forging Materials, The Specimen Shall Be Taken From The Integral Part of The Forging.
7. Heat treatment start and stop temperature chart shall be witnessed & signed by TPIA. Power failure log book / sheet shall be maintained
8. TPIA shall ensure that Ball and Stem are Electroless Nickel Plated (ENP) with minimum thickness of 75 microns as per data sheet requirement.
9. Contractor in coordination with Supplier/Sub vendor shall issue detailed Production and Inspection schedule indicating the dates and the locations to facilitate Owner/Owner's representative and TPIA to organise Inspection.
10. Certification requirements shall comply with European Standard EN 10204 (latest edition)
11. In case of conflict between purchase specification, contract documents and QAP, more stringent conditions shall be applicable.

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		QUALITY ASSURANCE PLAN **GLOBE** **SIZE 2" AND ABOVE**		**QAP No**	**P.019141 G11013 M003**		
				Date	**26.09.2024**		
				Prepared by	**AML**	**Checked :GGA**	
				Approved by	**SSM**		
				Client	**BGL**		
				Consultant	**TEPL**		

Sl. Nos.	**ACTIVITY**	**Applied standard e/o Procedure**	**Acceptance criteria**	**Document type**	**Scope of Inspection**		
					Manufacturer	**TPIA (By Manufacturer / Contractor)**	**Control Authority**
1	**CONTROL BEFORE MANUFACTURING**						
	- list of operation in manufacturing and control	As per tender specification / data Sheet / Ref Std.	As per tender specification / data Sheet / Ref Std.		Perform	review point	review point
	- material part list				Perform	review point	review point
	- dimensional drawings				Perform	review point	review point
	- calculation butt welding ends				Perform	review point	review point
	- calculation of body bolting, Bonnet, Cover (For Pressure Retaining Parts)	ASME B16.34	specification,		Perform	review point	review point
	- Fixation of Operation Methodology		specification, Data Sheet		Perform	review point	review point
	- qualified welding procedures/welders performances qualification record		specification		Perform	review point	review point
	- heat treatment procedure		specification		Perform	review point	review point
	- non destructive testing procedures		specification		Perform	review point	review point
	- pressure test procedure		specification		Perform	review point	review point
	- painting procedure		specification		Perform	review point	review point
2	**CONTROL ON RECEIPT OF MATERIAL**						
2.1	**Casts**						
2.1.1	**Non Destructive Testing**						
	Radiography Testing - 100%: each type / size / rating	ASME V, Art. 2	ASME VIII-1, App. 7 ASME B31.3(Latest), Table 341.3.2A, Severe Cyclic cond.	certif. 3.1	Perform	review point	review point
	Penetrant Testing - 100%: each type / size / rating	ASME V, Art. 6 - ASTM E-165	ASME VIII-1, App. 7 & 8	certif. 3.2	Perform	Witness point	review point
	Magnetic Particle Testing - (alternative for PT)	ASME V, Art. 7	ASME VIII-1, App. 6 & 7	certif. 3.2	Perform	Witness point	review point
2.1.2	Chemical analysis, Carbon Equivalent (each heat and product)	Referred API / ASTM	Referred API / ASTM	certif. 3.2	Perform	Witness point	review point
2.1.3	Mechanical tests (YS, UTS, YS/UTS, %EL, RA, Bend, Micro / macro, hardness etc. as applicable) - on samples taken from mill. (Remark : marking transfer by TPIA)	Referred API / ASTM	Referred API / ASTM	certif. 3.2	Perform	Witness point	Witness point
2.1.4	Charpy Impact test - 2 test sets (1 Longitudinal & 1 Transverse) (Remark : marking transfer by TPIA)	ASTM A-370	- **At 0°C Minimum Average Absorbed Energy** shall be SMYS (Mpa)/10, with a minimum of 27 J, for the transerve direction. - **At 0°CMinimum Individual Energy value** shall not be less than 80 % of the Minimum required average value, for the transerve direction.	certif. 3.2	Perform	Witness point	Witness point

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2.2	**Forgings**						
	Non Destructive Testing						
	Penetrant Testing - 10%: on Disc / Wedge & Stem after final machining	ASME V, Art. 6	ASME VIII-1, App. 8	certif. 3.2	Perform	Witness point	review point

		QUALITY ASSURANCE PLAN GLOBE SIZE 2" AND ABOVE		**QAP No**	**P.019141 G11013 M003**		
				Date	**26.09.2024**		
				Prepared by	**AML**	**Checked :GGA**	
				Approved by	**SSM**		
				Client	**BGL**		
				Consultant	**TEPL**		
Sl. Nos.	**ACTIVITY**	**Applied standard e/o Procedure**	**Acceptance criteria**	**Document type**	**Scope of Inspection**		
					Manufacturer	**TPIA (By Manufacturer / Contractor)**	**Control Authority**
2.2.1	Ultrasonic Testing - 100%: on Body & Bonnet	ASME B 16.34, App. IV / ASME Sec V Art 5	ASME B 16.34, App. IV / ASME Sec V Div. 1 UF 55	certif. 3.2	Perform	Witness point	review point
	Magnetic Particle Testing - 100% on pressure retaining parts	ASME V, Art. 7	ASME VIII-1, App. 6	certif. 3.2	Perform	Witness point	review point
2.2.2	Chemical analysis, Carbon Equivalent (each heat and product)	Referred API / ASTM	Referred API / ASTM	certif. 3.2	Perform	Witness point	review point
2.2.3	Mechanical tests (YS, UTS, YS/UTS, %EL, RA, Bend etc. as applicable) - on samples taken from mill. (Remark : marking transfer by TPIA)	Referred API / ASTM	Referred API / ASTM	certif. 3.2	Perform	Witness point	review point
2.2.4	Charpy Impact test - 2 test sets (1 Longitudinal & 1 Transverse) (Remark : marking transfer by TPIA)	ASTM A-370	- **At 0°C Minimum Average Absorbed Energy** shall be SMYS (Mpa)/10, with a minimum of 27 J, for the transerve direction. - **At 0°CMinimum Individual Energy value** shall not be less than 80 % of the Minimum required average value, for the transerve direction.	certif. 3.2	Perform	Witness point	review point
2.3	**Plate**: Cover, Disc, Seat Ring Flap, Arm (Chemical & Mechanical Properties)	As per Approved Procedure / Purchase Specification	As per Approved Procedure / Purchase Specification	certif. 3.2	Perform	Witness point	review point
2.4	**Bolting/ Fasteners**						
2.4.1	Penetrant Testing (on each batch after final machining)	ASME V, Art. 6	ASME VIII-1, App. 8	certif. 3.1	Perform	review point	review point
2.4.2	Heat Treatment (on each Heat Treatment batch)	Referred ASTM	Referred ASTM	certif. 3.1	Perform	review point	review point
2.4.3	Chemical analysis, Carbon Equivalent (each heat and product)	Referred API / ASTM	Referred API / ASTM	certif. 3.2	Perform	Witness point	review point
2.4.4	Mechanical tests (YS, UTS, YS/UTS, %EL, RA, Bend etc. as applicable) - on samples taken from mill. (Remark : marking transfer by TPIA)	Referred API / ASTM	Referred API / ASTM	certif. 3.2	Perform	Witness point	review point

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2.4.5	Charpy Impact test as per Material specification requirement 2 test sets (1 long./1 trans.) (Remark : marking transfer by TPIA)	ASTM A-370	As per material specification	certif. 3.2	Perform	Witness point	Random Witness point
2.5	Actuators (If Applicable)	Compliance to purchase order	Purchase Specification	report	Perform	review point	review point
2.6	BW ends - each piece.	100 % RT ASME V, Art. 2	ASME B31.3(1990), Table 341.3.2A, severe cyclic cond.	report	Perform	review point	review point
2.7	Welds & weld repairs - each piece	100 % RT ASME V, Art. 2 & ASME IX	ASME B31.3(1990), Table 341.3.2A, severe cyclic cond.	report	Perform	review point	review point
3	**FINAL INSPECTION TEST**						

	QUALITY ASSURANCE PLAN **GLOBE** **SIZE 2" AND ABOVE**	**QAP No**	**P.019141 G11013 M003**	
		Date	**26.09.2024**	
		Prepared by	**AML**	**Checked :GGA**
		Approved by	**SSM**	
		Client	**BGL**	
		Consultant	**TEPL**	

Sl. Nos.	**ACTIVITY**	**Applied standard c/o Procedure**	**Acceptance criteria**	**Document type**	**Scope of Inspection**		
					Manufacturer	**TPIA (By Manufacturer / Contractor)**	**Control Authority**
3.1	Hydrostatic Shell Test (duration minimum 15 min)	BS 1873 / API 598 / ASME B16.34 / ASTM A-530 & Data Sheet	BS 1873 / API 598 / ASME B16.34 / ASTM A-530 & Data Sheet	certif. 3.2	Perform	Witness point	Witness point
3.2	Hydrostatic Seat Test (duration minimum 30 min)			certif. 3.2	Perform	Witness point	Witness point
3.3	Hydrostatic Back Seat Test (duration minimum 30 min)			certif. 3.2	Perform	Witness point	Witness point
3.4	Pneumatic Shell & Seat Test (at 7 Bar with Nitrogen)			certif. 3.2	Perform	Witness point	Witness point
3.5	Air seat test (duration minimum 5 min)			certif. 3.2	Perform	Witness point	Witness point
3.6	Helium Leak Test (duration minimum 30 min)			certif. 3.2	Perform	Witness point	Witness point
3.7	Cyclic Pressure Test - 1 per valve per size (6"& above) (10 Open Close - Open Cycles with Maximum differential Pressure)			certif. 3.2	Perform	Witness point	Witness point
3.8	Torque Test			certif. 3.2	Perform	Witness point	Random Witness point
3.9	High Pressure Closure Test & Low Pressure Closure Test (3 Opening & Closure at Atmospheric & Maximum differential pressure)			report	Perform	Witness point	Random Witness point
3.1	Cyclic Pressure Test - 1 Valve per size (6" & above) (10 Open - Close - Open cycles with Maximum differential pressure)			report	Perform	Witness point	Random Witness point
3.11	Fire safe tested (Type Test) (Certificates of previously conducted tests shallbe submitted)	API 6FA / API 607 / BS 5146 / OCMA	API 6FA / API 607 / BS 5146 / OCMA	report	Perform	review report	review report

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3.12	Actuator Functional Test (If applicable)	Open, Close time, Torque, Limit setting	Functioning in Hydrostatic Test	report	Perform	Witness point	Witness point
3.13	Visual & Dimensional examination	ASME Sec-V, Art. 9	Referred ANSI dimensions	report	Perform	review report	review report
4	Surface Preparation, Painting & Preservation	As per Approved procedure	As per Approved procedure		Perform	Witness point	review report
5.1	Marking	As per Approved procedure	As per Approved procedure	X	Perform	review report	review report
5.2	Inspector's stamp	-	-	X	Perform	hold point	review report
6	Control of all certificates & Final Certificate	-	-	certif. 3.2	Perform	hold point	review report

EGENDS:

RT: Radiographic test **PT:** Liquid penetrant test **MT**: Magnetic particle test **TPIA**: Third Party Inspection Agency; .

P: Performed **R:**Review W: Witness **Control Authority** : Owner/Engineer or their Authorized Inspection Agency

Hold point = No further steps may be undertaken before the intervention of the appointed responsible takes place.

Witness point = The appointed responsible has to be notified of the operation in advance, but production will continue whether the intervention took place or not.

Notes:

1 The Above Testing and acceptance criteria are minimum requirements, however, equipment supplier shall ensure and that the product also comply to the additional requirements as per Technical specifications and data sheets. TPIA shall issue the EN10204 3.2 Certification for the Final Product. Welding & Welder Qualification "W" for Customer/CA. Heat treatment as per Specification.

2 The supplier shall submit their own detailed QAP prepared on the basis of the above for approval of Owner/Owner's representative and TPIA.

	QUALITY ASSURANCE PLAN GLOBE SIZE 2" AND ABOVE			**QAP No**	**P.019141 G11013 M003**		
				Date	**26.09.2024**		
				Prepared by	**AML**	**Checked :GGA**	
				Approved by	**SSM**		
				Client	**BGL**		
				Consultant	**TEPL**		
Sl. Nos.	**ACTIVITY**	**Applied standard e/o Procedure**	**Acceptance criteria**	**Document type**	**Scope of Inspection**		
					Manufacturer	**TPIA (By Manufacturer / Contractor)**	**Control Authority**

3 Supplier shall submit Calibration certificates of all Instruments/Equipment to be used for Inspection and Testing to TPIA with relevant procedures and updated standards for TPIA review/Approval.

4 TPIA will have Right to Inspect minimum 10% of all manufacturing activities on each day or as specified above.

5 TPIA along with Owner/Owner representative shall review/approve all the documents related to QAP/Quality manuals/Drawings etc. submitted by supplier.

6 TPIA shall also Review the Test certificates submitted by the Actuator manufacturer.

7 Contractor shall in coordination with Supplier/Sub vendor shall issue detailed Production and Inspection schedule indicating the dates and the locations to facilitate Owner/Owner's representative and TPIA to organize Inspection.

8 Certification requirements shall comply with European Standard EN 10204 (latest edition)

9 All bought out items will be procured with 3.2 Certificates.

10 For All Forging / Casting Materials, The Specimen Shall Be Taken From The Integral Part of The Forging / Casting

11 Heat treatment start and stop temperature chart shall be Witnessed & signed by TPIA. Power failure log book / sheet shall be maintained

12 In case of conflict between purchase specification, contract documents and QAP, more stringent conditions shall be applicable.

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		QUALITY ASSURANCE PLAN **GLOBE** **SIZE BELOW 2 INCH**		**QAP No**	**P.019141 G11013 M003**		
				Date	**26.09.2024**		
				Prepared by	**AHR**	**Checked :SSA**	
				Approved by	**SSM**		
				Client	**BGL**		
				Consultant	**TEPL**		

Sl. Nos.	**ACTIVITY**	**Applied standard e/o Procedure**	**Acceptance criteria**	**Document type**	**Scope of Inspection**		
					Manufacturer	**TPIA (By Manufacturer / Contractor)**	**Control Authority**
1	**CONTROL BEFORE MANUFACTURING**						
	- list of operation in manufacturing and control	As per tender specification / data Sheet / Ref Std.	As per tender specification / data Sheet / Ref Std.		Perform	review point	review point
	- material part list				Perform	review point	review point
	- dimensional drawings				Perform	review point	review point
	- calculation butt welding ends				Perform	review point	review point
	- calculation of body bolting, Bonnet, Cover (For Pressure Retaining Parts)	ASME B16.34	specification,		Perform	review point	review point
	- Fixation of Operation Methodology		specification, Data Sheet		Perform	review point	review point
	- qualified welding procedures/welders performances qualification record		specification		Perform	review point	review point
	- heat treatment procedure		specification		Perform	review point	review point
	- non destructive testing procedures		specification		Perform	review point	review point
	- pressure test procedure		specification		Perform	review point	review point
	- painting procedure		specification		Perform	review point	review point
2	**CONTROL ON RECEIPT OF MATERIAL**						
2.1	**Casts**						
2.1.1	**Non Destructive Testing**						
	Radiography Testing - 100%: each type / size / rating	ASME V, Art. 2	ASME VIII-1, App. 7 ASME B31.3(Latest), Table 341.3.2A, Severe Cyclic cond.	certif. 3.1	Perform	review point	review point
	Penetrant Testing - 100%: each type / size / rating	ASME V, Art. 6 - ASTM E-165	ASME VIII-1, App. 7 & 8	certif. 3.1	Perform	review point	review point
	Magnetic Particle Testing - (alternative for PT)	ASME V, Art. 7	ASME VIII-1, App. 6 & 7	certif. 3.1	Perform	review point	review point
2.1.2	Chemical analysis, Carbon Equivalent (each heat and product)	Referred API / ASTM	Referred API / ASTM	certif. 3.1	Perform	review point	review point
2.1.3	Mechanical tests (YS, UTS, YS/UTS, %EL, RA, Bend, Micro / macro, hardness etc. as applicable) - on samples taken from mill. (Remark : marking transfer by TPIA)	Referred API / ASTM	Referred API / ASTM	certif. 3.1	Perform	review point	review point
2.1.4	Charpy Impact test - 2 test sets (1 Longitudinal & 1 Transverse) (Remark : marking transfer by TPIA)	ASTM A-370	- **At 0°C Minimum Average Absorbed Energy** shall be SMYS (Mpa)/10, with a minimum of 27 J, for the transerve direction. - **At 0°CMinimum Individual Energy value** shall not be less than 80 % of the Minimum required average value, for the transerve direction.	certif. 3.1	Perform	review point	review point

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2.2	**Forgings**						
	Non Destructive Testing						
	Penetrant Testing - 10%: on Disc / Wedge & Stem after final machining	ASME V, Art. 6	ASME VIII-1, App. 8	certif. 3.1	Perform	review point	review point

	QUALITY ASSURANCE PLAN GLOBE SIZE BELOW 2 INCH			**QAP No**	**P.019141 G11013 M003**		
				Date	**26.09.2024**		
				Prepared by	**AHR**	**Checked :SSA**	
				Approved by	**SSM**		
				Client	**BGL**		
				Consultant	**TEPL**		
Sl. Nos.	**ACTIVITY**	**Applied standard e/o Procedure**	**Acceptance criteria**	**Document type**	**Scope of Inspection**		
					Manufacturer	**TPIA (By Manufacturer / Contractor)**	**Control Authority**
2.2.1	Ultrasonic Testing - 100%: on Body & Bonnet	ASME B 16.34, App. IV / ASME Sec V Art 5	ASME B 16.34, App. IV / ASME Sec V Div. 1 UF 55	certif. 3.1	Perform	review point	review point
	Magnetic Particle Testing - 100% on pressure retaining parts	ASME V, Art. 7	ASME VIII-1, App. 6	certif. 3.1	Perform	review point	review point
2.2.2	Chemical analysis, Carbon Equivalent (each heat and product)	Referred API / ASTM	Referred API / ASTM	certif. 3.1	Perform	review point	review point
2.2.3	Mechanical tests (YS, UTS, YS/UTS, %EL, RA, Bend etc. as applicable) - on samples taken from mill. (Remark : marking transfer by TPIA)	Referred API / ASTM	Referred API / ASTM	certif. 3.1	Perform	review point	review point
2.2.4	Charpy Impact test - 2 test sets (1 Longitudinal & 1 Transverse) (Remark : marking transfer by TPIA)	ASTM A-370	- **At 0°C Minimum Average Absorbed Energy** shall be SMYS (Mpa)/10, with a minimum of 27 J, for the transerve direction. - **At 0°CMinimum Individual Energy value** shall not be less than 80 % of the Minimum required average value, for the transerve direction.	certif. 3.1	Perform	review point	review point
2.3	**Plate**: Cover, Disc, Seat Ring Flap, Arm (Chemical & Mechanical Properties)	As per Approved Procedure / Purchase Specification	As per Approved Procedure / Purchase Specification	certif. 3.1	Perform	review point	review point
2.4	**Bolting/ Fasteners**						
2.4.1	Penetrant Testing (on each batch after final machining)	ASME V, Art. 6	ASME VIII-1, App. 8	certif. 3.1	Perform	review point	review point
2.4.2	Heat Treatment (on each Heat Treatment batch)	Referred ASTM	Referred ASTM	certif. 3.1	Perform	review point	review point
2.4.3	Chemical analysis, Carbon Equivalent (each heat and product)	Referred API / ASTM	Referred API / ASTM	certif. 3.1	Perform	review point	review point
2.4.4	Mechanical tests (YS, UTS, YS/UTS, %EL, RA, Bend etc. as applicable) - on samples taken from mill. (Remark : marking transfer by TPIA)	Referred API / ASTM	Referred API / ASTM	certif. 3.1	Perform	review point	review point

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2.4.5	Charpy Impact test as per Material specification requirement 2 test sets (1 long./1 trans.) (Remark : marking transfer by TPIA)	ASTM A-370	As per material specification	certif. 3.1	Perform	review point	Random review point
2.5	Actuators (If Applicable)	Compliance to purchase order	Purchase Specification	report	Perform	review point	review point
2.6	BW ends - each piece.	100 % RT ASME V, Art. 2	ASME B31.3(1990), Table 341.3.2A, severe cyclic cond.	report	Perform	review point	review point
2.7	Welds & weld repairs - each piece	100 % RT ASME V, Art. 2 & ASME IX	ASME B31.3(1990), Table 341.3.2A, severe cyclic cond.	report	Perform	review point	review point
3	**FINAL INSPECTION TEST**						

QUALITY ASSURANCE PLAN **GLOBE** **SIZE BELOW 2 INCH**	**QAP No**	**P.019141 G11013 M003**	
	Date	**26.09.2024**	
	Prepared by	**AHR**	**Checked :SSA**
	Approved by	**SSM**	
	Client	**BGL**	
	Consultant	**TEPL**	

Sl. Nos.	**ACTIVITY**	**Applied standard e/o Procedure**	**Acceptance criteria**	**Document type**	**Scope of Inspection**		
					Manufacturer	**TPIA (By Manufacturer / Contractor)**	**Control Authority**
3.1	Hydrostatic Shell Test (duration minimum 15 min)	BS 1873 / API 598 / ASME B16.34 / ASTM A-530 & Data Sheet	BS 1873 / API 598 / ASME B16.34 / ASTM A-530 & Data Sheet	certif. 3.1	Perform	review point	review point
3.2	Hydrostatic Seat Test (duration minimum 30 min)			certif. 3.1	Perform	review point	review point
3.3	Hydrostatic Back Seat Test (duration minimum 30 min)			certif. 3.1	Perform	review point	review point
3.4	Pneumatic Shell & Seat Test (at 7 Bar with Nitrogen)			certif. 3.1	Perform	review point	review point
3.5	Air seat test (duration minimum 5 min)			certif. 3.1	Perform	review point	review point
3.6	Helium Leak Test (duration minimum 30 min)			certif. 3.1	Perform	review point	review point
3.7	Cyclic Pressure Test - 1 per valve per size (6"& above) (10 Open Close - Open Cycles with Maximum differential Pressure)			certif. 3.1	Perform	review point	review point
3.8	Torque Test			certif. 3.1	Perform	review point	Random review point
3.9	High Pressure Closure Test & Low Pressure Closure Test (3 Opening & Closure at Atmospheric & Maximum differential pressure)			report	Perform	review point	Random review point
3.1	Cyclic Pressure Test - 1 Valve per size (6" & above) (10 Open - Close - Open cycles with Maximum differential pressure)			report	Perform	review point	Random review point
3.11	Fire safe tested (Type Test) (Certificates of previously conducted tests shallbe submitted)	API 6FA / API 607 / BS 5146 / OCMA	API 6FA / API 607 / BS 5146 / OCMA	report	Perform	review report	review report

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3.12	Actuator Functional Test (If applicable)	Open, Close time, Torque, Limit setting	Functioning in Hydrostatic Test	report	Perform	review point	review point
3.13	Visual & Dimensional examination	ASME Sec-V, Art. 9	Referred ANSI dimensions	report	Perform	review report	review report
4	Surface Preparation, Painting & Preservation	As per Approved procedure	As per Approved procedure		Perform	review point	review report
5.1	Marking	As per Approved procedure	As per Approved procedure	X	Perform	review report	review report
5.2	Inspector's stamp	-	-	X	Perform	review report	review report
6	Control of all certificates & Final Certificate	-	-	certif. 3.1	Perform	review report	review report

EGENDS:

RT: Radiographic test **PT:** Liquid penetrant test **MT**: Magnetic particle test **TPIA**: Third Party Inspection Agency; .
P: Performed **R:**Review W: Witness **Control Authority** : Owner/Engineer or their Authorized Inspection Agency

Hold point = No further steps may be undertaken before the intervention of the appointed responsible takes place.

review point = The appointed responsible has to be notified of the operation in advance, but production will continue whether the intervention took place or not.

Notes:

1 The Above Testing and acceptance criteria are minimum requirements, however, equipment supplier shall ensure and that the product also comply to the additional requirements as per Technical specifications and data sheets. TPIA shall issue the EN10204 3.1 Certification for the Final Product. Welding & Welder Qualification "W" for Customer/CA. Heat treatment as per Specification.

2 The supplier shall submit their own detailed QAP prepared on the basis of the above for approval of Owner/Owner's representative and TPIA.

QUALITY ASSURANCE PLAN
GLOBE
SIZE BELOW 2 INCH

QAP No	**P.019141 G11013 M003**	
Date	**26.09.2024**	
Prepared by	**AHR**	**Checked :SSA**
Approved by	**SSM**	
Client	**BGL**	
Consultant	**TEPL**	

Sl. Nos.	**ACTIVITY**	**Applied standard e/o Procedure**	**Acceptance criteria**	**Document type**	**Scope of Inspection**		
					Manufacturer	**TPIA (By Manufacturer / Contractor)**	**Control Authority**

3 Supplier shall submit Calibration certificates of all Instruments/Equipment to be used for Inspection and Testing to TPIA with relevant procedures and updated standards for TPIA review/Approval.

4 TPIA along with Owner/Owner representative shall review/approve all the documents related to QAP/Quality manuals/Drawings etc. submitted by supplier.

5 Contractor shall in coordination with Supplier/Sub vendor shall issue detailed Production and Inspection schedule indicating the dates and the locations to facilitate Owner/Owner's representative and TPIA to organize Inspection.

6 Certification requirements shall comply with European Standard EN 10204 (latest edition)

7 For All Forging / Casting Materials, The Specimen Shall Be Taken From The Integral Part of The Forging / Casting

8 Heat treatment start and stop temperature chart shall be Witnessed & signed by TPIA. Power failure log book / sheet shall be maintained

9 In case of conflict between purchase specification, contract documents and QAP, more stringent conditions shall be applicable.

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QUALITY ASSURANCE PLAN
SKID FABRICAION

P.019141
G11013
M004

Sr.No	Description	Characteristic	Class	Type of Check	Quantum of Check	Reference Document	Acceptance Norms	Format Of Records	Inspection By			Remarks
									M	TPIA	Owner	
1	**Incoming Material for skid spool fabrication**											
1.1	Pipe	As per Specification	Major	laboratory + Dimensional	1 piece per pipe size	A106 Gr. B (Seamless)	/A106 Gr. B (Seamless)	Mfr / lab cert.	P	W	W/R	
1.2	Pipe Fittings	As per Specification	Minor	laboratory	Per heat	ASTM A105	ASTM A105	Mfr / lab cert.	P	W	W/R	
			Major	laboratory	Per heat	ASTM A105	ASTM A105	Mfr / lab cert.	P	W	W/R	
			Minor	Visual	10%	ANSI B16.9	ANSI B16.9	Mfr cert.	P	W	W/R	
1.3	Flanges	As per Specification	Minor	laboratory	100%	ASTM A105	ASTM A105	lab cert.	P	W	W/R	
			Major	laboratory	Per heat	ASTM A105	ASTM A105	Mfr / lab cert.	P	W	W/R	
			Minor	Visual	10%	ANSI 16.5	ANSI 16.5	Mfr cert.	P	W	W/R	
1.4	Stud and Bolts/ gaskets	Chemical, physical and impact test	Minor	Visual +10% Dimensional	Random selection one piece/size	ASME Sec II and ANSI B1.1	ASME Sec II and ANSI B1.1	Mfr cert.	P	R	W/R	
1.5	Structure	Dimensional	Minor	Visual + Dimensional	100%	as per IS 2062	as per IS 2062	Mfr cert.	P	W	W/R	Fabricator W/S
2	**Welding, NDT & Testing for skid Piping fabrication**											
2.1	WPS/WQP/PQR	Welders Qualification & Welding Procedure	Major	Welders Qualification & Welding Procedure	100%	Approved WPS/WQR/PQR	ASME Sec.IX	WPS/WQP/PQR	P	R	W/R	
2.2	UT or DPTof Non Radiography for Joints	DPT after Final Welding	Major	DPT on other than buttweld joints + UT Report	100%	DPT Report + UT Report	ASME + Sec. V	DPT Report + UT Report	P	10%W	W/R	UT / DPT Report 100% Review
2.3	Radiography Test	Radiography after Final Welding	Major	100% Process Piping	100%	Radiography Report	ASME Sec.VIII/ Div.1 & ASME Sec. V	Radiography Report	P	* R	* W/R	* Film to be Reviewed
2.4	Hydro Test for Interconnecting Pipe spools (with 0.2% Inhibitor)	Hydro Test at 1.4 times the Design Pressure	Major	Strength	100%	GA Drawing and hydro test procedure	ASME B 31.8, IGE/TD/13. No Leakage	Hydro Test Report	P	W	W/R	
2.5	Internal Cleaning of Pipe Spools after Hydro Test.	Internal Surface Finish	Major	Visual	100%	Internal Report	Internal Report	Internal Report	P	R	W/R	
2.6	Surface Preparation and Painting of Skid	Surface Preparation and Painting	Major	Visual + DFT Measurement	100%	Approved Painting Specification	Approved Painting Specification	Inspection Report	P	W	W/R	Random DFT Measurement Witness
2.7	Pneumatic Leak Test for skid	Pneumatic Leak Test at 7.7 Bar for 30 min.	Major	leakage	100%	GA Drawing and Pneumatic test procedure attached	ASME B 31.8, IGE/TD/13. No Leakage	Pneumatic Report	P	W	W/R	
2.8	Final Inspection of Assembled Skid with all Instruments	Tender Specs.	Major	Visual	100%	GA Drawing + P&ID	Approved Specification	Internal Report	P	W	W/R	
2.9	Skid Preservation with N2 purging	N2 Purging - 2Kg/cm2g Preservation-0.3Kg/cm2g	Major	Visual	100%	GA & N2 Drg.+Preservation Procedure	No Leakage	Internal Report	P	R	W/R	
2.10	Necessary Protection during Transportation		Major	Visual	100%	Protection Procedure	Protection Procedure	Internal Report	P	R	W/R	

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		QUALITY ASSURANCE PLAN SKID FABRICAION						P.019141 G11013 M004				
									Inspection By			
Sr.No	Description	Characteristic	Class	Type of Check	Quantum of Check	Reference Document	Acceptance Norms	Format Of Records	M	TPIA	Owner	Remarks
3	**Incoming Material Identification of Bought out Items**											
3.1	Ball Valve	As per specifications	Major	As per specifications	As per specifications	As per specifications	Approved Specification	MFR's TC	P	W/R	W/R	
3.2	Globe Valve / Check valve	As per specifications	Major	As per specifications	As per specifications	As per specifications	Approved Data Sheet	MFR's TC	P	W/R	W/R	
3.3	Pressure Safety Valve	As per attached QAP	Major	As per attached QAP	100%	As per attached QAP	Approved Data Sheet	MFR's TC	P	W/R	W/R	
3.4	Pressure &Temperature Transmitter/Level Gauge, DPT,LT etc	As per attached QAP	Major	As per attached QAP	As per attached QAP	Vendor's QAP	Approved Data Sheet	MFR's TC	P	W/R	W/R	
3.5	Mass Flow Meter/RPD Flow meter and USM/Turbine meter with meter run & flow profiler.	Dimensional Drawing	Major	Dimensional, Visual, Model Operation of Orifice Assembly	100%	Vendor's Manual	Approved Data Sheet	MFR's TC	P	R	W/R	
3.6	Panel / FC /EVC	Physical / Electrical	Major	Continuity check	100%	Loop Diagram, Panel GA	Approved Data Sheet	MFR's TC	P	W	W/R	
3.7	Natural Gas Filter	As per specifications	Major	As per specifications	As per specifications	As per specifications	Approved Data Sheet	MFR's TC	P	W/R	W/R	
3.8	Slam Shut Valve + Regulators	As per attached QAP	Major	As per attached QAP	As per attached QAP	As per attached QAP	Approved Data Sheet	MFR's TC	P	W/R	W/R	
3.9	SS Fittings	As per specifications	Major	As per specifications	As per specifications	As per specifications	Approved Data Sheet	MFR's TC	P	W/R	W/R	
3.10	Pressure Gauge/Temperature Gauge/DPG	As per attached QAP	Major	Calibration, Dimensional, Range Model & Visual	100%	Approved Data Sheet	Approved Data Sheet	MFR's TC	P	W/R	W/R	
3.11	Cable	Test Reports	Major	MTC, Visual & Dimensional	100%	MTC's, tender Specification	Approved Data Sheet	MFR's TC	P	W/R	W/R	

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3.12	Junction Box & Cable Gland	Visual & Dimensional Review of Certificates	Major	Visual & Dimensional	100%	Approved P&ID and GA Drawing	Approved P&ID and GA Drawing	MFR's TC	P	R	W/R	

QUALITY ASSURANCE PLAN
SKID FABRICAION

P.019141
G11013
M004

Sr.No	Description	Characteristic	Class	Type of Check	Quantum of Check	Reference Document	Acceptance Norms	Format Of Records	Inspection By			Remarks
									M	TPIA	Owner	
4	**Final Inspection**											
4.1	Factory Acceptance Test (Panel)	FAT as per Submitted FAT Manual	Major	FAT Procedure	100%	Approved FAT Manual	Approved FAT Manual	Inspection Report	P	W	W/R	
4.2	Completeness + Inspection Release Certificate (IRC)	---	Major	Visual + Dimensions	100%	Approved Bill of Material	Approved Bill of Material	Inspection Report	P	W	W/R	
5	**Packing and Shipping Control**											
5.1	Dispatch	---	Major	Verification of Documentation	100%	Verification of Documentation	Verification of Documentation	Dispatch Clearance by Client	---	R	W/R	
5.2	Name Plate Verification	Name Plate Verification	---	Name Plate Verification	100%	Approved Drawing	Approved Drawing	Approved Drawing	---	R	W/R	
6	**Site Acceptance Test**											
6.1	Pneumatic Leak Test for Skid Assembly	Pneumatic Leak Test at 7.7 Bar for 30 min.	Major	Strength	100%	Approved P&ID and GA Drawing	No Leakage	Inspection Report	---	W	W/R	
6.2	Site Acceptance Test	SAT as per submitted SAT Manual	Major	SAT Procedure	100%	Approved SAT Manual & FDS	Approved SAT Manual & FDS	Inspection Report	---	W	W/R	
7	**Final Documentation**											
7.1	Design and Calculation, Material TC, Calibration, Inspection and Test Report, As Built GA Drawing and P&ID	As per Tender Copy	Major	Verification of Documentation	100%	Approved Specification & As per Tender Doc.	Approved Specification & As per Tender Doc.	Vendor Document Report	---	R	W/R	

Legend

M	Manufacturer	P	Perform
C	Client/Owner	R	Review
TPIA	Third Party Inspection Agency appointed by bidder.	W	Witness
		W/R	Witness of Test & Review of Certificates & Documents as per QAP

Bought-out items may be procured under 3.1 certification. However, TPIA carrying out the final inspection of the skid will review all 3.1 certification of bought-out items and include the details in the final inspection report.

NOTE

1 Review of existing WPS/PQR by TPIA for suitabling . If not suitable, Testing has to be carried out under witness of TPIA

2 EPMC / Owner's Inspection shall not be a Hold Point.

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		QUALITY ASSURANCE PLAN FLANGES							**P.019141 G11013 M005**	
S.No.	**ACTIVITY**	**PTS chap.**	**Frequency**	**Applied standard e/o Procedure**	**Acceptance criteria**	**Document type**	**Scope of Inspection**			
							Manufacturer	**TPIA**	**Client / Consultant**	
0	**CONTROL BEFORE MANUFACTURING**									
	- list of operation in manufacturing and control	9.1	1 per purchase order		specification		Perform	review point	review point	
	- Fabrication and Control procedure	9.1			specification		Perform	review point	review point	
	- material part list	9.1; 2 and 3			specification		Perform	review point	review point	
	- dimensional drawings	9.2 ; 2			specification		Perform	review point	review point	
	- heat treatment procedure	2, 4, 5, 6 & 7			specification		Perform	review point	review point	
	- non destructive testing procedures	6			specification		Perform	review point	review point	
	- painting procedure	As per PTS			specification		Perform	review point	review point	
1	**BASE MATERIAL**									
1.1	**Mechanical tests** (remark : marking transfer by TPIA)									
	Tensile tests (YS, UTS, YS/UTS, %EL, RA, Bend etc. as applicable)	5.1.1	1 per lot*		PTS / Mat. Spec.	certif. 3.2	Perform	hold point	review report	
	Charpy Impact test at temp. as per Mat. Spec.	5.1.2	1 per lot* (1 set of 3 specimen per temp. range)		PTS / Mat. Spec.	certif. 3.2	Perform	hold point	review report	
1.2	**CHEMICAL COMPOSITION**									
	Check chemical analysis	3.10	1 per heat		PTS-Table1		Perform	review report	review report	
2	**FABRICATION AND TESTS**									
2.1.	Heat treatment (Loading & Unloading shall be witnessed by TPIA, Power failure log shall be maintained)	4.3	all fittings	T/T Graph	PTS	certif. 3.2	Perform	Witness Point (Loading & Unloading)	review report	
	- time temperature chart	4.3.1	1 per furnace charge			report	Perform	review report	review report	
	- micrographic examination	4.3.2	1 per lot*	ASTM E 112	Grain size : range 8 to 12	certif. 3.2	Perform	hold point	review report	
2.2.	Mechanical tests (remark : marking transfer by TPIA)					certif. 3.2	Perform	hold point	review report	
2.2.1	- Tension test for flanges (YS, UTS, YS/UTS, %EL, RA, Bend etc. as applicable)	4.2.4 & 5.1.1	1 sample per lot of HT per Raw material Heat	ASTM A 350 § 6.1.3 + E/R <= 0.85 / PTS	PTS & Mat. Spec.	certif. 3.2	Perform	hold point	review report	

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2.2.2	-	Charpy Impact test for flanges (Longitudinal & Transverse)	4.2.4 & 5.1.2	2 sets of 3 specimens per lot of HT per RM Heat	ISO 148 - Charpy V-Notch	- **At 0°C Minimum Average Absorbed Energy** shall be SMYS (Mpa)/10, with a minimum of 27 J, for the transerve direction. - **At 0°C Minimum Individual Energy** value shall not be less than 80 % of the Minimum required average value, for the transerve direction.	certif. 3.2	Perform	hold point	review report

QUALITY ASSURANCE PLAN
FLANGES

P.019141
G11013
M005

S.No.	ACTIVITY	PTS chap.	Frequency	Applied standard e/o Procedure	Acceptance criteria	Document type	Scope of Inspection		
							Manufacturer	TPIA	Client / Consultant
3	**NON DESTRUCTIVE EXAMINATIONS (NDE)**								
3.1	Radiographic examination	6.1.1 and 6.1.3.4	All butt welds	ASME Section-V	Girth welds : API 1104 section 6.0	certif. 3.2	Perform	witness point	review report
3.2	Ultrasonic inspection	6.1.2.1, 6.1.2.2, 6.1.2.4 , 6.1.3.3	100%	ASME Section-V, Art-23, SA-388	ASME section VIII division1 UF-55	certif. 3.2	Perform	witness point	review report
3.3	Magnetic particle inspection	6.1.2.1, 6.1.2.4, 6.1.3.2, 6.1.3.5,	100%	ASME Section-V	ASME section VIII division1 appendix 6	certif. 3.2	Perform	witness point	review report
3.4	After machining								
	- Magnetic particle or liquid penetrant of the bevels	6.1.2.4, 6.1.3.5,	all finished bevels	ASME Section-V	PTS § 5.3.3.5.	certif. 3.2	Perform	witness point	review report
	- Ultrasonic inspection of 25 mm of base material	6.1.2.1, 6.1.2.2, 6.1.2.4 , 6.1.3.3	wall thickness ≥ 6 mm all finished bevels	ASME Section-V	PTS § 5.3.3.5.	certif. 3.2	Perform	witness point	review report
3.5	Visual examination	6.1.2.3 & 6.1.3.1	100%		PTS	certif. 3.2	Perform	hold point	review report
3.6	Dimensionnal examination	6.1.2.5	10% NPS ≤ 6"		PTS	certif. 3.2	Perform	witness point	review report
			100% NPS > 6"						
4	**FINAL INSPECTION TEST**								
4.1	Marking	8	all				Perform	witness point	review report
4.2	Inspector's stamp	8.1.1	all			certif. 3.2	Perform	hold point	review report
4.3	Documentation	9	-	PTS & P.O.	PTS & P.O.	certif. 3.2	Perform	hold point	review report
*	**LOT - A lot consists of all fittings from one heat of steel with same initial wall thickness, from the same furnace charge for final normalizing heat treatment, from the same shape and the same main pipe dimension.**								

LEGEND:

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RT : Radiographic test | PT : Liquid penetrant test | MT : Magnetic particle test | HT : Heat treatment | VT : Visual test | RM : Raw Material

R : Review | W : Witness | P : Performed | TPIA : Third Party Inspection Agency; | SMYS : Specified Minimum Yield Strength;

Hold point = No further steps may be undertaken before the intervention of the appointed responsible takes place.

Witness point = The appointed responsible has to be notified of the operation in advance, but production will continue whether the intervention took place or not.

Note:

1. The Above Testing and acceptance critera are minimum requirements, however, equipment supplier shall ensure that the product also comply to the additional requirements as per Technical specifications and data sheets.
2. The supplier shall submit their own detailed QAP prepared on the basis of the above for approval of Owner/EPMC and TPIA, for each size. Impact test at -20 deg C shall be conducted in addition to respective material requirement.
3. Supplier shall submit Calibration certificates of all Instruments/Equipment to be used for Inspection and Testing to TPIA with relavant procedures and updated standards for TPIA reveiew/Approval.
4. TPIA will have Right to Inspect minimum 10% of all manufacturing activities on each day or as specified above. Owner reserves the right to inspect any quantity of item at any time during execution.
5. TPIA along with Owner/EPMC shall review/approve all the documents related to QAP/Quality manuals/Drawings etc.submitted by supplier.
6. Manufacturer shall in coordination with Sub vendor shall issue detailed Production and Inspection schedule indicating the dates and the locations to facilitate Owner/EPMC and TPIA to organise Inspection.
7. Certification requirements shall comply with European Standard EN 10204 (latest edition)-3.2 issued by TPIA and Vendor.
8. Heat treatment start and stop temperature chart shall be witnessed & signed by TPIA. Power failure log book / sheet shall be maintained
9. For All Forging Materials, The Specimen Shall Be Taken From The Integral Part of The Forging.

	QUALITY ASSURANCE PLAN FLANGES	P.019141 G11013 M005

S.No.	ACTIVITY	PTS chap.	Frequency	Applied standard e/o Procedure	Acceptance criteria	Document type	Scope of Inspection		
							Manufacturer	TPIA	Client / Consultant
10	Certification requirements shall comply with European Standard EN 10204 (latest edition)								
11	In case of conflict between purchase specification, contract documents and QAP, more stringent conditions shall be applicable.								

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QUALITY CONTROL TABLE
INSULATING GASKET

QCT No. : P.019141 G11013 M006
Date: 26.09.2024 | **Revision: 0**
Prepared : AML
Checked : GGA
Approved : SSM

S. No	DESCRIPTION	QUANTUM OF CHECK	CHARACTERISTICS	ACCEPTANCE CRITERIA	DOCUMENTATION	INSPECTION		REMARKS
						MANUF.	TPIA / CA	
1	**Raw Material Inspection**							
1.1	Insulating Gaskets	1 sample per heat	PHYSICAL , CHEMICAL	PTS / Data sheet	Test report	H	R	
1.2	Insulating Washer							
1.3	Insulating Sleeve							
1.4	Machine Cut Washer							
2	**Final Inspectiom**							
2.1	Raw Material		PHYSICAL , CHEMICAL	PTS / Data sheet	Test report	P	W	
2.2	Hydrotest and Pneumatic Test	Each Batch	PTS	PTS / Data sheet / Approved Procedure	Inspection report	P	W	
2.3	Visual & Dimensional check	100%	Measurement	PTS / Data sheet	Inspection report	P	R	
2.4	Marking	Each Batch	PTS	PTS / Data sheet / Approved Procedure	Inspection report	P	R	
2.5	Packing	Each Batch	PTS	PTS / Data sheet / Approved Procedure	Inspection report	P	R	
2.6	Documentation		PO / PTS	PTS / Data sheet	Inspection report	P	W	

LEGENDS: **R - Review, W - Witness, RW - Random Witness, H - Hold, P - Perform, TPIA - Third Party Inspection Agency, CA - Control Authority (Owner / owner's representative) , P.O. - Purchase order**

Notes: -

1. The Above Testing and acceptance critera are minimum requirements, however, manufacturer shall ensure that the product shall also comply to the additional requirements as per Particular Technical specifications(PTS)
2. The testing of Flange and Stud Bolts shall be as per QCT Flanges (P.013313 D 11013 141) and QCT Fastners (P.013313 D 11013 143) respectively.
3. The supplier shall submit their own detailed QAP prepared on the basis of above / Technical specification for approval of Owner/Owner's representative.
4. Owner/Owner representative shall review/approve all the documents related to QAP/Quality manuals/Drawings etc.submitted by supplier.
5. Contractor in coordination with Supplier/Sub vendor shall issue detailed Production and Inspection schedule indicating the dates and the locations to facilitate Owner/Owner's representative and TPIA to organise Inspection.
6. Special manufacturing procedures have to be specially approved or only previously approved procedures have to be used, in case of conflict between specifications more stringent condition shall be applicable.
7. Owner / Owner's representative including TPIA will have the right to inspect any activity of manufacturing at any time.
8. All reference Codes/ Standards, Documents, P.O. Copies shall be arranged by vendor / supplier for reference of TPIA/CA at the time of Inspection
9. At the time of deleivery of materail in stores, vendor will submit copy of all related document of inspection along with release note & MTC.

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FASTENERS

Checked : GGA
Approved : SSM

SR. NO	COMPONENTS & OPERATIONS	TYPES OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	INSPECTION		
							VENDOR	TPIA (By Manufacturer / Contractor)	CONTROL AUTHORITY
1	**RAW MATERIAL**								
	1. RAW MATERIAL	1. VISUAL INSPECTION, MARKING & CORRELATION WITH MANUFACTURE TEST CERTIFICATE)	100%	ASTM A 320 L7 / A 194 GR4/GR7	ASTM A 320 L7 / A 194 GR4/GR7	MTC 3.1	R	W	R
		2. CHEMICAL COMPOSITION	PER HEAT	ASTM A 320 L7 / A 194 GR4/GR7	ASTM A 320 L7 / A 194 GR4/GR7	MTC / LAB TEST REPORT 3.1	R	R	R
		3. MECHANICAL PROPERTIES	PER HEAT	ASTM A 320 L7 / A 194 GR4/GR7	ASTM A 320 L7 / A 194 GR4/GR7	INSPECTION REPORT 3.1	R	R	R
		4. PMI CHECK	100%	ASTM A 320 L7 / A 194 GR4/GR7	ASTM A 320 L7 / A 194 GR4/GR7	INSPECTION REPORT 3.2	P	W	R
2	**INPROCESS INSPECTION.**								
	1. MFG. OF BOLT & NUT	1.CUTTING , GRINDING, FORGING, THREADING ETC.	100%	VENDOR DRG./ ASTM A 320 L7 / A 194 GR4/GR7/ ASME B18.2.1&2.2	VENDOR DRG./ ASTM A 320 L7 / A 194 GR4/GR7/ ASME B18.2.1&2.2	DIMENSION REPORT 3.1	P	R	R
		2. PRODUCT DIMENSIONS	100%	VENDOR DRG./ ASTM A 320 L7 / A 194 GR4/GR7/ ASME B18.2.1&2.2	VENDOR DRG./ ASTM A 320 L7 / A 194 GR4/GR7/ ASME B18.2.1&2.2	DIMENSION REPORT 3.1	P	R	R
	2. HEAT TREATMENT	1. HEAT TREATMENT CYCLE (TEMP. / TIME CHART)	100%	ASTM A 370 / A 320 L7 / A194 GR4/GR7/ SPECIFICATION.	ASTM A 370 / A 320 L7 / A194 GR4/GR7/ SPECIFICATION.	HT GRAPH / INSPECTION REPORT 3.1	P	R	R
	3.STAMPING OF SAMPLE FOR TESTING	1. STAMPING OF TEST SAMPLE	100%	ASTM A 370 / A 320 L7 / A194 GR4/GR7/ SPECIFICATION.	ASTM A 370 / A 320 L7 / A194 GR4/GR7/ SPECIFICATION.	INSPECTION REPORT 3.2	P	W	R
	4. MECHANICAL TESTING	1. TENSILE TESTING (TS,YS,EL%)	ONE / HEAT/LOT	ASTM A 370 / A 320 L7 / A194 GR4/GR7/ SPECIFICATION.	ASTM A 370 / A 320 L7 / A194 GR4/GR7/ SPECIFICATION.	INSPECTION REPORT 3.2	P	W	R
		2. PROOF LOAD TEST	ONE / HEAT/LOT	ASTM A 370 / A 320 L7 / A194 GR4/GR7/ SPECIFICATION.	ASTM A 370 / A 320 L7 / A194 GR4/GR7/ SPECIFICATION.	INSPECTION REPORT 3.2	P	W	R
		3. HARDNESS TESTING	5 % / HEAT/LOT	ASTM A 370 / A 320 L7 / A194 GR4/GR7/ SPECIFICATION.	ASTM A 370 / A 320 L7 / A194 GR4/GR7/ SPECIFICATION.	INSPECTION REPORT 3.2	P	W	R
		4. IMPACT TEST AT - 101° C	ONE / HEAT/LOT	ASTM A 370 / A 320 L7 / A194 GR4/GR7/ SPECIFICATION.	AVG 27J & IND 20J / SPECIFICATION.	INSPECTION REPORT 3.2	P	W	R
	5. PRODUCT CHEMICAL CHECK ANALYSIS	1. CHEMICAL ANALYSIS	ONE / HEAT/LOT	ASTM A 370 / A 320 L7 / A194 GR4/GR7/ SPECIFICATION.	A 320 L7 / A194 GR4 / GR7 / SPECIFICATION.	INSPECTION REPORT 3.1	P	R	R
		2. PMI TEST	5 % / HEAT/LOT	A 320 L7 / A194 GR4/GR7/ SPECIFICATION.	A 320 L7 / A194 GR4 /GR7 / SPECIFICATION.	INSPECTION REPORT 3.2	P	W	R
3	**FINAL INSPECTION**								
	1.FINAL INSPECTION	1. VISUAL \ STAMPING \ MARKING \ COLOR CODING.	100%	SPECIFICATION./ ASTM A 320 L7 / A194 GR4/GR7	SPECIFICATION./ ASTM A 320 L7 / A194 GR4/GR7	INSPECTION REPORT 3.2	P	100% W	R
		2. DIMENSIONS	100%	APPRD. DRG./ ASTM A 320 L7 / A194 GR4/GR7	APPRD. DRG./ ASTM A 320 L7 / A194 GR4/GR7	INSPECTION REPORT 3.2	P	10% W	R
4	**FINAL DOCUMENTS**								
	1. FINAL DOCUMENTS	1. QAP / PO / MTC / IR / COMPLIANCE CERTIFICATES	100%	AS PER SPECIFICATION / AS PER APPR. DRG. & QAP	AS PER SPECIFICATION / AS PER APPR. DRG. & QAP	COMPLIANCE CERTIFICATE	P	R	R
		2. INSPECTION RELEASE NOTE	100%	AS PER SPECIFICATION / AS PER APPR. DRG. & QAP	AS PER SPECIFICATION / AS PER APPR. DRG. & QAP	COMPLIANCE CERTIFICATE	H	P	R

Legend: P-Perform, R-Review, W-Witness, H-Hold, TPIA: Third Party Inspection Agency , Control Authority : Owner / Owner's representatives.

NOTE :

1. TPIA SHALL ISSUE 3.2 CERTIFICATE AS PER BS EN 10204
2. MATERIAL & TYPE SHALL BE AS PER SPECIFICATIONS / DATA SHEET
3. START & STOP TEMP. CHART SHALL BE SIGNED BY TPIA, ALSO POWER FAILURE LOG SHALL BE MAINTAINED.
4. SAMPLE FROM ANY ONE LOT/HEAT SHALL BE TESTED BY CLIENT UNDER THEIR WITNESS AT ANY NABL ACCREDITED LAB.
5. IN CASE OF CONFLICT BETWEEN PURCHASE SPECIFICATION, CONTRACT DOCUMENTS AND QAP, MORE STRINGENT CONDITIONS SHALL BE APPLICABLE.

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BHAGYANAGAR GAS LIMITED (BGL)

MOTHER STATION COMPOSITE WORKS (CIVIL, MECHANICAL, INSTRUMENTATION AND ELECTRICAL WORKS)

PTS - CIVIL CONSTRUCTION

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	PTS - CIVIL CONSTRUCTION	P.019141 G 11077 C205

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1.0 CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

1.1. Introduction

This document describes brief scope, technical specification and acceptance criteria for the execution, construction, materials, and workmanship for all Civil, Structural and Architectural (CSA) works for construction of MOTHER STATIONS OF BGL HYDERABAD). This PTS shall be read in conjunction with the General Conditions of Contract (GCC), Special Conditions of Contract (SCC), General Technical Specifications (GTS) of work, drawings, Schedule of rates (SOR), Instruction to Bidders (ITB) and other documents forming part of the tender wherever the context so requires.

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

The Bidder shall inspect and examine the site and its surrounding and shall satisfy himself before submitting his bid as to the nature of the ground and subsoil, the form and nature of the site, the quantum and the nature of work and material necessary for successful completion of the works and the means of access to site and in general shall himself obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect his Tender. Under no circumstances, extra payment consequent on any misunderstanding or otherwise on the part of the Contractor shall be allowed.

Latest CPWD (Centre Public Works Department) Technical Specification (Vol. 1 & 2), item description mentioned in Schedule of Rates (SOR) and details provided in tender drawings shall be followed by the Contractor for the technical details not specified in this technical specification for Civil, Structural and Architectural Works. In case of any discrepancy between this tender specification & above stated documents, the description of items mentioned in SOR and details shown in approved IFC drawings shall be followed.

1.2. DEFINITIONS AND INTERPRETATION

The terms used in the technical document must be understood as follows:

AGREEMENT	Designates the agreement concluded between the OWNER and the CONTRACTOR, under which the latter undertakes to the former the GOODS and/or SERVICES according to the stipulations which are agreed and specified in the form of an order.
OWNER	Designates the purchaser of the GOODS and/or SERVICES which are the subject of the AGREEMENT.
CODE	Designates a set of systems and Indian rules or international standardization documents for design, materials, tests, etc.

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CONTRACTOR	Designates the individual or legal entity with whom the order has been concluded by the OWNER. The term "CONTRACTOR" may be used indifferently for a supplier, a manufacturer, an erection CONTRACTOR, etc.
DAYS - WEEKS - MONTHS	Specify the number of calendar days, weeks, or months and not of working days, weeks or months.
OWNER'S REPRESENTATIVE	Designates the individual or legal entity to which the OWNER has entrusted various tasks in relation with the carrying out of his PROJECT.
GOODS and/or SERVICES	Designate, depending on the case, all or part of the drawings or documents, substances, materials, equipment, structures, plant, tools, machinery, to be studied, designed, manufactured, supplied, erected, built, assembled, adapted, arranged or put into service by the CONTRACTOR under the AGREEMENT, including all the studies, tasks, works and services specified by the order. The terms GOODS or SERVICES may be indifferently used one for the other as required by the context.
PROJECT	Designates the aggregate of GOODS and/or SERVICES to be provided by one or more CONTRACTORS.
STANDARD	Designates a set of models or references, corresponding to common practice and generally used by the OWNER'S REPRESENTATIVE. This can be typical standard drawings or documents.
SPECIFICATION	Designates a document describing in some details general or requirements for specific type of works.

1.3. LAWS –CODES –RULES & STANDARDS

General

Basically, the following are applicable:

Basic Laws – Codes – Rules & Standards, mandatory by law in Haryana of India.

The complete set of which are part of the present technical volume.

Particular Codes & Standards as per Section 1.4 in PTS and GTS.

The "Rules of Art" and "Sound Practices" of the engineering.

OISD & PNGRB guidelines and requirements related to Construction procedure, safety and methodology.

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

1.4. Particular Codes & Standards (Latest editions)

All materials, design, workmanship test and acceptance criteria etc., must conform to the latest edition of the following standards:

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- Indian Standard Codes (IS)
- Special Publications (SP)
- Indian Road Congress Standards (IRC)
- National Building Codes (NBC)
- CPWD Specifications
- MORTH Specifications

Other International standards are also acceptable provided those ensure a quality equal or higher than Indian Standards. If any, standard/clauses of the standard contains a provision which is inconsistent with a provision in Indian Standard, the more stringent requirement as per the interpretation of the OWNER shall prevail. All work shall be carried out on the basis of latest edition of applicable codes & standards mentioned. A list of specific codes is given below:

1	IS:875 (Part I to V)	:	Code of Practice for design loads (other than earthquake) for building and structures.
2	IS:1893	:	Criteria for Earthquake resistant design of structures.
3	IS:2911	:	Code of Practice for design and construction of pile foundation.
4	IS:456	:	Code of practice of Plain and Reinforced Concrete.
5	IS:1786	:	Code of practice of specifications for high strength deformed steel bars and wires for concrete reinforcement.
6	IS:1566	:	Code of Practice of hard-drawn steel wire fabric for concrete reinforcement.
7	IS:432	:	Code of Practice of specifications for mild steel and medium tensile steel bars and hard-drawn steel wires for concrete reinforcement.
8	IS:13920	:	Code of practice for ductile detailing of reinforced concrete structures subjected to seismic forces.
9	IS: 800	:	Code of practice for general construction in steel.
10	IS: 806	:	Code of practice for use of steel tubes in general building construction
11	IS: 2062	:	Code of practice for Steel for general structural purposes
12	IS: 3502	:	Code of practice for Steel chequered plates.
13	IS: 1363	:	Code of practice for Hexagonal head bolts, screws and nuts of product grade C.

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14	IS: 1367	:	Code of practice for Technical supply conditions for threaded steel fasteners
15	IS: 5624	:	Code of practice for Specification for foundation bolts.
16	IS: 2016	:	Code of practice for Plain washers
17	IS: 277	:	Code of practice for Galvanized steel sheet (Plain and corrugated)
18	IS: 1230	:	Code of practice for Cast Iron rainwater pipes and fittings
18	IS: 2386	:	Method of test of aggregates for Concrete and other tests
18	IS: 2700	:	Method of test of soil
20	IS: 5640	:	Method for determining the aggregate impact value of soft coarse aggregate
21	IS: 6509	:	Code of practice for installation of joints in concrete pavements.
22	IS: 6579	:	Specification for coarse aggregate for water bound macadam
23	IS: 10379	:	Code of practice for field control of moisture and compaction of soils of embankment and subgrade.
24	IS: 15658	:	Precast concrete blocks for paving-Specification
25	IS: 5758	:	Specification for precast concrete kerbs, channels, edgings, quadrants and gutter aprons
26	IS: 1838 Part 1	:	Specification for preformed fillers for expansion joints in pavements and structures: Part 1 Bitumen impregnated fiber
27	IS: 516	:	Methods of test for strength of concrete
28	IS: 1728	:	Code of practice for Specification for sheet metal rainwater pipes, normal size gutters, fittings and accessories.
29	IRC 3	:	Dimensions and weights of Road Design vehicles
30	IRC 6	:	Standard specification and code of practice for road bridges, section II – loads and stresses
31	IRC 15	:	Standard specification and code of practice for construction of concrete roads
32	IRC 19	:	Standard Specifications and Code of Practice for Water Bound Macadam (Second Revision)
33	IRC 20	:	Recommended Practice for Bituminous Penetration Macadam (Full Grout)
34	IRC 27	:	Tentative specification for bituminous macadam (base and binder course)

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35	IRC 29	:	Specification for bituminous concrete (Asphaltic concrete) for road pavements
36	IRC 32	:	Standard for vertical and horizontal clearances of overhead electric power and telecommunication lines as related to roads
37	IRC 16	:	Specification for priming of base course with bituminous binders
38	IRC 34	:	Recommendations for road construction in waterlogged area
39	IRC 37	:	Guidelines for the Design of Flexible Pavements (First Revision)
40	IRC 49	:	Recommended Practice for the Pulverization of Black Cotton Soils for Lime Stabilization
41	IRC 50	:	Recommended Design Criteria for the Use of Cement Modified Soil in Road Construction
42	IRC 57	:	Recommended practice for sealing of joints in concrete pavements
43	IRC 58	:	Guidelines for the design of plain jointed rigid pavement for highways
44	IRC 73	:	Geometric design of highway roads
45	IRC 75	:	Guidelines for the Design of High Embankments
46	IRC 86	:	Geometric design standards for urban roads in plains
47	IRC SP 11	:	Handbook of quality control for construction of roads and roadways
48	IS: SP 23	:	Handbook on concrete mixes (based on Indian standards)
49	IS1200	:	Mode of Measurements (all parts)
50	MORTH (5th Revision)	:	Specification by Ministry of Road Transport & Highways
51	Latest CPWD specifications	:	Central Public Works Department (GOI): Specifications
52	Oil Industry Safety Directorate (OISD) publications	:	
53	Architectural works	:	National Building Code of India
a		:	Bureau of Indian Standard
b		:	State Government Factory Acts

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xc		:	Local Municipality / Authority's Byelaws as applicable
d		:	TAC (Tariff Advisory Committee) Recommendations
e		:	BPE (Bureau of Public Enterprises) Guidelines
f		:	Any other rules/ regulations/ recommendations as applicable for a particular project

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Apart from the above list, specific code requirements are mentioned in the relevant sections in this tender document.

1.5. Conflict of Standards

In the instances where Other Standards and Codes are to be used, the Contractor shall identify which Standards it proposes to use and present a list to OWNER for review and approval. The Contractor shall prepare a tabulated list of discrepancies between this Specification and the Standards for review by OWNER. Resolution of any such conflicts shall be obtained from OWNER in writing before proceeding. Where conflict exists between OWNER Arrangement drawings, SOR and Standards, the Drawings shall govern. Where conflict exists within Project Specific Standards, OWNER shall be notified. The affected Standards will be revised by OWNER as necessary to clarify requirements.

1.6. Scope of Supply

a) Contractor shall procure & supply to site all the materials including cement, reinforcing steel, steel sections, plates, pipes, MS Angle Posts, Concertina coil, RBT fencing wire, Chain link fencing, chequered plate, Colour coated steel sheets, False ceiling, mesh and other accessories, other masonry materials, bitumen/asphalt, admixtures & bonding agents, sealants, kerb stones, paver block, sand, boulder, etc., and any other construction material / item required to complete the civil & structural works.

b) All costs towards quality testing/inspection of materials/goods shall be taken by the Contractor.

c) All materials used in the works shall be of the best quality of their respective kinds as specified herein, obtained from sources and suppliers approved by the OWNER or his representative and shall comply strictly with the tests prescribed hereinafter or, where tests are not laid down in this specification, with the requirements of the latest issue of the relevant Indian or any other International Standards or other Standards approved by the OWNER or his representative.

d) Material will be strictly follows as described in this specification, item description stated in SOR of this document. Samples of all materials proposed to be used in the works may be called for at any time by the Owner's Engineer. The work shall be carried out by competent personnel skilled in their respective trades.

e) Before commencing the works, the contractor shall ascertain the locations and nature of all existing underground services and shall take every possible precaution against any damage occurring to them or interference therewith, during the execution of the works.

f) Construction work including supply of labour, construction materials, construction equipment, survey, tools & tackles, dismantling & modification / strengthening,

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supervision, testing etc. required to complete all the structures, foundations, roads, drains, pavements, finishes, supply, fabrication, erection of steel structures, LCV Platform, cat ladder, Chain link fencing and gates etc, painting, including site grading/earthwork in cutting & filling etc. as specified and required to complete the civil & road works in all respect.

g) All enabling works e.g., construction water, casting/fabrication yard, electricity, site stores & office, safety and security measures, coordination with other contractors/Vendors working at site etc. shall be Contractor's responsibility.

h) Special permits such as 'Hot Permit", "Fire Safety Permit", "permissions for controlled blasting of rock from concerned authorities" etc. to work at terminals shall be contractor's responsibility.

1.7. SCOPE OF WORK

The scope of work to be performed under this contract shall include complete Civil, Architectural and Structural works as per plans, equipment layout, drawings & technical specifications and SOR for the 'CGD station work'. Scope of work shall be broadly, but not limited to, the following.

a) Clearing the site, removal of bushes and trees etc. as per site requirement.

b) Dismantling of existing facility (if any) as per project requirements and disposal of debris outside the plant in the areas designated by Owner.

c) Striping of top existing soil layer and removal of the same outside property boundary in areas designated by Engineer-in-charge.

d) Land development including filling of plot area up to FGL level

e) Dewatering of underground water, water at founding level with suitable means for completion of construction, as suitable. No extra charge shall be payable for dewatering.

f) Construction of building and structure (if any) e.g. Site officer building, guard house etc. as per detail drawings to be issued.

g) Supply and fixing of Chain link fencing and steel gates as per layout requirements.

h) RCC cable trenches: complete civil works for cable trench including providing inserts plates, conduits (GI, PVC, or HDPE etc.) And PVC coated MS Chequered cover plate / Precast concrete covers as per requirement.

i) Construction of Equipment foundations i.e., Compressor, Air compressor, C02, Air receiver, DG Set, Cascade etc. as per details drawing.

j) Interlocking paver block paving as per plot layout and paving drawings.

k) RCC and brick masonry storm water drains, catch pits, pipe culverts, RCC box culverts etc. complete work as per system requirement and detail drawings including rainwater harvesting system.

l) Construction /modifications in approach roads etc. as per drawing.

m) Construction of Electrical pole, high masts, cable pits etc. as per requirement.

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n) Construction of sanitary works & plumbing for entire project.

o) Preparation of plumbing and sanitary layout/drawings as per provided drawings and plot plan.

p) Construction of Percolation Pit as per drawing.

q) Construction of SS Tube Trench as per drawing.

r) Preparation of fabrication drawings along with connection details of steel structures as per erection drawings to be issued.

s) Preparation of detail erection details of false ceiling/false flooring system based on provided Architectural drawings of buildings.

t) Grouting of all base plates/frames of equipment foundations and structural bases.

u) Providing of all inserts, conduits, pre-cast covers, fixing of free issue items into permanent works etc.

v) During construction and on completion of construction (inclusive of all internal and external finish) clearing all the debris and waste materials scattered around the site and disposal of the same as per direction of the Engineer-in-Charge, shall be in the scope of the Contractor.

w) Any other work not specifically mentioned but required to make the station functional.

x) Preparation of As-built drawings as per actual site and submission the same for Owner/PMC review & acceptance.

y) The scope will cover construction, fabrication and erection works including material procurement / supply and transportation to site, dismantling of existing structure (if required), site formation and development etc. including all associated works that are necessary for the operation of CGD station.

z) Fabrication drawing shall be prepared by Contractor in line with Framing drawing provided by Owner/Owner's Consultant and will be submitted for information and inspection of execution of steel work. Bar bending schedules, any other design and drawing required for execution of works shall be prepared by Contractor and provided for Engineer in charge's review.

aa) Contractor shall provide all the design and execution drawings for plumbing layout of structures under scope, false floor arrangements, glass partition walls with aluminium frames, reflected ceiling plans of buildings, any temporary structure required for execution works, etc. based on IFC drawings for structures & area issued to contractor.

bb) The scope of work under this tender includes supervision through qualified and technical Personnel, skilled and unskilled labour, etc. and mobilization of all relevant and adequate Plants, tools and tackles, equipment, machineries, etc., to carry out all Civil, Structural and Architectural works for successful operation of the proposed plant. All the works shall be carried out strictly in accordance with the "Technical Specifications and SOR enclosed with this document and detail drawings to be provided.

cc) The item wise quantities are provided in the SOR along with item description for the work to be done under Scope of this tender. However, these quantities may slightly vary during actual site work based on detail design drawings and the Contractor shall be liable to do the additional work in the same unit rate of this Contract. Site and Lab tests of all the

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Materials are in the Contractor's scope, the Contractor shall not charge any extra amount for the quality tests of materials.

dd) Contractor to do construction work upto the quantity available in the SOR/PO and no work shall be carried out for such items without taking approval from BGL for the additional quantities. If contractor do the work based on issued drawings without taking approval of additional quantities, Owner/PMC will not be held responsible for quantity approval of such work.

ee) Contractor to track the PO quantity based on executed work. If the PO quantity exhausted and additional quantity is required, Contractor to raise change PO request along with quantity estimation for BGL's approval.

ff) The Contractor shall be responsible for providing all material, equipment, and services, specified or otherwise which are required to complete the scope and fulfil the intent of ensuring operability, maintainability and the reliability of the complete work cov ered under this specification. It is not the intent to specify completely herein, all aspects of construction. Nevertheless, the construction shall conform in all respects to high standards of engineering, design and workmanship, in a manner acceptable to OWNER, who will interpret the meaning of the specification, drawings, on site construction etc. and shall have a right to reject or accept any work or material which in his assessment is not complete to meet the requirements of this specification, quality standards specified in relevant IS codes and/or applicable National and International standards mentioned elsewhere in the specification and drawings.

gg) The scope shall be on the basis of the single point responsibility completely covering the supplies and services in respect of all works specified and covered under the specifications. This specification shall be read in conjunction with the drawings, SOR, technical requirements, CPWD specifications and provisions of NBC-2016, wherever specified in this document.

hh) Contractor, at their own cost, shall provide for all royalty, statutory requirements, etc. for all construction materials at all stages like purchase, supply, transport, disposal, etc.

ii) Contractor to supply Civil materials (construction materials) accompanying the invoice / challan as per the rules & regulations of Statutory guidelines.

jj) All the statutory permissions required for carrying out blasting work for excavation and other purpose shall be in the scope of Contractor at their own cost.

kk) Relocation (if required) of existing above ground or underground facilities encountered before or during construction shall be carried out with the approval of the OWNER / PMC.

1.8. PREMEABLE TO SCHEDULE OF RATES

The Preamble to Schedule of Items is an integral part of the schedule of quantities and rates and this is to be considered incorporated into the description of items themselves. The Contractor's rate for any item of work in the schedule of item shall, unless stated otherwise be held to include the cost of all materials including wastage, conveyance, and delivery, unloading, storing, fabrication, all consumable materials, like MS bolts, washer, electrodes, putty, gases, splices paints, tools and plants, power fuel, consumables, all taxes, royalties, other revenue expenses, temporary facilities like roads etc.

The item shall include all the safety provisions listed below:

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a) The site should be properly barricaded.

b) Unauthorised persons /materials on site should not be allowed.

c) All persons including all labour, supervisors, visitors etc. on site must wear hand gloves, helmet and safety shoes. The responsibility of this shall rest with the main contractor.

d) All workmen while working on height shall have PPEs like safety belt, safety helmets etc.

e) All workmen such as welders/ fitters etc. shall wear protective mask, gloves, protective glasses etc. and as per the requirement and demands of the trade.

f) All excavated pits/holes shall be cordoned off with red tape with warning notice.

g) All inflammable material shall be kept in non-inflammable containers that are always fixed with screwed on caps. The containers should be marked with danger sign and the name of the material shall be marked on the outside. There should be at least one person who should be responsible for the safe custody of these materials.

h) All areas of work shall have appropriate safety signage depending on the nature of work, prominently displayed to prevent any mishap, particularly signs in fluorescent paint for night vision. These signs should be visible from a reasonable distance for a vehicular traffic at designated speed limits for a given road/ location. All necessary city traffic rules and signage specifications shall be observed with strict adherence.

i) All gadgets must have required safety devices in working conditions as per the manufacturers' recommendations and the law of the country.

j) All the persons on site must be insured against injury and death due to accidents.

k) The contractor shall not use the site for any activity other than what it is authorised for.

l) Children below the age of 16 shall not be allowed to work on site. The contractor shall prepare a secured crèche adjacent to the site, for the children of labor working on site and there shall be at least one person dedicated to look after the safety and other needs of these children at all time.

1.9. GENERAL REQUIREMENT

1.9.1. General

Contractor shall furnish all tools, plants, instruments, qualified supervisory personnel, labour, materials, any temporary works, consumables, anything and everything necessary, whether or not such items are specifically stated herein, for completion of the job in accordance with specification and requirements.

Contractor shall carry out the survey of the site before commencing excavation and set properly all lines and establish levels for various works such as earthwork in excavation for site grading, foundations, plinth filling, roads, drains, cable trenches, pipelines, etc. Such survey shall be carried out by studying thoroughly the drawings for the existing plant and modus operandi for earthwork shall be discussed with Engineer-in-Charge. Ground levels shall be taken and properly recorded by the Contractor and shall be checked and certified by Engineer-in-Charge.

The excavation shall be carried out to correct lines and levels. This shall also include, where required, proper shoring to maintain excavations and also furnishing, erecting and maintaining

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of substantial barricades around excavated areas and warning lamps to ensure safety at night.

The excavation shall also include for dumping of excavated materials in required heaps, bunds, riprap with regular slope as directed by Engineer-in-Charge, within the lead specified and levelling the same so as to provide stability and natural drainage.

Soil excavated shall be stacked properly as directed by Engineer-in-Charge. As a rule, all softer materials shall be laid along the centre of heaps, the harder and more weather resisting materials forming the casing on the sides and the top.

1.9.2. Site Clearance

Complete works for the site clearing so that the site is suitable for construction activity. Brief description of major items shall be as follows:

a) Clearing jungle including uprooting of rank vegetation, grass, brush wood, trees and saplings of girth up to 1.5 cm measured at a height of 1 m above ground level and removal of rubbish outside the periphery of the area.

b) Earth work in surface excavation /striping of existing top soil layer and disposal of excavated earth outside the property line.

c) Dismantling of all existing structures (if any) in brick masonry/stone masonry/RCC/PCC, road, fence, sheds, cladding, sheets etc. so that the site becomes suitable for construction activity.

d) Disposal of all material to be cleared from the site to any authorised disposal site/ storage yard.

e) Provide all assistance/co-ordination/liaison between all government/semi government agencies connected with the scope mentioned and also with the body owning/maintaining the access road to the site.

1.9.3. Demolition & dismantling

Demolition and dismantling of Existing structures Brickwork and cement concrete, Rcc Paving, paver blocks, RCC (part or whole) & Reinforcement steel shall be following all statutory safety regulations and any other special requirement as shown/noted on the drawings. Prior consent and approval of the Owner/PMC shall be obtained in writing before starting any dismantling works. Any restrictions imposed regarding working hours shall also be strictly followed by the Contractor.

All materials obtained from dismantling/demolition operations shall be the property of the Owner unless otherwise specified and shall be kept in safe custody until handed over to the Owner/PMC.

Where it becomes necessary to disconnect any existing service line(s) (such as electrical, piping etc.) during dismantling/demolishing operation and where so required by the Owner/PMC, suitable alternate arrangement shall be made by the Contractor to maintain the continuity and proper functioning of the affected service line(s) with the approval of Owner/PMC at no extra cost to the Owner.

Refer GTS Z 02007 for Detail Specification and refer SOR for Item rate of Demolishing &

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Dismantling

1.9.4. Excavation

Earthwork shall be done as per approved detailed construction drawings to be issued to the successful bidder. Offer to be prepared by the tenderer b as e d on the enclosed SOR and on lump sum unit rate (per M3). Contractor to refer GTS for details of items. PCC area shall be measured for excavation works for payments.

1.9.5. Earth Work in Filling

Complete ea rthwork in filling with borrowed earth is included in the scope. Brief description of major items shall be as follows.

a) Taking pre-work and finished levels.
b) De-watering of excessive water.
c) Strutting and shoring to retain the earth.
d) Borrowing of approved quality good earth from any lead.
e) Filling in layers of 150 mm.
f) Watering and compaction up to '95% or as per direction of Engineer in charge' of its MDD with mechanical means.

Note:

Payment for item earthwork in filling shall be paid for compacted net volume of filling after deductions of foundations, culverts, etc

1.9.6. Sand Filling and dry rubble stone soling

Complete works in filling is included in the scope and SOR. Brief description of major items shall be as follows

a) Taking pre-work and finished levels
b) Borrowing of approved quality sand/stone from any lead.
c) Filling in layers of 150 mm
d) Providing and laying dry rubble stone soling 100-150 mm size in layers of 150 mm with spreading binding material like murrum, bajri, stone grit and compaction with road roller etc. complete the surface as per specifications including cost of material.
e) Watering and compaction by 10 T vibratory rollers.

Note:

Payments to be done on completed work profiles by considering the plan dimensions only. Sand filling and dry rubble stone soling shall be done as per approved detailed construction drawings to be issued to the successful bidder. Offer to be prepared by the bidder based on the enclosed drawings and on lump sum unit rate (per M3).

1.9.7. ANTI-TERMITE TREATMENT

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The treatment shall be carried out by an approved agency specialized in the field with 10 warrantee period. Apart from this specification, the work shall be carried out in compliance with IS:6313. In case of any contradiction, this specification shall govern and refer General technical Specification GTS :Z/020016 for detail.

a) MATERIAL:

• Materials shall be chloropyrifos emulsifiable concentrates (1%) conforming to IS 8944 in water emulsions. Alternatively, Imidacloprid 30.50 SC, Permathrin, Cypermethrine, Fenvalerate, Isofenphose or equivalent Government approved material shall be used for Anti-termite treatment.

• The treatment shall be carried out by a licensed and approved agency specialized in the field.

• Dosage of the application of emulsion given in this specification shall be treated as minimum requirements. However, in case of variation in dosage based on manufacturer's recommendations, the more stringent requirements shall govern.

b) SITE PREPARATION:

Prior to start of chemical treatment, area(s), shall be made free from logs, stumps, timber offcuts, levelling pegs, roots of plants/trees etc. Soil treatment shall start when foundation trenches/pits are ready to take concrete masonry in foundations and plinth area ready for laying the subgrade. Treatment shall not be carried out when it is raining, or the subsoil water level is at the same or higher than the level of treatment. In the event of waterlogging of foundations, the water shall be pumped out and the chemical emulsion applied when the soil is absorbent.

c) TREATMENT FOR PITS/TRENCHES AND BACKFILLED FOUNDATION.

• The bottom surface and the lower 300 mm side surfaces of the excavated pits/trenches for foundations of masonry works and RCC plinth beams supporting such masonry works, shall be treated with specified chemical emulsion @ 5 litres/m2 of the surface area. However, no such treatment shall be required in case of pits/trenches made for RCC foundations supporting RCC walls and/or columns.

• On completion of construction of masonry foundations, the backfill in immediate contact with the substructure shall be treated in layers of 300 mm with emulsion @ 7.5 litres/m2 of the vertical surface of the substructure (i.e. 7.5 x 0.300 = 2.25 litres/meter of perimeter) for each side. The treatment shall be given after ramming of each layer of soil, by rodding the earth at 150 mm

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centres close to the wall surface and working the rod backward and forward (parallel to the wall surface) and then spraying the specified dosage of emulsion. The emulsion shall be directed towards the masonry surfaces so that the soil in contact with these surfaces is well treated with the chemical. After the treatment, the soil shall be tamped back into place. This shall be done for full depth of the fill.

- For RCC walls and columns, the treatment as specified in (b) shall start from a depth 500 mm below the finished ground level and shall be done up to the FGL.

d) TREATMENT OF PLINTH/BASEMENT AND APRON

- The top surface of the consolidated earth below the non-suspended floor slabs and the peripheral aprons of widths up to 750 mm, the bottom surface and side surfaces of the excavated pits for the basements shall be treated with chemical emulsion @ 5 litres/m2 of the surface area. Holes 50 to 75 mm deep at 150 mm centres, both ways, shall be made on the surface with 12 mm diameter mild steel rod and then emulsion shall be sprayed uniformly over the area. At expansion joint locations, anti-termite treatment shall be supplemented by treating through the expansion joint @ 2.0 litres per linear metre of joint after the subgrade has been laid.
- Treatment of Junctions of plinth filling and wall/column faces shall be done after making a small channel 30 mm x 30 mm, by making rod holes 150 mm apart (up to the ground level) in the channel and then by moving the rod backward and forward @ 7.5 litres/m2 of the vertical wall/column surface to soak the soil right to the bottom. The soil shall be tamped back into place after the treatment.

e) TREATMENT OF SOIL ALONG EXTERNAL PERIMETER OF BUILDING.

After the building is complete, the earth along the external perimeter shall be rodded at intervals of 150 mm and to depth of 300 mm. The rod shall be moved backward and forward parallel to the wall to break up the earth and chemical emulsion poured along the wall @ 7.5 litres/m2 of vertical surface (i.e., 7.5 x 0.300 = 2.25 litres/metre of perimeter). After the treatment, the earth shall be tamped back into place**.**

1.10. Reinforced Cement Concrete – Sub Structure

Brief description of major items shall be as follows

a) Earth Work in excavation including back filling using serviceable surplus/ borrow material, disposal of surplus earth (wherever required), including bailing out water (wherever required), shoring / strutting etc.

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b) 75 mm thk. PCC 1:4:8 (M-7.5) nominal mix for binding concrete below foundations as per detail drawing.

c) Providing shuttering and strutting of all types

d) RCC M25 as per drawing. & Specification including supply of cement, coarse aggregate, fine aggregate, and placement of concrete at all levels and depths, all inclusive & testing of concrete and other materials.

e) All Steel reinforcement bars shall be of Fe500D grade and should be Supplied by Approved Vendor

f) Providing and fixing of all anchor bolt and nuts into permanent works etc.

g) Providing and fixing of all inserts, conduits, precast covers into permanent works etc.

h) Provision of chequered plates, gratings into permanent works as per SOR item of Structural works.

i) Grouting of all base plates/frames of equipment foundations as per requirement.

j) Application of two coats of hot bitumen on surfaces in contact with soil.

Note:

- For all these items only net RCC quantity in M3 shall be measured for payment.
- Earth work with borrowed earth shall be paid vide respective SOR item.
- Anchor bolts and nuts shall be paid vide respective SOR item.
- Grouting with non-shrinkable compound shall be paid vide respective SOR item.

1.11. Reinforced Cement Concrete – Super Structure

Brief description of major items shall be as follows.

a) RCC M25 as per drawing. & Specification including supply of cement, coarse aggregate, fine aggregate and placement of concrete at all levels, all inclusive & testing of concrete and other materials.

b) Grouting of all base plates/frames of equipment foundations and structural bases as per requirement.

c) Providing shuttering and strutting of all types

d) Providing and fixing of all anchor bolt and nuts into permanent works etc.

e) Providing and fixing of all inserts, conduits, precast covers into permanent works etc.

f) Provision of chequered plates, gratings into permanent works as per SOR item of Structural works.

Note:

- For all these item only net RCC quantity in M3 shall be measured for payment.
- Anchor bolts and nuts shall be paid vide respective SOR item.
- Grouting with non-shrinkable compound shall be paid vide respective SOR item

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1.12. Reinforcement Steel

a) Supplying, Fabricating and Fixing in position HYSD Steel Reinforcements/ TMT Grade Fe-500 conforming to IS1786-1985 at all levels and positions.

b) Straightening, Cutting, Bending, Cranking, Binding, Welding, Provision of necessary Chairs and Spacers for reinforcement bars as per drawing and construction requirements.

c) Preparation of bar bending schedule Drawings and getting the same approved by Site Engineers as directed by EIC.

Note:

- Rate to include cost of all labour, tools, tackles, equipment, hire charges, supply of all materials such as steel Reinforcement, binding wire and other minor construction materials, testing etc. all bye works and sundry works complete in all respects.
- Chairs, laps, spacers, wastage etc. shall be to contractor's account.
- Only net Reinforcement bars as per approved BBS / as laid at site shall be considered for payment.

1.13. Brick Work in Sub Structure

Complete works in brick masonry sub structure is included in the scope. Brief description of major civil items shall be as follows:

a) Earth Work in Excavation including back filling using serviceable surplus material or approved borrow material and transportation of excess earth beyond plot limits. Preparation of sub-base including dewatering and compaction.

b) Brick work in sub structure shall be of M-7.5 grade bricks in 1:4 cement sand mortar (in coarse sand) and 1:6 cement sand mortar. M5.0 grade Bricks may also be used in case of non-availability of M 7.5 grade bricks.

c) DPC 40 mm with cement concrete M-15 (1:2:4) as per requirement with water proofing compound and application of bituminous paint

d) 18 mm thick plastering in CM (1:6) (in coarse sand) on exposed brick surfaces.

e) Application of two coats of hot bitumen on surfaces in contact with soil.

f) Applying Cement based paint / Weatherproof paint /washable distemper on plastered faces in sub structure as specified in drawings.

g) Making weep holes with 75mm dia. PVC pipe stone filter pack at 1.0 m intervals in both the directions.

Note:

- Only net brick masonry quantity excluding plaster thickness shall be measured in M3 for payment purpose.
- Earth work in backfilling with borrowed earth shall be paid vide respective SOR item.

The construction of brick work shall be done as per detailed construction drawings to be

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issued to the successful tenderer. Offer to be prepared by the tenderer based on work described above.

1.14. Brick Work in Super Structure

Complete works in brick masonry super structure is included in the scope. Brief description of major civil items shall be as follows:

a) Brick work in Boundary wall super structure shall be fly ash brick confirming to IS: 12894 of class designation 10 average compressive strength in 1:4 cement sand mortar (in coarse sand).

b) 18 mm thick. Cement plastering in two coats under layer 12 mm thick cement plaster 1:5 (1 cement : 5 coarse sand) and a top layer 6 mm thick cement plaster 1:3 (on exposed brick surfaces.

c) 12mm thick plaster in CM 1:4 shall be done in internal walls. Ceiling plaster shall be 6mm thick with CM 1:3.

d) All niches, offsets, pockets etc shall be considered part of the work.

e) Providing shuttering / supports etc. as per requirement

f) Applying Cement based paint / Weatherproof paint / oil bound distemper/Acrylic paint on plastered faces in super structure as specified in drawings

Note:

- Only net brick masonry quantity excluding plaster thickness shall be measured for payment purpose.

The construction of brick work shall be done as per detailed construction drawings to be issued to the successful tenderer. Offer to be prepared by the tenderer based on work described above and payment will be made on rate (per M3) of brickwork done.

1.15. Half Brick Work in Super Structure

Complete works in brick masonry super structure is included in the scope. Brief description of major civil items shall be as follows:

a) Half brick work in super structure for internal partitions shall be Autoclaved aerated cement (AAC) blocks.

b) 12mm thick plaster in CM 1:4 shall be done in internal walls. Ceiling plaster shall be 6mm thick with CM 1:3.

c) All niches, offsets, pockets etc shall be considered part of the work.

d) Providing shuttering / supports etc. as per requirement

e) Applying Cement based paint / Weatherproof paint / oil bound distemper/Acrylic paint on plastered faces in super structure as specified in drawings

Note: Only net brick masonry quantity excluding plaster thickness shall be measured for

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payment purpose.

The construction of brick work shall be done as per detailed construction drawings to be issued to the successful tenderer. Offer to be prepared by the tenderer based on work described above and payment will be made on rate (per M2) of brickwork done.

1.16. Autoclaved aerated cement blocks masonry

Materials

a) Cement complying with any of the Indian Standard may be used as per the direction of the manufacturer.

b) Use of Fly ash conforming to IS 3812-1981 may be permitted to a limit of 20% in cement conforming to IS 269-1976.

c) The lime shall satisfy the requirement for class C lime specified as IS 712-1973.

d) The aggregate used for the manufacture of Autoclave Aerated Concrete Block shall conform to the following requirements

- Sand-Conforming to IS 383-1970 except for the grading which may be made to suit the product and silica content shall not be less than 80%.
- Fly ash – Conforming to IS 3812-1981 with loss on ignition not more than 6%.

e) The water used in the manufacture of Autoclave Aerated Concrete Block shall be free from matter harmful to concrete or reinforcement or matter likely to cause efflorescence in the block and shall meet the requirements of IS 456-2000.

f) Additives and Admixtures may be added either as additives to the cement during manufacturing or as additive or admixtures to the concrete mix. Additive or admixtures used in the manufacture of concrete block may be

- Accelerating , water reducing and air –entraining admixtures conforming to IS 9103-1979
- Water proofing agent conforming to IS 2645-1975
- Colouring pigments

Physical requirements

a) All Autoclave Aerated Concrete Block shall be sound, free of cracks or other defects which interfere with the proper placing of block units, impair the strength or performance of the construction.

b) Where block units are to be used in exposed wall construction, the face or faces that are to be exposed shall be free of chips, cracks or other imperfections except that if not more than 5% of a consignment contains slight cracks or small chippings not larger than 25mm, this shall not be deemed grounds for rejection.

c) Dimensions- The overall dimension of the block units when measured shall be in accordance with followings:

Length : 400, 500 or 600 mm

Height : 200, 250 or 300 mm

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Width : 100, 150, 200 or 250 mm

In addition, Autoclave Aerated Concrete Block shall be manufactured in half length of 200, 250 or 300 mm correspond to the full lengths.

The maximum variation in the length of the Autoclave Aerated Concrete Block shall not be more than plus/minus 5mm and maximum variation in the height and width of Autoclave Aerated Concrete Block, not more than plus/minus 3mm.

d) Block Density - The Block density shall conform to the requirements specified in table, when tested accordance with para h) 1 below.

S. No.	Density in oven dry condition (Kg/m_2)	Compressive Strength (Min)		Thermal Condition in Air dry condition (W/m.k)
		Grade-I (N/mm_2)	Grade-II (N/mm_2)	
1	451 to 550	2	1.5	0.21
2	551 to 650	4	3	0.24
3	651 to 750	5	4	0.30
4	751 to 850	6	5	0.37
5	851 to 1000	7	6	0.42

e) Compressive Strength - The min. compressive strength being the average of twelve block units shall be as prescribed in above table, when tested accordance with para h) 2 below.

f) Thermal Conductivity - The thermal conductivity shall be not exceeding the values specified in above table, when tested accordance with para h) 3 below.

g) Drying Shrinkage – the drying shrinkage shall be not more than 0 .05% for grade –1 block and 0.10% for grade-2 block when tested accordance with para h) 4 below.

h) Tests

1. Block Density- The block density shall be determined in the manner described in IS 6441 (part-1) -1972
2. Compressive Strength- The compressive strength of block shall be determined in accordance with IS 6441 (part-5) -1972
3. Thermal Conductivity- The thermal conductivity of block shall be determined in accordance with IS 3346 -1980
4. Drying Shrinkages-The drying shrinkage of block shall be determined in the manner described in IS 6441 (part-2) -1972

Sampling

a) Lot - In any consignment, all the blocks of the same size and from the same batch of manufacture shall be grouped together into a minimum number of groups of 10000 blocks or less. Each such group shall constitute a lot.

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b) From each lot, a sample of 24 blocks shall be selected at random. The required numbers of Blocks shall be taken at regular intervals during the loading of the vehicle or unloading the vehicles depending on whether sample is taken before delivery or after delivery. When this is not practicable, sample shall be taken from the stack in which case the required number of blocks shall be taken at random from across the top of the stacks, the sides accessible and from the interior of the stacks by opening trenches from the top.

c) The sample of blocks shall be marked for future identification of the consignment it represents. The blocks shall be kept under cover and protected from extreme conditions of temperature, relative humidity and wind until they are required for test. The tests shall be undertaken as soon as practicable after the sample has been taken.

Number of tests

a) All the 24 Blocks shall be checked for dimensions and inspected for visual defects.

b) Out of the 24 blocks, 12 blocks shall be subjected to the test for compressive strength, 3blocks to the test for density, 3 blocks to the test for thermal conductivity and 3 blocks to the test for drying shrinkage. The remaining 3 blocks shall be reserved for re-test for drying shrinkage if a need arises.

c) The samples of AAC blocks (each sample consisting of 6 specimen) shall be chosen randomly from the lot procured and tested for various parameters specified in para 6 above. One samples shall be tested for every 100 cum or part thereof. However, minimum one sample shall be tested from each lot received at site if the quantity procured in the lot is less than 100 cum. If required, Engineer-in-Charge or his authorized representative shall inspect the factory during production of the material for this work and also collect samples (of materials used for making AAC blocks and precast AAC blocks) from the factory itself. The contractor shall consider this contingency also while placing the order with one of the approved firms. Nothing extra shall be payable on this account.

Criteria for conformity

a) The number of blocks with dimensions outside the tolerance limit and or with visual defects, among those inspected, shall not be more than two.

b) For density, the mean value shall be within the range specified in above Table.

c) For compressive strength, the mean value, say X shall be determined. The test results shall be grouped into groups of 4, individual values of ranges shall be determined, the average range a calculated from these values and shall satisfy the following condition:

X- 0.6 R> minimum value specified in above Table.

d) For thermal conductivity, the mean value shall be equal to or less than the value specified in above Table.

e) For drying shrinkage, all the test specimens shall satisfy the requirements of the test. If one or more specimens fail to satisfy the requirements, the remaining 3 blocks shall be subjected to these tests. All these blocks shall satisfy the requirements.

Manufacturer's Certificate

The manufacturer shall satisfy himself that the masonry units conform to the requirements of this specification and, if requested, shall supply a certificate to this effect to the purchaser or his representative.

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Independent Tests

a) If the purchaser or his representative requires independent tests, the samples shall be taken before or immediately after delivery, at the option of the purchaser or his representative and the tests shall be carried out in accordance with this specification.

b) The Contractor/manufacturer shall supply free of charge the units required for testing.

Storage

General requirements of storage of autoclaved cellular (aerated) concrete blocks shall be as described in IS : 4082-1977*.

Marking

a) Each lot of concrete masonry units manufactured in accordance with this specification shall be suitably marked with information-

(i) The identification of the manufacture

(ii) The grade and block density of the unit

(iii) The month and year of manufacturing

Each block may also be marked with the ISI Certification mark.

b) The R.C C bend shall be provided on 150mm /230mm/300mm thick masonry to increase the strength and compatibility . The RCC bend shall be provided at sill level and at lintel level over throughout the wall. This thickness of the bend shall be approved by the Engineer in charge or as specified in drawing. The payment of RCC bend and reinforcement shall be paid separately.

Autoclave Aerated Concrete Block masonry shall be provided with polymer modified adhesive mortar. The polymer modified adhesive mortar shall be provided @ 30 kg per cum or with cement mortar 1:4 (1 cement : 4 coarse sand).

c) Autoclave Aerated Concrete Block with 100 mm thick masonry shall be provided with two number 6mm dia reinforcement steel bar at every third course. The payment of reinforcement shall be paid separately.

d) Autoclaved Aerated Concrete Block confirming the IS Code – 2185 (Part-3) 1984 (Reaffirmed 2005)

Measurements

a) Autoclave Aerated Concrete Block Masonry shall be measured in cubic metres unless otherwise specified.

Any extra work over the specified dimensions shall be ignored. Dimensions shall be measured correct to the nearest 0.01 metre. i.e., 1 cm. Areas shall be calculated to the nearest 0.01 sqm and the cubic contents shall be worked out to the nearest 0.01 cubic metres.

Note : (i) Autoclave Aerated Concrete Block work in parapet walls, mumty, lift machine room and water tanks constructed on the roof up to 1.2 m height above roof shall be measured together with the corresponding work of the floor next below.

b) No deductions or additions shall be done and no extra payment made for the following:

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Note: Where minimum area is defined for deduction of an opening, void or both, such areas shall refer only to opening or void within the space measured.

- Ends of dissimilar materials (that is, joists, beams, lintels, posts, girders, rafters, purlins, trusses, corbels, steps etc.); up to 0.1 m2 in section.
- Opening up to 0.1 m2 in area (see Note);
- Wall plates, bed plates, and bearing of slabs, chajjas and the like, where thickness does not exceed 10 cm and bearing does not extend over the full thickness of wall;
- Cement concrete blocks as for hold fasts and holding down bolts;
- Iron fixtures, such as wall ties, pipes up to 300 mm diameter and hold fasts for doors and windows;
- Chases of section not exceeding 50 cm in girth; and
- Bearing portion of drip course, bearing of moulding and cornice.

Note: In calculating area of an opening, any separate lintel or sills shall be included with the size of the opening, but end portions of lintel shall be excluded. Extra width of rebated reveals, if any, shall also be excluded.

c) String courses, projecting pilasters, aprons, sills and other projections shall be fully described and measured separately in running metres stating dimensions of each projection.

d) Square or rectangular pillars shall be measured separately in cubic metres

e) Circular pillars shall be measured separately in cubic metres as per actual dimensions.

f) Autoclave Aerated Concrete Block work curved on plan shall be measured like the block work in straight walls and shall include all cutting and wastage of blocks, tapered vertical joints and use of extra mortar, if any. Block work curved on plan to a mean radius not exceeding six metres shall be measured separately and extra shall be payable over the rates for block work in straight walls. Nothing extra shall be payable if the mean radius of the block work curved in plan exceeds six metres.

g) Tapered walls shall be measured net as walls and extra payment shall be allowed for making tapered surface for block work in walls.

Rate

The rate shall include the cost of materials and labour required for all the operations described. The rate shall also include the following:

a) Raking out joints or finishing joints flush as the work proceeds.

b) Preparing tops of existing walls and the like for raising further new block work.

c) Rough cutting and waste for forming gables, splays at eaves and the like.

d) Leaving holes for pipes up to 150 mm dia. and encasing hold fasts etc.

e) Rough cutting and waste for block work curved in plan and for backing to stone or other types off acing.

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f) Polymer modified adhesive mortar and cement mortar as required

g) Embedding in ends of beams, joists, slabs, lintels, sills, trusses etc.

h) Bedding wall plates, lintels, sills, roof tiles, corrugated sheets, etc. in or on walls if not covered in respective items

i) Leaving chases of section not exceeding 50 cm in girth or 350 sq. cm in cross-section; and

j) Block on edge courses, cut brick corners, splays reveals, cavity walls, brick works curved on plan to a mean radius exceeding six metres.

1.17. Paver Block (60 MM Thk.) Pavements in Non-vehicular movement area

Paver block road / paving shall be provided as per details shown in the road layout/plot plan. Factory made precast paver block of M-35 grade or otherwise specified to be used. Paver blocks to be of approved brand, approved manufacturer and of approved size, shape, design and quality. Minimum strength as prescribed by manufacturer and as per direction of Engineer-in-Charge for the grade specified to be tested as per method mentioned within this specification or sub-head cement concrete of CPWD Specification Vol. I.

Paving thickness and design shall be in accordance with the Codes and Standards. Detail cross sectional drawing based on design of road pavement shall be provided to Contractor during execution stage.

Area paving shall be done after construction of all the building/structures, trenches, equipment foundations (as applicable), and other underground facilities to avoid rectification and reworks requirements of paving. Contractors to take approval regarding clearance of paving area from Engineer-In-Charge prior to start area paving works. So that repetitive paving works can be avoided.

However, as a minimum the paving thickness shall consist of the following: -

- Levelled and filled up Compacted sub-grade
- Compacted Granular sub-base up to minimum 95% MDD.
- Sand Bed
- Pavers

1.18. RCC Kerb Stone in Specified Areas

Brief description of major works to be considered in this item is as follows.

a) Earth Work in excavation including back filling up to required level (including using borrow earth and disposal of surplus earth).

b) Supplying and fixing M-25 grade Kerb Stone Blocks of required size shall be fixed over 75 mm thk. PCC – 1:4:8 grade.

c) Filling joints between the blocks with cement mortar (1:3) (in coarse sand).

d) Actual work shall be carried out as per certified construction drawings to be issued to successful tenderer.

Note:

- Complete civil works for Kerb Stone including, earth work in excavation,preparation of base i.e., compacted sub grade, 75 mm thk. PCC, etc. shall be payable under respective items.

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1.19. Road Crossing

Necessary road crossing for pipes and other facility shall be done prior to starting of the road work activity for sub-base and top layers. RCC NP2/NP3 Hume pipe shall be provided under road for underground drainage crossings up to 4.5m wide roads and RCC box culverts shall be provided for rest of the crossing (storm water and other pipes) under the road and paving.

1.20. ROAD / PAVEMENT

1.20.1 Paver Block (80 MM Thk.) Pavements in Vehicular movement Areas

Paver block road / paving shall be provided as per details shown in the road layout/plot plan.

Factory made precast paver block of M-40 grade or otherwise specified to be used. Paver blocks to be approved brands, approved manufacturer and of approved size, shape, design and quality. Minimum strength as prescribed by manufacturer and as per direction of Engineer-in-Charge for the grade specified to be tested as per method mentioned within this specification or sub-head cement concrete of CPWD Specification Vol. I.

Paving thickness and design shall be in accordance with the Codes and Standards. Detail cross sectional drawing based on design of road pavement shall be provided to Contractor during execution stage.

Area paving shall be done after construction of all the building/structures, trenches, equipment foundations (as applicable), and other underground facilities to avoid rectification and reworks requirements of paving. Contractors to take approval regarding clearance of paving area from Engineer-In-Charge prior to start area paving works. So that repetitive paving works can be avoided.

However, as a minimum the paving thickness shall consist of the following: -

- Levelled and filled up Compacted sub-grade.
- Compacted Granular sub-base up to minimum 95% MDD.
- WMM layers.
- Sand Bed.
- Pavers.

a) Sub-grade.

The sub-grade shall be prepared as per work under Levelling and grading package works. Contract The exposed levelled surface shall then be scarified moistened and compacted by Mechanical rolling so as to achieve minimum dry density of 95% of maximum Dry density as measured by the Modified Proctor Test as IS 2720 Part 8.

Preparation and consolidation of sub grade shall be done with power road roller of 8 to 12 ton capacity after excavating earth, dressing to camber and consolidating with road roller to achieve density requirements including making good the undulations etc. and re-rolling the sub grade and disposal of surplus earth all complete as per direction of engineer-in-charge.

b) Sub-base

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The sub-base shall be of layers of granular sand or approved materials compacted in layers of max. 200mm thickness to achieve 95%-97% of maximum dry density as measured as measured by the Modified Proctor Test as IS 2720 Part 8. Necessary profile or slope shall be followed as per drawing.

The surface of the formation for a width of sub-base, which shall be 15 cm more on either side of base course, shall first be cut to a depth equal to the combined depth of sub-base and surface courses below the proposed finished level (due allowance being made for consolidation). It shall then be cleaned of all foreign substances. Any ruts or soft yielding patches that appear due to improper drainage conditions, traffic hauling or from any other cause, shall be corrected and the sub-grade dressed off parallel to the finished profile.

The finished surface shall be uniform and conform to the lines, grades and typical cross section shown in the drawings, when tested with the template and straight edge, the variation shall be within the tolerances specified in Table below:

Longitudinal profile maximum permissible undulation when measured with a 3 meter straight edge	Cross profile maximum permissible variation from specified profile when measured with a camber template
24mm	15mm

Where the surface irregularity of the sub grade falls outside the specified tolerances, the contractor shall be liable to rectify these with fresh material or quarry spoils as the case may be, and the sub-grade rerolled to the satisfaction of Engineer-in-Charge.

The length and width of sub grade and sub-base work shall be measured correct to a cm. The area shall be worked out in square meter, correct to two places of decimal.

c) Wet Mix Macadam

Providing, laying, spreading and compacting graded crushed stone aggregate to wet mix macadam (WMM), including cost of all materials, including pre-mixing the material with water at OMC in mechanical mix plant, carriage of mixed material by tipper to the site, laying in uniform layers with paver in base courses on well-prepared surface and compacting with vibratory roller of 80-100 kN weight to achieve the desired density, to proper grade and camber, including barricading, diversion of the traffic, all labour charges, hire charges of the machinery, consumables etc., completed as per the direction of the Engineer-In-Charge and as per MORTH specification 406 (5th revision) for finished item of work. Proper slope is to be maintained using the wet mix macadam for the area to be asphalted.

- Materials

  Coarse aggregates shall be crushed stone. If crushed gravel / shingle is use, not less than 90 percent by weight of the gravel / shingle pieces retained on 4.75 mm sieve shall be at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table 400-10 of MORTH Specification.

  If the water adsorption value of the coarse aggregate is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS: 2386 (Part 5).

- Grading requirements:

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The aggregates shall conform to the grading given in Table 400-11 of MORTH Specification. Materials finer than 425 microns shall have Plasticity Index (PI) not exceeding 6. The final gradation approved within these limits shall be well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa.

- Construction Operations

Preparation of mix: Wet Mix macadam shall be prepared in an approved mixing plant of suitable capacity having provision for controlled addition of water and forced / positive mixing arrangement like pugmill or pan type mixer of concrete batching plant. For small quantity of wet mix work, the Engineer-in-charge may permit the mixing to be done in concrete mixers.

Optimum moisture for mixing shall be determined in accordance with IS: 2720 (Part 8) after replacing the aggregate fraction retained on 2.4 mm sieve with material of 4.75 mm to 22.4 mm size. While adding water, due allowance should be made for evaporation losses, However, at the time of compaction, water in the wet mix should not vary from the optimum valued by more than agreed limits. The mixed material should be uniformly wet, and no segregation should be permitted.

Spreading of mix: Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared sub-grade / sub-base / base in required quantities. In no case should these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed stretch be permitted.

The mix may be spread either by a payer finisher or motor grader, for portions where mechanical means cannot be used, manual means as approved by the Engineer-in-charge shall be used. The motor grade shall be capable of spreading the martial uniformly all over the surface. Its blade shall be capable of spreading the martial uniformly all over the surface. Its blade shall have hydraulic control suitable for initial adjustments and maintaining the same so as to achieve the specified slope and grade.

The paver finisher shall be self-propelled, having the following features:

- Loading hoppers and suitable distribution mechanism
- The screed shall have tamping and vibrating arrangement for initial compaction to the layer as it is spread without rutting or otherwise marring the surface profile.
- The paver shall be equipped with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.

The surface of the aggregate shall be carefully checked with templates and all high or low sports remedied by removing or adding aggregate as may be required. The layer may be tested by depth blocks during construction. No segregation of layer and fine particles should be allowed. The aggregates as spread should be of uniform gradation with no pockets of fine materials. Compacted thickness of layers shall be as per details drawing.

Compaction: After the mix has been laid to the required thickness, grade and cross fall/ camber the same shall be uniformly compacted, to the full depth. The compaction shall be done with the help of vibratory roller of minimum static weight of 80 to 100 KN or equivalent capacity roller. The speed of the roller shall not exceed 5 km/h.

In portion shaving unidirectional cross fall / super elevation, rolling shall commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the center line of the road uniformly overlapping each preceding track by at least one third width until the entire surface has been rolled alternate trips of the roller shall be terminated in stops at least 1 m away from any preceding step.

Testing: Site testing shall be done as per MORTH specification for each layer of work. 1st layer to be cleared through site testing before proceeding to 2nd layer of construction for road.
Necessary QAP shall be followed for site construction activity. Necessary lab facility to be

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made available by the contractor for site testing of each work activity.

- Measurement
  The quantity of wet mix macadam shall be computed in cubic meters.

1.21. Pre-Cast Slab

Factory made approved brand Heavy duty 600mmx550mmx70mm thick precast RC Slab / covers in trenches shall be provided and fixed as per requirement specified in the IFC drawings and instruction of Engineer-in-charge.

1.22. Providing & Laying Floor Hardener

Heavy duty non- metallic hardener compound of STP, Roff, Fosroc, CICO of approved manufacture or equivalent laid in panels at all locations over well compacted concrete bed complete with all works, with minimum coverage as per manufacturers' specifications, drawings and as directed by EIC shall be provided and laid. All preparation and laying to be done under specialist supervision and a performance guarantee be furnished for a long term service life.

1.23. Grouting With Non-Shrinkable Compound

Before placing the grout, the concrete surface shall be thoroughly cleaned, preferably with compressed air and the surface shall be thoroughly wetted with water for several hours. Before placing the grout, all free water shall be removed, and the flat surface shall be coated with thin cement slurry. The grout shall be carefully observed for initial settlement. If any settlement is observed, further grout is to be poured and compacted by rods.

Material shall be as approved by the Engineer-in-Charge. placement of grout shall be continuous so as to avoid "cold joints" under base plate and thoroughly worked under so as to eliminate air bubbles and voids. Rods or chains may be used to expedite this procedure.

Grout shall be placed so as to provide full and uniform bearing under all bearing surfaces. Where forms are used for grouting, they shall remain in place for a period of 24 hours unless directed otherwise. All exposed grout with a thickness of 25 mm or more shall be sloped at about 45 degrees unless otherwise noted.

1.24. Signage Works

1.24.1. Building Fascia, as per drg. on top of building faces in elevation

4mm thick ACM (of approved make) cladding in a combination of corporate colours with the use of Retro Reflective Sheeting Type XI DG3 Microprismetice as per ASTM D 4956-09 duly pasted on ACM in required size & shape (colour scheme to be approved) on mild steel framework. Structural frame to be fasteners/ Nut Bolted to the building walls with dash fasteners and leveling 'arrangement. Building fascia to be made in maximum length of straight panels (with minimum no. of joints) straight panels factory plan/processed at converters factory and assembled/installed at site. Corner piece (1 metre both sides) on both sides, also to be factory plan/processed/assembled and installed at site. Only bottom trim and top flashing is to be Plan/processed and installed at site. All work to be done in line, level and plumb, all complete with by works, as approved.

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1.24.2. Direction sign

4mm thick. ACM (Aluminum Composite Material) cladding on steel framework with the use of 3M (or approved equivalent make) Retro Reflective Sheeting Type XI DG3 Microprismetice as per ASTM D 4956-09 duly pasted on ACM in require size & shap & back-lit panels in 10 mm thick Acrylic/ PC duly CNC Routed in require shape & Size as per direction of concerned engineer or 3 mm thick, thermoformed PET-G (Spectra Copolymer/ Relstar) on both sides. Front face of PET-G panels to have acrylic of appropriate colour with cutout for arrow sign as indicated in drawings and the sides to be white. The sign frame to be fixed securely to CC foundation as shown in drawings. The CC foundation shall have 8mm thick polished black granite tiles cladding on top and all exposed side surfaces. Sufficient no. of LED/ T5 (14 W) tube lights with electronic chokes fixed with plastic holders and electric conections. Multi-strand copper conductors with PVC insulation to be used. All work to be done in line, level and plumb, all complete with by works, as approved.

1.25. FORM WORK

Forms shall be constructed from sound materials of sufficient strength, and shall be properly braced, strutted and shored, to ensure rigidity throughout the placing and compacting of the concrete. Forms shall be constructed in such a way that they can be removed without shock or vibration to the concrete. Internal ties shall be made of metal and shall either be capable of complete removal without damage to the concrete or, if remaining permanently embedded in the concrete, be no nearer to any finished surface than the largest value of 50 mm or the specified cover to reinforcement. The resulting cavity shall be so formed as to permit satisfactory filling as specified hereafter.

All joints shall be close fitting to prevent leakage of grout and at construction joints the formwork shall be secured tightly against previously cast or hardened concrete to prevent stepping or the formation or ridges on exposed surfaces. Formwork shall be constructed to provide the correct shape, lines and dimensions of the concrete shown on the Drawings. Due allowance shall be made for any deflection which will occur during the placing of concrete within the forms. Panels shall have true edges to permit accurate alignment and to provide a neat line with adjacent panels and at all construction joints. All panels shall be fixed with their joints either vertical or horizontal, unless otherwise specified or approved. When chamfers are to be formed the fillets shall be cut accurately to the correct sizes to provide a smooth and continuous chamfer.

The Contractor shall make do allowance for the renewal and/or repair of formwork in case it must be re-used.

Preparation of formwork for concreting

The formwork shall be coated with an approved mould oil and all excess shall be removed carefully. Mould oil shall not be allowed to come into contact with concrete already placed or with reinforcement.

Before concrete is placed, all formwork and supports shall be cleaned thoroughly. Temporary openings shall be provided to assist in the removal of the rubbish.

Concrete shall not be placed until the relevant formwork has been inspected and approved by the OWNER/PMC although the giving of this approval does not relieve the CONTRACTOR from his responsibilities concerning the requirements of soundness, finish and accuracy,

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specified elsewhere.

A period of not less than 24 hours' notice shall be given to the OWNER/PMC to allow for his examination and, if satisfactory, approval of the reinforcement and formwork prior to the placing of the concrete.

Removal of formwork

Forms shall be removed in such a way that they do not damage the concrete. No forms shall be removed until the concrete has gained sufficient strength to support itself. Centres and props may be removed when the member being supported has gained sufficient strength to carry itself and the load to be supported on it with a reasonable safety factor.

The following table is a guide to the minimum periods which must elapse between the completion of the concreting operations and the removal of formwork. Notwithstanding this table, no prop nor formwork shall be removed without the permission of the OWNER/PMC and this permission shall not relieve the CONTRACTOR from his responsibilities for the safety of the structure.

Vertical sides of beams, walls, **columns - lift not exceeding 1.2 mm**	**12 hours**
Vertical sides of beams, walls, columns - lift exceeding 1.2 mm	**36 hours**
Soffits of beams and main slabs (Props left under)	**5 days**
Beams and main slabs - removal of props	**18 days**

After removal of formwork no remedial works shall be attempted until the work has been inspected by the OWNER/PMC. If, according to the OWNER/PMC, any defect cannot be cured to his satisfaction, he may direct the CONTRACTOR to replace such work at the CONTRACTOR'S expense. For other and detail Specification refer General Technical Specification GTS – Z-020004.

1.26. RCC GRADE SLAB:

Complete civil works and other finishes in the fore court are included in the scope.

Brief description of major civil items shall be as follows.

a) WMM compacted with Plate Compactor and river sand filling in voids.

b) PCC of grade and thick to be specified in Detail engineering drawings.

c) Laying of all required conduit, cables, pipes etc. and fixing them securely to the reinforcement bars (payable under separate item).

d) Design mix RCC M25 of minimum 100 mm thick laid to slope including reinforcement and inserts, PVC sleeves, expansion joints and brush finish.

e) Providing & laying 50 mm thick M25 screed over RCC floor with 4 mm dia and 75 X75 mm wire mesh (payable under separate item) or size specified in Detail drawings.

f) Applications of non-metallic compounds, as per manufacturer's specifications to make the surface hard enough to bear abrasion, improve permeability & resist weathering. The compound to be used shall be non-metallic hardener of Roff/ Fosroc/ STP/ CICO or

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equivalent (payable under separate item).

g) Providing bituminous joint filler sealant in expansion and Contraction joints (payable under relevant item).

h) Provide Floor finishing as per Finishing Schedule drawing and SOR.

h) Making of cable and steel tube trench covered with Chequered plate with lifting arrangement (payable under separate item but area of trench will be deducted from forecourt).

i) Making dispenser islands including Granite/Vitrified tile top fixing and all its finishes (payable under separate item).

j) Concrete paver blocks laid over PCC (payable under separate item).

k) Fixing of concrete kerb stone blocks. Kerb stone blocks shall have niche with reflective material fixed in it (payable under separate item).

l) Manhole, gully trap including RCC covers.

Notes:

Only area of completed forecourt shall be measured for payment.

The construction of fore court shall be done as per approved detailed construction drawings to be issued to the successful tenderer. Offer to be prepared by the tenderer based on the enclosed architectural drawings and on lump sum unit rate (per Sq. m) for complete work.

1.27. ROOF WATER PROOFING:

The roof water proofing shall be rendered as per drawing / documents with APP Bitumen based heavy duty membrane (As SOR Line Item & Description) and it shall be approved vendor with 10 years of warranty period.

Providing and laying APP (Atactic Polypropylene Polymer) modified prefabricated five-layer, 3 mm thick water proofing membrane, black finished reinforced with non-woven polyester matt consisting of a coat of bitumen primer for bitumen membrane @ 0.40 litre/sqm by the same membrane manufacture of density at 25°C, 0.87-0.89 kg/ litre and viscocity 70-160 cps. Over the primer coat the layer of membrane shall be laid using Butane Torch and sealing all joints etc and preparing the surface complete. The vital physical and chemical parameters of the membrane shall be as under: (a) Joint strength in longitudinal and transverse direction at 23°C as 650/450N/5cm. (b) Tear strength in longitudinal and transverse direction as 300/250N. (c) Softening point of membrane not less than 150°C. (d) Cold flexibility shall be up to -2°C when tested in accordance with ASTM, D-5147. The laying of membrane shall be got done through the authorised applicator of the manufacturer of membrane. Water Proofing procedure shall be as per Vendor's Specifications and comply with the specification as mentioned above & in GTS Z-020010

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1.28. WATER SUPPLY

- Potable & Domestic water shall be tapped from the from existing Water Supply Facilities. Provision of Bore well shall be made for unavailability/ Inadequacy of water supply from Existing water Supply facility.
- One numbers of roof water tanks of 1000 litters (service water) depending on the number of users shall be provided as per drawings for 48 hours storage shall be provided for Facility Building.
- Galvanized iron pipes of medium class shall be used for internal piping works for potable water supply.

1.29. STRUCTURAL STEEL WORK

1.29.1. Material

Steel material shall be as follows:

Item	Grade	Code / reference
Steel Tube and Pipes	YST310/YST240	IS: 1239 - 2004
Rolled steel sections and plates	E250 A, fy = 250 MPa	IS: 2062 - 2011
Connection Bolts	8.8	IS: 1367 - PART 3
Grating Grade	E250 A, fy = 250 MPa	IS: 2062 - 2011
Chequered plates	fy = 250 MPa	IS: 3502

Tubular structural steel : Supplying, transporting, fabricating, erecting in position of pre-fabricated steel structures at all elevations for canopy/hoarding using tubular structural steel sections conforming to is 1161-latest edition, including cutting, welding or bolting, supply of bolts/nuts/washers etc., complete as per drawings including surface preparation and applying one coat of zinc phosphate primer before erection, one coat after erection and two coats of synthetic enamel paint as per specification after erection and all materials and labour complete (no welding is permitted at site).

Other structural steel : Supplying, transportation, fabricating and erection/fixing in position structural steel for posts, struts, inserts, bottom pipe etc., for shed erection/chain link fencing and gate structure including cutting to required sizes, straightening/bending if required, edge preparation, bolting, welding, gas cutting, grinding, fixing in line and level with temporary staging inclusive of all bolts, screws, fasteners like 'J' bolts, etc., fixing of gate rail, grouting with ordinary cement grout, preparing the surface for painting of primer, supply and application of one coat zinc phosphate primer and two coats of synthetic enamel paint on structural steel posts/struts etc. complete as per specification and instructions of OWNER'S Engineer. Preparation of line and fabrication drawing, submission and obtaining OWNER'S

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approval is also part of the job.

Chequered plate shall conform to IS: 3502 (latest) and minimum thickness of chequered plate for floorings, covers etc. shall be 6 mm O/P.

Steel shall be procured from SAIL/TISCO or equivalent brand with prior approval of Engineer-in-charge / OWNER.

Shop connections will be all welded and field connections will generally be bolted unless otherwise. Field bolts, wherever provided shall be high tensile of 16 mm dia or of higher diameter and of property class 8.8 (minimum) as per IS: 1367 (latest) for all major connections. All bolts, nuts and washers shall be procured from the manufacturers as approved by Engineer. Supply, Transportation, fabrication, erection in position of pre-fabricated steel structures at all elevations using tubular structural steel sections Confirming to IS 1161-Latest edition, including cutting, welding or bolting, supply of bolt/nuts/washers etc. are covered under this item.

1.29.2. Anchor Bolt

Materials for anchor bolts (Grade 4.6) such as MS bars, washers, nuts, pipe sleeves and plates etc. shall conform to IS: 1363 & IS: 1364 of 1992.

1.29.3. Welding

Welding shall be in accordance with the recommendation of IS:816 (latest) Code of Practice for arc of metal arc welding for general construction in mild steel and IS:9595 (latest) recommendation for metal arc welding of carbon and carbon manganese steels. Built-up members will be fabricated using submerged arc welding procedure. All electrodes, flux, bare wire etc. shall be procured by the contractor only from approved manufacturers. All butt-welds in beams, girders & columns will be of full penetration. All butt-welds will be radio-graphically or ultrasonically tested as per IS-822 and standard practice.

1.29.4. Quality control/Tests:

Manufacture test certificate of each lot shall be handed over to Engineer-in-charge by the Contractor. Contractor shall carry out following minimum quality tests of Structural steel, welding, bolts etc.

Test for structural steel shall be done as per QAP appended with this specification. Moreover, if instructed by Engineer-In-Charge for specific test of any lot of material, such test shall be done as per provision in the relevant IS code /CPWD specifications.

The bare wire electrodes for submerged are welding shall conform to IS: 7280 (latest). The combination of wire and flux for submerged arc welding shall be as follows:

Filler wire shall be of classification AWS-A-5.17-EH14 and flux shall be of agglomerated type of classification AWS-A-5.17F7 A2-EH14.

Low hydrogen electrodes as approved by the Engineer-in-charge shall invariable be used in the following cases: -

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- For welding of all important joints such as butt-joints in columns (flange or web), butt-joints in main frame beams (flange or web) etc.
- For welding the steel having thickness more than 20 mm.
  In case of fillet weld between two components, the thickness of the thicker part shall be considered as the limit for (ii).

Minimum preheat & interpass temperature for welding over 40 mm to 63 mm (thickness of the thicker part at the point of welding) shall be 66°C and for over 63 mm, it shall be 110°C. However, higher preheat & interpass temperature may be required due to joint restraint etc. and shall be followed as per approved welding procedure.

1.29.5. Erection

Steel work shall be hoisted and placed in position carefully without any damage to itself and other building work and injury to workmen. Where necessary mechanical appliances such as lifting tackle winch etc. shall be used. The suitability and capacity of all plant and equipment used for erection shall be up to the satisfaction of the Engineer-in-charge.

1.29.6. Fabrication

Fabrication shall generally be done as specified in IS: 800. In major works or where so specified, shop drawings giving complete information for the fabrication of the component parts of the structure including the location, type, size, length and details or rivets, bolts or welds, shall be prepared in advance of the actual fabrication and approved by the Engineer-in-charge. The drawings shall indicate the shop and field rivets, bolts and welds. The steel members shall be distinctly marked or stencilled with paint with the identification marks as given in the shop drawings.

High accuracy shall be observed in the fabrication of various members, so that these can be assembled without being unduly packed, strained or forced into position and when built up, shall be true and free from twist, kinks, buckles or open joints. The steel sections as specified shall be straightened and cut square to correct lengths and measured with a steel tape. The cut ends exposed to view shall be finished smooth. No two pieces shall be welded or otherwise jointed to make up the required length of member.

All straightening and shaping to form, shall be done by pressure. Bending or cutting shall be carried out in such a manner as not to impair the strength of the metal.

1.29.7. Supply, Fabrication and Erection of Chain link wire mesh fencing and Gates

Brief description of major items shall be as follows.

a) Supply, Fabrication and erection of mild steel welded wire mesh fencing and gates fabricated from MS Pipes, welded mesh, plates etc with all fixtures like MS Pivot, locking arrangement, ms tower bolts, hinges, and any other fixture to complete the work as per tender drawing.

b) Painting of MS Gate as per specification and drawings

c) Fencing and Gates shall be fabricated and erected as per detailed construction drawing to be issued to the successful tenderer.

1.29.8. Supply, Fabrication and Erection of Miscellaneous steel structural works.

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Brief description of major items shall be as follows

a) Supply, Fabrication and erection of Loading unloading platform, LCV Stand, Hoarding, cat ladder for approach on building, safety guard for dispenser, pipe supports, chequered plate cover, Grating, etc. shall be fabricated from rolled Steel section and built up section conforming to IS:2062 Grade-A and pipes conforming to IS:1161,as per requirement.

b) Painting of steel structure as per specification and drawing.

c) All steel structure shall be fabricated and erected as per detailed construction drawing to be issued to the successful tenderer.

Note: All works shall be considered for payment on MT basis

The cost of MS bolts (permanent and service), washers, electrodes, putty, gases, cost of straightening the raw materials, cutting of flats from plates and providing splices, paints, tools, plants, electric power, water. Other consumables, as required for the work shall be deemed to be included in the quoted rates.

All handling and transport charges of raw materials and fabricated structures including double handling, as required, for completion of work in accordance with time schedule, are deemed be included in the quoted rates.

1.30. Precoated galvanised iron profile sheets

Providing and fixing precoated galvanized iron profile sheets (size, shape and pitch of corrugation as approved by Engineer-in-charge) 0.50 mm (+ 0.05 %) total coated thickness with zinc coating 120 grams per sqm as per IS: 277, in 240 mpa steel grade, 5-7 microns epoxy primer on both side of the sheet and polyester top coat 15-18 microns. Sheet should have protective guard film of 25 microns minimum to avoid scratches during transportation and should be supplied in single length upto 12 metre or as desired by Engineer- in charge. The sheet shall be fixed using self-drilling /self-tapping screws of size (5.5x 55 mm) with EPDM seal, complete upto any pitch in horizontal/ vertical or curved surfaces, excluding the cost of purlins, rafters and trusses and including cutting to size and shape wherever required.

1.31. Deck Slab

Construction of deck slab using GI sheet of minimum 1mm thickness with placement of a reinforced as per design/ drawing, adhering to specified design dimensions as per the requirements. This includes the provision of all necessary materials, such as grade of concrete and high-strength reinforcement bars, along with formwork and finishing (as mentioned in SOR), studs, fixtures etc. complete. The contractor is responsible for ensuring proper alignment, compaction, and curing of the concrete to achieve the required strength. Quality control measures, including strength testing and reinforcement inspection, must be implemented throughout the construction process. This also includes site preparation and compliance with safety and regulations.

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1.32. Architectural Works

All the Architectural works shall be caried out as per item description specified in SOR and specifications mentioned in the GTS appended with this Specification. Detail drawing with finish details shall be provided during construction to successful bidder/Contractor.

1.33. Field Quality Assurance Plan

The contractor shall carry out the following minimum testes, unless otherwise mentioned and as directed by the Engineer-in-charge at his own expense. The Engineer-in-charge reserves the right to ask the contractor to carry out any further tests on the materials which is being used in the project.

Based on the guidelines mentioned in this clause, Contractor to provide detailed FQAP for approval of OWNER/PMC.

For particle size test, it is recommended that the set of sieves and weighing machines be arranged by the contractor at site. Necessary qualified manpower for conduction of the tests also to be arranged by the contractor.

For crushing strength of concrete, it is recommended that the contractor arrange the compression testing machine at the site along with the calibration certificate for gauge.
In case, if any of the machine comes to repairs and tests could not be carried out at the site, contractor shall arrange to transport the material to an approved laboratory to carry out the tests. All transports and labour costs also are to be borne by contractor.

The Tests listed in QAP are minimum requirement. Contractor shall provide a field quality assurance plan with formats for record of test results for all the works considering requirements of this specification and other relevant specification document/IS Codes. Field Quality Plan approved by OWNER/PMC shall be followed for all the works under scope of the tender. Cost of all tests shall be borne by the Contractor.

All tests shall be recorded in forms acceptable to the Engineer-In-Charge.

The contractor shall submit work procedure documents (step to step works activity) for each works and get it approved from OWNER/PMC prior to start any work. All works shall be carried out in sequential manner based on approves work procedure documents.

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1: Executed By: Contractor	P: Performer	H: Hold Point	MRIE: Material Receiving Inspection	W.O. NO.: Date:
2: By PMC	W: Witness	RM/S: Random/ Surveillance	WPS: Welding Procedure	TS: Technical Specification
3: By OWNER	R: Drawing	Drg: Drawing	PQR: Procedure Qualification Record	WQT: Welder Qualification Test

Sl No.	Activity Description	Nature of Check	Method of check	Extent of Check	Ref. Document	Acceptance Standard	Format of Records	Inspection By			Remarks
								1	2	3	
1	Material for Civil Foundation (PVC Pipes, Pipe Fittings, Cement, Aggregates Water, Structural steel, Reinforcement steel etc.)	Visual, Dimensional, Marking verification and Review of MTC	Visual & Verification	100 %	P.O. Approved drawings / TS	Applicable material Spec. / Manufacturer TC	Raw Material Inspection Report	P	R	R	
1a	Cement	Visual Inspection, Compressive Strength, Initial & Final Setting Time, Soundness, Fineness, Chemical Composition, Visual	Submission of Manufacturers TC for each batch	100 %	P.O. Approved drawings / TS	IS 269 / 8112 / 12269 / IS 1489 / IS 455	Batch TC	P	R	R	

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Sl No.	Activity Description	Nature of Check	Method of check	Extent of Check	Ref. Document	Acceptance Standard	Format of Records	Inspection By			Remarks
								1	2	3	
		Storage Inspection									
1b	Coarse Aggregates	Visual Inspection, Flakiness, Index, Serve Analysis, Crushing Value Abrasion Value, Water Absorption, Soundness, Deleterious Materials, Specific Gravity	At the start of work & thereafter for every change of source, before mix design.	100 %	As per Tech. Spec. IS 383, IS 2386, IS 2340 & Tech Spec.	As per Tech. Spec. IS 383, IS 2386, IS 2340 & Tech Spec.	Test Report	R	R	R	
1c	Fine Aggregates	Sieve Analysis, Bulking of sand, Silt Content,	Visual & Verification	Minimum twice a week /	IS 383, IS 2386, IS 2340 &	IS 383, IS 2386, IS 2340 & Tech Spec.	Test Report	R	R	R	

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Sl No.	Activity Description	Nature of Check	Method of check	Extent of Check	Ref. Document	Acceptance Standard	Format of Records	Inspection By			Remarks
								1	2	3	
		Bulk Density Specific Gravity		40 M3 per source	Tech Spec.						
1d	Water	Visual Inspection, Tet for presence of Acid, Alkali, Organic materials / salts, etc. & PH volume	Visual & Verification	Once in a month	IS CODE & TS	Limit No.: Less than 6	Test Report	P	R	R	PH value of water shall be within range of 6.5 to 9
1e	Reinforcement Steel	Visual, Dimensional, Marking verification and review of MTC	Visual & Verification	100 %	P.O. Approved drawings / TS and IS 1786	Applicable material Spec / Manufacturer TC	Raw Material Inspection Report	P	R	R	
1f	Laterite	Visual Inspection Compressive	Visual & Verification	100 %	P.O. Approved drawings / TS	Applicable material Spec / Manufacturer TC	Raw Material Inspection Report				

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Sl No.	Activity Description	Nature of Check	Method of check	Extent of Check	Ref. Document	Acceptance Standard	Format of Records	Inspection By			Remarks
								1	2	3	
		strength & physical dimensions Scaffolding Size of stone			and IS 1786						
1g	Structural Steel	Visual, Dimensional, Marking verification and Review of MTC	Visual & Verification	100 %	P.O. Approved drawings / TS and IS 1786	Applicable material Spec / Manufacturer TC	Raw Material Inspection Report	P	R	R	
2	Earth work										
2a	Earth Work (Excavation)	Check Layout, pre & post level, dimension & depth, Side slope & other	Visual, Dimensional	100 %	As per site condition Tech. Spec / IS 3764	Approved Drawing, IS CODE & TS	-	P	W	R	

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Sl No.	Activity Description	Nature of Check	Method of check	Extent of Check	Ref. Document	Acceptance Standard	Format of Records	Inspection By			Remarks
								1	2	3	
		safety considera tion									
2b	Earth Work (Filling)	Edge preparatio n, Optimum Moisture content, laboratory dry density, max. & min. dry density (for sand), Field dry density / compacti on factor / relative density.	Visual , Dimen sional	100 %	Tech . Spec . / IS 2720	Approved Drawing, IS CODE & TS	Test Report	P	W	R	
3	Form Work										
3a	Material	Visual, verificatio n and	Visual & Verific	100 %	P.O., Appr oved Drg /	Applicabl e material Spec / Manufact	Raw Materi al Inspec	P	R	R	

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Sl No.	Activity Description	Nature of Check	Method of check	Extent of Check	Ref. Document	Acceptance Standard	Format of Records	Inspection By			Remarks
								1	2	3	
		review of MTC	ation		TS	urer TC	tion Report				
3b	Staging	Visual Inspection, Vertical of Props, Fixity of Props & bracing, Bearing area under props, Fixity of nails clamps, Bolts.	Visual & Verification	100 %	Appd. Procedure, TS/ Drawing	Appd. Procedure, TS/Drawing	-	P	W	R	
3c	Shuttering	Visual Inspection for alignment, Verticality & Fixity of support, Level checking	Visual, Dimensional	100 %	Appd. Procedure, TS/ Drawing	Appd. Procedure, TS/ Drawing	Pour Card	P	R	R	

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Sl No.	Activity Description	Nature of Check	Method of check	Extent of Check	Ref. Document	Acceptance Standard	Format of Records	Inspection By			Remarks
								1	2	3	
3d	De-Shuttering	Stripping time for bottom & side	Visual	100 %	Appd. Procedure, TS/ Drawing	Appd. Procedure, TS/ Drawing	Pour Card		P	R	R	
5	Reinforcement Work											
5a	Bar Bending	Visual Inspection Prepare & Check for Bending Schedule Linearity, shape, size & no. of Bars	Visual, Dimensional	100 %	Appd. Procedure, TS/ Drawing	Appd. Procedure, TS/ Drawing	Bar Bending Schedule		p	W	R	
5b	Bar Fixing	Size & Mix of cover block Location & no. of Bars Typing of	Visual, Dimensional	100 %	Appd. Procedure, TS/ Drawing	Appd. Procedure, TS/ Drawing	Bar Bending Schedule		p	W	R	

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Sl No.	Activity Description	Nature of Check	Method of check	Extent of Check	Ref. Document	Acceptance Standard	Format of Records	Inspection By			Remarks
								1	2	3	
		Bars, Lapping									
6	Concrete Work										
6a	Concrete Work (Other than Ready Mix)	Design Mix, Inspection of Ingredients	For each grade of mx initially from approved engineering college & thereafter trial mixes at site for any change in condition and	100 %	IS 10262 / IS 456 / Tech. Spec.	Appd. Procedure, TS/ Drawing	Test Report	p	W	R	

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Sl No.	Activity Description	Nature of Check	Method of check	Extent of Check	Ref. Document	Acceptance Standard	Format of Records	Inspection By			Remarks
								1	2	3	
			aggregate source								
6b	Concrete Work Ready Mix	Design Mix, Quality of Ingredients	Submission of manufactures Mix Design & TC for each grade of Mix Submission of manufacturers Tests Reports	100 %	IS 10262 / IS 456 / Tech. Spec.	Appd. Procedure, TS/ Drawing	Mix Design Report	p	W	R	
6c	During Concreting	Scaffolding for walkway	Visual & Verific	100 %	IS CODE / Tech	Appd. Procedure, TS/ Drawing	Cube Register / Pour	p	W	R	

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Sl No.	Activity Description	Nature of Check	Method of check	Extent of Check	Ref. Document	Acceptance Standard	Format of Records	Inspection By			Remarks
								1	2	3	
		Calibration of Weigh Batchers/ batching plant Batching of materials Slump Cone Tests Compaction Compressive strength test sample Level Checking Construction Joint, Specific gravity	ation		Spec.		card / Sketch, Calibration Certificate				
6d	Pot Concreting	Visual Inspection after	Visual & Verific	100 %	IS CODE / Tech	Appd. Procedure, TS/ Drawing	Cube Test Report	p	W	R	

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Sl No.	Activity Description	Nature of Check	Method of check	Extent of Check	Ref. Document	Acceptance Standard	Format of Records	Inspection By			Remarks
								1	2	3	
		De-Shuttering Calibration of cube testing machine (Pressure Gauge), Strength test	ation		Spec.						
7	Excavation										
7a	Excavation in Soil	Check layout, spot level	visual, Dimensional	100 %	IS CODE / Tech Spec.	Appd. Procedure, TS/ Drawing	Level Records	P	S	R	
7b	Filling in Soil	Visual inspection of filling materials Lab dry density OMC Grain size analysis / after berg	visual, Dimensional	100 %	IS CODE / Tech Spec.	Appd. Procedure, TS/ Drawing	Test Report	P	S	R	

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1: Executed By: Contractor		P: Performer	H: Hold Point		MRIE: Material Receiving Inspection		W.O. NO.: Date:					
2: By PMC		W: Witness	RM/S: Random/ Surveillance		WPS: Welding Procedure		TS: Technical Specification					
3: By OWNER		R: Drawing	Drg: Drawing		PQR: Procedure Qualification Record		WQT: Welder Qualification Test					
Sl No.	Activity Description	Nature of Check	Method of check	Extent of Check	Ref. Document	Acceptance Standard	Format of Records	Inspection By			Remarks	
								1	2	3		
		limits, plasticity index and dry density Field dry density										
8	Masonry											
8a	Brick Masonry	Minimum average compressive strength	Tested in accordance with IS 3495	Samples of each type of brick as per IS 5454; not less than 1 in 5,000	IS 3495 (Part 1) IS 5454	As given in the code IS 3495 for a particular class of work	Test report	P	R m	R		
		Water absorption		Samples of each	IS 3495 (Part 2)	Shall not be more than 20% by its dry	Test report	P	R m	R		

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								1	2	3	
				type of brick as per IS 5454; not less than 1 in 5,000		weight for class 5 brick when soaked in cold water for 24 hours. Refer code for other class.					
9	Pointing										
	Pointing	Raking & Cleaning, Washing of Joints, Cement Mortar Proportion Curing	Visual	100 %	IS CODE / Tech Spec.	Appd. Procedure, TS/ Drawing		P	Rm	R	
10	Sub-Base (WMM / WBM)										
10a	Coarse aggregates	Loss Angles, abrasion value or	Lab	Per 200 m3	IS2386 Spec	IS2386 Spec	Test report	P	R	P	

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Sl No.	Activity Description	Nature of Check	Method of check	Extent of Check	Ref. Document	Acceptance Standard	Format of Records	Inspection By			Remarks
								1	2	3	
		aggregate Impact value, Flakiness index. Grading requirement	Field	Per 100 m3							
10 b	Fine Aggregate	Deleterious Materials	Lab	As per EIC	IS2386 Spec	IS2386 Spec	Test report	P	R	R	

LEGEND: -
Hold: Do not proceed till inspectors clear the item / activities, H - HOLD
Witness: Intimation for inspection request to be given to inspector, wait for 24 hours or written clearance from inspector, whichever is earlier, (W-Witness)
Review: Job can be performed, Inspector to review relevant records (R-Review)
Inspection of bought out items at sub vendor's works shall be carried out by TPL as per approved QA plan for bought out items.
R/W - Review or Witness, Rm - Random witness, A- Approval.

Note:

The Tests listed in QAP are minimum requirement. Contractor shall provide a field quality assurance plan with formats for record of test results for all the works considering requirements of this specification and other relevant specification document/IS Codes. Field Quality Plan approved by OWNER/PMC shall be followed for all the works under scope of the tender. Cost of all tests shall be borne by the Contractor.

All tests shall be recorded in forms acceptable to the Engineer-in-charge.

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Sl. No	Item/ Name of Manufacturer	Place	Brand Name
1.0	**Floor Finishing**		
1.1	Terrazzo Tiles		
A	Nitco	Delhi	NITCO
B	Hindustan Tiles	Delhi	Hindustan Tiles
1.2	Ceramic Tiles		
A	Regency Ceramics Ltd.	Hyderabad	Regency
B	Kajaria Ceramics Ltd.	Delhi	Kajaria
C	Orient Ceramics & Industies Ltd.	Delhi	Orient
D	Bell Ceramics	Vadodara	BELL
E	SPL Ltd.	Delhi	Somany
F	H & R Johnson (I) Ltd.	Mumbai	Johnson
G	Spartek Ceramics	Chennai	Spartek
H	Murudeshwar Ceramics Ltd.	Hubli	Naveen
1.3	Vitrified Tiles		
A	Regency Ceramics Ltd.	Hyderabad	Regency
B	Orient Ceramics & Industies Ltd.	Delhi	Orient
C	SPL Ltd.	Delhi	Somany
D	H & R Johnson (I) Ltd.	Mumbai	Johnson
E	Murudeshwar Ceramics Ltd.	Chennai	Spartek
F	Kajaria Ceramics Ltd.	Hubli	
1.4	Acid Resistant Tiles		
A	Regency Ceramics Ltd.	Hyderabad	Regency
B	H & R Johnson (I) Ltd.	Mumbai	Endura
1.5	PVC Tiles/ Rolls		
A	All Manufacturers Listed (Having Operative and Valid License) by HIS AI BIS Web Site		
B	Armstrong World Insutries	Mumbai	Excelln
C	Bhor Industries	Delhi	MARBLFX
D	Shyam Vinyl	Chennai	Shyam Vinyles
1.6	PVC Tiles/ Rools / Anti-Static)		
A	Armstrong World Insutries	Mumbai	Solid LG1
B	Premier Poly Film Ltd.	Delhi	ANSTAT
1.7	Epoxy Coating		
A	Fosroc Chemical (I) Pvt. Ltd.	Bangalore	Nitofloor SL
B	Sika	Kolkata	Sika Floor
C	Buildtech Products (I) Pvt. Ltd.	Delhi	Buildpoxy-SL
D	Anupam Industries	Kolkata	-
E	STP	Delhi	
1.8	Floor Hardener		
A	Cico Technologies Limited	Delhi	CICO
B	Samcock Chemicals (P) Ltd.	Ahmedabad	Samhard STD
C	PCC CSS Procfssor and Traders	Kolkata	Doronite
1.9	Designer Paver Tiles/ Interlocking Tiles ISI Marked/ Grass-Jointed Tiles (1st Quality Only)		
A	Pavit, Ultra, Hindustan, Eurocon, Vyara, National Tiles,		
B	Rammica Indusries	Delhi	Rammica
C	The Bombay Burmah Trading Corpn.	Delhi	Formica
2.0	**Woodwork**		

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A	Block Board/ Flush Door		
	All Manufacturers Listed (Having Operative and Valid License) by HIS Al BIS Web Site		
2.1	Plywood		
A	All Manufacturers Listed (Having Operative and Valid License) by HIS Al BIS Web Site		
2.2	Laminates		
A	All Manufacturers Listed (Having Operative and Valid License) by HIS Al BIS Web Site		
2.3	MDF Boards		
A	Nuchem Limited	Faridabad	NULAM/NVWUD
B	Mangalam Timber Products Limited	Delhi	Nuwud
C	Western Bio Systems Ltd.	PUNF	Ecoboard
D	Bajaj Eco-Tech Products Limited	Noida	Bajaj
2.4	Particle Board (Plain/ Veneered/ Pre-Laminated)		
A	All Manufacturers Listed by BIS Under IS 3097 (Having Operative and Valid License) at BIS Web Site http://www.bis.org.in/		
2.5	Pressed Steel Door Frames/ Cupboard and Window Frames (Fabricators)		
	M/s SAIL		
	M/s TATA		
3.0	**Steel/ Aluminium/ Fire Rated Doors, Windows, Ventilators**		
3.1	Pressed Steel Doors/ Windows		
A	SKS Steel Ind.	Delhi	-
B	Dhiman Steel	Delhi	-
C	Supper Steel Windows Co.	Delhi	-
D	RDG Engineering	Mumbai	-
E	Anand Industries	Delhi	-
F	Raymus Engineering	Gurgaon	-
G	M/s Loyal Safe Works Mayapur	New Delhi	
H	M/s Multiwyn Industrial Corpn. Clacutta	Kolkata	
I	M/s Metal Window Corpn.	New Delhi	
J	M/s Chhabra Steel Udyog	260 Sadar Bazar, Meerut	
K	M/s Delite Safe Works,	Rani Jhansi Road, New	
L	M/s Ishwar Industries,	175/A Bomay Bazar, Meerut Cantt	
M	M/s Chandni Industries	J-142, Patel nagar 1st,	
3.2A	Aluminimum/ Doors/ Windows Sections		
A	Jindal Aluminium Limited	Bangalore	
B	Hindalco	Mumbai	
3.2B	Alluminuml Door/ Windows/ Glazing Fabricator and Anodized		
A	M/s Alumilite Pvt. Ltd., C. AHLCON	New Delhi	
B	M/s Ajit India Pvt. Ltd.	Mumbai	
3.3	Fire Proof Doors		
A	Navair International	Delhi	Viper
B	RDG Engineering	Bombay	Radiant
S	Item/ Name of Manufacturer	Place	Brand Name
3.4	Steel Windows, Ventilators (as per IS-1038 of 1983) & frames pressed steel dorr/ window)		
A	M/s Multiwyn Industrial Corpn Calcutta	Kolkata	

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B	M/s Metal Window Corp N/Delhi	New Delhi	
C	M/s Govind Enterprises, Delhi	Delhi	
D	M/s Chhabra Steel Udyog 260, Sadar Bazar, Meerut		
E	M/s Chandni Industries, J-142, Patel Nagar Ist, Ghaziabad	Ghaziabad	
3.5	Rolling Shutters (ISI marked)		
A	Swastic	Mumbai	
B	Hercules	Bangalore	
C	Shubdwar		
D	M/s Bharat Rolling Shuters Industries Agra Rama Rolling Shutter Works		
E	Gandhi Entrance Automations Private Limited		
4	**Door/ Windows Fittings**		
4.1	Mortice Locks with Handles		
A	Godrej & Boyce	Mumbai	Godrej
B	Everite Agencies (P) Ltd.	Delhi	Everite
C	Golden Industries	Delhi	Golden
4.2	Hydraulic Door Closer (Overhead/ Floor Mounted)		
A	All Manufactureres Listed by BIS Under is 3087 (Having Operative and Valid License) at BIS Web Site http://www.bis.org.in/		
B	Doorking Industries	Delhi	Doorking
4.3	Misc. Door Fittings e.g. Hingee, Tower Bots, Latches, Stoppers etc.		
A	All Manufacturers Listed by BIS under IS:3087 (Having operative and valid license) at BIS Web		
B	Everite Agencies (P) Ltd.	Delhi	Everite
C	EBCO Industries	Delhi	EBCO
D	ECIE (P) Ltd.	Mumbai	ECIE
D	Hardwyn Traders	Mumbai	Hardwyn
	Aluminimum/ Doors/ Windows Fittings		
	M/s Wlite 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		
	Argent New Delhi,		
	Golden Industries Pvt. Ltd.	Delhi	
4.4	Automatic Glass Door		
A	Ditec (Gandhi)	Mumbai	
4.5	Aluminium Grill		
A	Alu Grill, Arihant Aluminium Corporation,	Bangalore	Decogrille
4.6	Builders Hardware		
A	M/s Golden Industries Pvt.Ltd. Everite, Solo	delhi	
5.0	**Roof Treatment (Water - Proofing)**		
5.1	P.U. Based Waterproofing (One Component)		
A	Llyod Insulations (I) Ltd.	Delhi	Isothane Ema

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B	Cico Technologies Ltd.	Delhi	Corchem 2061
C	Fosroc Chemical (I) Pvt. Ltd.	Bangalore	Nitoproof
5.2	P.U. Based Waterproofing (Two Component)		
A	Shivalik Agro Poly Products Pvt. Ltd.	Delhi	Shivabond 903
B	Industrial Product Manufacturing Company	Pune	EZECOAT
C	Fosroc Chemical (I) Pvtl. Ltd.	Bangalore	Brushbond
D	Sika	Kolkata	Sikalastic
E	Sip Industries Limited	Chenna	Sipguard
5.3	Approved Membrane		
A	Llyod Insulations (I) Ltd.	Delhi	Lloyed
B	Buildtech Products Pvt. (I) Ltd.	Delhi	Buil Dwrap P
C	Cico Technologies Ltd.	Delhi	CICO Shield
D	Fosroc Chemical (I) Pvt. Ltd.	Bangalore	Proofex
F	Sika	Kolkata	Sika WP
G	STP Ltd	Kolkata	Super
H	IWL India Ltd.	Chenna	Hyperplas
I	Pure Leathers Pvt. Ltd.	Delhi	Roofseai
6.0	**Painting Works**		
	Plastic/ Acrylic Emulsion Paint	Jodhpur	
6.1	(Internal and External, Distemper/ Acrylic Distemper)		
A	ICI Paints/ ICI India Ltd.	Kolkata	
B	Berger Paints	Kolkata	Lewis Berger
C	Asian Paints	Mumbai	Asian Paint
D	Shalimar Paints	Mumbai	Color Space
E	Nerolac Paints	Mumbai	
F	Acropaints/ Imited	Delhi	
G	Godavari Paints Pvt. Ltd.	Mumbai	
H	N E Paint Udyog	Sivasagar (Assam)	
6.2	Synthetic Enamel Paint (for Building Works)		
A	ICI Paints/ ICI India Ltd.	Kolkata	
B	Berger Paints	Kolkata	
C	Asian Paints	Mumbai	
D	Shalimar Paints	Mumbai	
E	Nerolac Paints	Mumbai	
F	Godavari Paints Pvt. Ltd.	Mumbai	
G	N E Paint Udyog	Sivasagar (Assam)	
6.3	Waterproof Cement Paint		
A	Killick Nixon Ltd.	Mumbai	Snowcem
B	Godavari Paints Pvt. Ltd.	Mumbai	Superemcem
C	Acropaints/ Imited	Delhi	Acrocfm
D	Snow White Industrial Corpn	Chennai	Superclm
E	Rajdoot Paints	Delhi	Xlracem 78 Super Cement
6.4	Decorative Textured Coating		
A	Luxture Surface Coatings Pvt. Ltd.	Ajmer	Luxture
B	Bakelite Hylam Ltd.	Secundrabad	Heritage
C	NCL Alltek and Seccolor Ltd.	Hyderabad	Alltek
D	Acro paints Ltd.	Delhi	Acrotextures
E	Unitile	Delhi	Unitile

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F	Spectrum Paint	Delhi	Spectrum
6.5	Ploshing (for Woodwork)		
A	Asian Paints	Mumbai	Asian Paint
B	Shalimar Paints	Mumbai	Mellac
7.0	**Roofing Sheets & Accessories**		
7.1	Precoated Profiled G.I./ Galvalume/ Zincalume Sheets		
A	Llyod Insulations (I) Ltd.	Delhi	Lloydeck
B	Interarch Building Products (P) Ltd.	Noida	Tracdek
C	Multi Colour Steel (I) Pvt. Ltd.	Delhi	Multi ……
D	Hardcastele & Waud Mfg. Co. Ltd.	Mumbai	Fero Colour
E	Japan Metal Building Systems Pvt. Ltd.	Bangalore	JMBS
F	TATA Bluescope Steel Limited	Pune	Trimdf CK
G	Era Building Systems Limited	Delhi	ERA
H	Shree Precoated Steels Limited	Mumbai	Metacolour
7.2	C.G.I. Sheet		
A	ISPAT Industries Ltd.	Delhi	Everest
B	Steel Authority of India Ltd.	-	SAIL
C	TATA Steel	-	TISCO
7.3	Aluminium Sheet		
A	Jindal Aluminium Limited	Bangalore	
B	Hindalco	Mumbai	
7.4	Fiber Glass Sheet & Panels		
A	Simba Frp (P) Ltd.	Delhi	
8.0	**Sanitary, Plumbing Fittings & Fixtures**		
8.1	Sanitary Fittings		
A	All Manufacturers Listed by BIS under IS:3087 (Having operative and valid license) at BIS Web Site http://ww.bis.org.in/		
8.2	Plumbing Fittings and Fixtures		
A	Jupiter Aqua Lines Ltd.	Mohali	Jupitor
B	Othello Faucets Pvt. Ltd.	Delhi	Mayur
C	Orient Ceramics	Delhi	Orient
D	Gem International	Faridabad	Gem
E	Parkash Brassware Industres	Delhi	Parko
F	Jaquar & Company Ltd.	Delhi	Jaquar
G	Plastocraft Sanitary India Pvt. Ltd./ HSW	Delhi	Kingston
8.2H	Cast Iron Pipes and Fittings Hinddustan Engineerng Products Company	Calcutta	
8.2I	RCC Pipes		
A	Indian Hume Pipe Company	Delhi/ Allahabad/	
B	Hindustan Pressure Pipes	Kolhapur	
C	Dhere Concrete Products Pune	Pune	

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Sl. No.	Item/ Name of Manufacturer	Place	Brand Name
8.2J	GI Pipes		
A	Indian Tube Company	Culcutta	
B	Kalinga Tubes Limited	Cuttack Gujarat	
C	Steel Tube		
D	Zenith Tube Co.	Kolaba	
E	Bharat Steel Tube	New Delhi	
F	Jindal		
G	Shivmoni Steel Tubes Limited	Bangalore	
H	Sekhar Iron Works	Calcutta	
I	Jain Tubes,	Ghaziabad	
J	Khandelwal Tubes	Nagpur	
8.2K	G.I. Fittings		
A	International Pipe Works	Calcutta	
B	R.M. Engineering Works	Jalandhar	
C	Bombay Metal Company	Bombay	
D	Tarapada Das & Sons	Howrah	
E	Annapurna Metal Works	Calcutta	
8.2L	Gun Metal Valves and Copper Alloy Valve		
A	Leader Engineering Wroks	Jalandhar	
B	Neta Engineering Works	Jalandhar	
C	Lakshmi Metal Works	Jalandhar	
D	Bombay Metal & AlloysCompany	Bombay	
E	Luster Sanitary Fittings	Jalandhar	
F	Annapurna Metal Works	Culcutta	

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8.2M	Sluice Valves, Check Valves etc.		

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A	Shiva Durga Iron Works,	Howrah	
B	Leader Engineering Wroks	Jalandhar	
C	Kirloskar Bros Limited	Pun	
D	Indian Valve	Calcutta	
E	Geeta Iron & Brass Works	Baroda	
8.2N	Brass Fittings		
A	Leader Engineering Wroks	Jalandhar	
B	L & K Mathura		
C	Luster Sanitary Fittings	Jalandhar	
D	Annapurna Metal Works	Calcutta	
E	Neta Engineering Works	Jalandhar	
F	Honey Industril Corporation	Bombay	
8.2O	C.P. Fittings		
A	Ego Metal Works	Ballabhgarh	
B	Jaquar & Company Ltd.	Delhi	
C	Soma Plumbing Fixtures Limited	Calcutta	
D	Gem Sanitary Appliances Pvt. Ltd.	Delhi	
E	Essco Sanitations	Delhi	
F	Bilmet	Bombay	
8.2P	Hydrants		
A	Brady's	Bombay	
B	Firex	Bombay	
C	Upadhya Valves	Calcutta	
D	Eddy Foundry	Calcutta	
E	Minimax	Delhi	

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Sl. No.	Item/ Name of Manufacturer	Place	Brand Name
8.2Q	Stone Ware (Salt - Glazed) Pipes		
A	Hind Ceramics Limited	Orissa	
B	Ceramic Industries Limited	Sambalpur	
C	Shrikamakshi Agencies	Madras	
D	Binary Udyog Pvt. Lmited	Howrah	
E	Tirumati Moulds Limited	Nagpur	
F	Kiran Potteries	Hyderabad	
G	Perfect Sanitary Pipes	Bharatpur	
8.3	Mirror/ Glass		
A	Atul Glass	Delhi	Atul
B	Gujarat Guardian Ltd./ Modi / Saint Govin	Delhi	Modiguard
C	Triveni Glass	Kolkata	Triveni
D	Continental Float Glass	Delhi	Continental
E	Hindustan Safety Glass	Kolkata	Hindustan
9.0	**False Ceiling**		
9.1	Aluminimum Strip/ Tray Type		
A	Interarch Building Products (P) Ltd.	Noida	Trac
B	Hunter Douglas	Delhi	Luxalon
C	Mascot Oversfas	Delhi	Mctacie/ Trulon
D	Llyod Insulations (I) Ltd.	Delhi	Lloyd Lineal
9.2	Gypsum Board		
A	Saint-Gobain Guproc India Ltd., LA, IP Board	Mumbai	Gypboard
9.3	False Ceiling (POP/ Gypsum Board)		
A	Armstrong, Daiken, Luxalon, Llyods		
10.	**False Flooring**		
A	United Insulation	Mumbai	
B	Llyod Insulations (I) Ltd.	Delhi	
C	Muti Floors	Delhi	
D	A.R & Brothers	Chennai	
E	Bestlock System & Concepts, Goderej	Mumbai	
11.	**Insulation**		
11.1	Underdeck Insulation		
A	Bakelite Hylam Ltd.	Secundrabad	Phenotherm
B	Llyod Insulations (I) Ltd.	Delhi	Isolloyd
C	UP Twiga Fibre Glass Limited	Delhi	TWIGA
11.2	Overdeck Insulation		
A	Llyod Insulations (I) Ltd.	Delhi	Lloyad Spray Foam
B	Best Plastronics Ltd.	Delhi	Best Plastronics
12.	**Miscellaneous Items**		
12.1	Water Proofing Compound in Plaster		
A	Cico Technologies Ltd.	Delhi	CICO No.1
B	Pidilite Industries	Mumbai	Pidiproof LA
C	Amit Chemicals (P) Ltd.	Delhi	CRETO ADMIX
12.2	CPRX Bituman Mastic		
A	Shai Imar Tar Products	Delhi	Shalimar Tar
13.	**Concrete Admixtures**		
13.1	Water Proofing Compound		
A	Cico Technologies Ltd.	New Delhi	CICO No.1
			CICO Super
			CICO Acry

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B	Kryton Buildmat Co Pvt. Ltd.	Delhi	KIM
C	Sika India Pvt. Ltd.	Kolkata	Plastocrete Plus
			Noleek
13.2	Water Reducing Compounds		
A	CICO Technologies Ltd.	Delhi	CICOPLAST Super
B	Fairmatf Chemicals Pvt. Ltd.	Vadodara	Faircrete N Fairflo
			Fairf LO S
C	Sika India Pvt. Ltd.	Kolkata	Plasti ment BV Plasti ment 81 Plasti ment 70 Sikam ent FF Sikam ent
14.	**Construction Chemicals**		
14.1	Polysulphide Sealant		
A	Cnowksfy Chemicals Pvt. Ltd.	Mumbai	Techse
B	Cico Technologies Ltd.	Delhi	CICOS
C	Fosroc Chemical	Delhi	Thioflex
D	Pidilite Industries	Mumbai	Pidiseal
E	Sika India Pvt. Ltd.	Kolkata	SIKA Polysul PH:DE
14.2	Silicon Sealants		
A	Pidilite Industries Ltd.	Mumbai	Dr. Fixit
15.	**Anchor Fasteners**		
15.1	Mechanical Anchor Fasteners		
A	Hilti India Pvt. Ltd.	Delhi	
B	Fischer Fixing Systems (MICO) Ltd.	Bangalore	
15.2	Chemical Anchor Fasteners		
A	Hilti India Pvt. Ltd.	Delhi	
B	Fischer Fixing Systems (MICO) Ltd.	Bangalore	
16.	**Electro-Forged Gratings**		
A	Greatweld Steel Gratings Pvt. Ltd.	Pune	
B	Indiana Gratings Pvt. Ltd.	Mumbai	
17	**Modular Partitions/ Furniture**		
A	Godrej, Blowplast, Featherlire, Duriar		
18.	**Wall Care Putty for Base Preparation (1st Quality Only)**		
A	Birla Wall Care Putty		
B	M/s Sahlimar Hardware		
C	Berger	delhi	
D	Jenson & Nichoison	Gurgaon	
E	JK White	Udaipur	

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19.	**White Cement (1st Quality Only)**		
A	Birla, JK		

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20.	**Sheet Glass/ Structural Glazing**		
A	Hindustan Pilkington Glass Works	Chennai	
B	Saint Gobain	Chennai	
C	Modi Float	Delhi	
D	Triveni Float Glass	Allahabad	
F	ASI		
G	Fresca		
H	Emirates		
21.	**Polycorbonate Sheet**		
A	GE Plastic, Everest		
22.	**Multiiell/ Multiwall Polycorbonate Panel**		
A	M/s Coxwell Domes Engineering, Delhi	Delhi	
B	M/s Lexan, M/s Galina India Pvt. Ltd.	New Delhi	
C	M/s Vijaynath Interiors & Exteriors Products	Mumbai	
23.	**Stainless Steel Railing**		
A	Jindal		
24.	**Punch Tape Concetina Coil**		
A	Global Technocrat, S.G. Engineers	Delhi	
25.	**Punch Tape In Plastic Spool**		
A	Global Technocrat, S.G. Engineers	Delhi	
26.	**Stainless Steel Railing**		
A	Jindal	New Delhi	
27.	**SGSW Pipes (IS-651) ISI marked**		
A	Perfect Agra, Devraj Ind. Gaziabad, Buran, RK, Prince, Supreme Pipe and Fittings		
28.	**CI (Centrifugally Cast) Pipes for Sewage Disposal ISI Marked**		
A	NICCO, SRIF, A-1 Singhal Casting Co Agra, Jindal Saw, Kesoram		
29.	**PVC Rain Water/ Sewage Pipes (IS-4985)**		
A	Reliance, Finolex, Supreme, Kisan, Prince		
30.	**HDPE Water / Sewage Pipes (Rotational Moulded)**		
A	Sintex, Swift, Nutech, Sheetal		
31.	**Asbestos Cement Pipes and Fittings**		
A	Ganga Asbestos Limited	U.P	
B	Hyderabad Asbestos Cement Products Limited		
C	J.K. Super Pipes Industries	Nanded	
D	Konark Cement and Asbestos Limited	Orissa	
E	Maharashtra Asbestos Lmited	Bombay	
F	Poddar Industrial Corporation	Patna	
G	Sarbamangala Mfg. Company	Calcutta	

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32.	**Wind Driyen Air Ventilators**		
A	Multi Colour		
	Anchit Ispat Pvt. Ltd.	Faridabad	
	Apurva Enterprises	Mumbai	
	SVS Wind Driven Turbo Ventilator	Ahmadnagar	
	Real Green Engineers Pvt. Ltd. Bagalores	Bangalore	
	Sun Green Ventilation System Pvt. Ltd	Mylapore	
33.	**HDPE Water Tanks**		
	Sintex , Uniplas, Unitank, Devi Polymer, Prakash, Diplast or approved ISI equivalent (to be approved by IndianOil)		
34.	**G.I. Sheet**		
	TATA, Jindal, Bhushan, Essar, Lloyd or equivalent		
35.	**PVC Pipe & Fittings**		
	Finolex, Supreme, Prince, Surya or equivalent		
36.	**Submersible Pump**		
	KSB, Crompton, CRI or equivalent		
37.	**Structural Steel**		
	Tata, Vizag, SAIL, IISCO, JISCO, Jindal, Essar,		
38.	**Tubular Section**		
	VIZAG /ASIAN /JINDAL / Surya Roshini/ TATA, SAIL, IISCO or Equivalent		
39.	**Reinforcement Steel**		
	TATA, SAIL, Vizag,SUJANA or IS approved make.		
40.	**Cement**		
	ACC, L&T, JK, Birla, Sriram, Jaypee, Ambuja,		
41.	**White Cement**		
	JK, Brila or equivalent		
42.	**Anti-Termite Treatment**		
	Pest Control (India) Ltd., Aristo Chemica or equivalent		
43.	**Chromium plated bath/ fitting**		
	Plumber, Essco, Jaquar, GEM, SS or equivalent		
44.	**G.I. Pipe**		
	Surya Prakash, TATA, Jindal or equivalent		
45.	**Kerb Stone**		
	Nimco Prefab, KK Manholes or equivalent		

SANITARY WORKS		
1	European Type Water Closet	Hindware, Parryware, Neycer, Cera (Catlogue No as per detailedspecifications or equivalent
2	Orissa Type Water Closet	Hindware, Parryware, Neycer, Cera (Catlogue No as per detailedspecifications or equivalent

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3	Vitreous Chinaware Sinks	Hindware, Parryware, Neycer, Cera (Catlogue No as per detailedspecifications or equivalent
4	Wash Basin	Hindware, Parryware, Neycer, Cera (Catlogue No as per detailedspecifications or equivalent
5	Plastic Seat Cover	Parryware, Patel, Barbie, Marshel or equivalent
6	Flushing Cistern	Hindware, Parryware, Neycer, Cera (Catlogue No as per detailedspecifications or equivalent
7	Soap Tray	Hindware, Parryware, Neycer, Cera, Chilli or equivalent
8	PVC Pipe Fittings	Star, Prince, Supreme or equivalent
9	Tower Rail	Metro, Parko, ARK, Soma, Essco, Chilli or equivalent
10	PVC Pipes	TATA, Supreme, Finolex, Prince, Prakash, Surya or
11	CP Brass Spray Shower with ball &Socket	Metro, Parko, ARK, Soma, Essco, or equivalent
12	Paper Holder	As per approved by Site Enginner
13	Floor Trap	Cast Iron : IS Approved CP Brass Fitting : Chilli PVC: Prince, Kishan
14	Brass Float Valves with Copper	Orient, Leader, Chilli or equivalent
15	CP Brass Pillar Taps	Metro, Parko, ARK, Soma, Essco, Gem, Chilli or equivalent
16	CP Brass Stop Cocks	Metro, Parko, ARK, Soma, Essco, Gem, Chilli or equivalent

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17	CI Frame & Cover for Inspection	IS Approved or equivalent
18	Manholes in Sewer	RFC, NECO or equivalent IS Approved or equivalent
19	Flush Valve	Metro, Parko, Essco or equivalent
20	Electric Water Heater	Johnson, Inalsa, Crompton, Venus, Bajaj, Voltas or equivalent
21	PVC Waste Pipe	Prince, Kishan or equivalent
22	Locks	Godrej, Harrison or equivalent

1.34. LIST OF GENERAL TECHNICAL SPECIFICATION

As mentioned in Tender document following are the General Technical Specification.

1.34.1. SITE PREPARATION EXCAVATION WORKS & BACK FILLING **(Z/020005).**

1.34.2. SITE PREPARATION EXCAVATION WORKS & BACK FILLING **(Z/020005).**

1.34.3. BRICK MASONRY **(Z/020026)**

1.34.4. DEMOLITION AND DISMANTLING **(Z/020027).**

1.34.5. MISC CIVIL AND STRUCTURAL WORK FOR UNDERGROUND PIPING & OTHER CIVIL WORKS **(Z/020015).**

1.34.6. MISC STEEL WORKS **(Z/020014).**

1.34.7. PLASTERING & POINTING **(Z/020025).**

1.34.8. PLUMBING & BUILDING DRAINAGE **(Z/020002).**

1.34.9. ROADS & PAVEMENT **(Z/020021).**

1.34.10. SANITARY FITTINGS & FIXTURES **(Z/020003).**

1.34.11. SEWER & DRAINAGE SYSTEM **(Z/020008)**

1.34.12. STEEL/ALUMINIUM DOORS, WINDOWS AND VENTILATORS (Z/020008).

1.34.13. STRUCTURAL CONCRETE **(Z/020004).**

1.34.14. STRUCTURAL STEEL WORK **(Z/020023)**

1.34.15. TOPOGRAPHY SURVEY **(Z/020033).**

1.34.16. UNDER/ABOVE GROUND G.I. PIPELINE SYSTEM (WATER SERVICES) **(Z/020020).**

1.34.17. WHITE WASHING, DISTEMPERING, PAINTING AND POLISHING **(Z/020009).**

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1.34.18. MISSCELLANEOUS ITEMS **(Z/020016).**

NOTE:

ANY EQUIVALENT MAKE BEFORE USING/INSTALLATION AT SITE, SHALL BE GOT APPROVED BY AUTHORISED REPRESENTATIVE OF BGL IN WRITING, WITH COST BENEFITS (if any) TO BE PASSED ON TO BGL BY THE CONTRACTOR.

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	GTS - STANDARD FIELD QUALITY PLAN	**Z/02 0064**

STANDARD FIELD QUALITY PLAN

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Section : CONSTRUCTION MATERIAL

S.No	Component Operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norms	Testing Agency	Remarks	Check
1.	CHECKING OF FOUNDATION MATERIALS					
A.	CEMENT					
i ii iii iv v	Fineness Compressive Strength Initial & final setting time Soundness Heat of Hydration for low heat cement (Not Applicable for OPC & PCC)	One sample per lot of 100 MT or part thereof from each source for MTCs and one sample per lot of 200 MT or part thereof from each source for site testing.	IS:456, IS:269, IS:8112, IS:12269, IS: 4489 & TEPL Specification	Manufacturer approved lab	Review of manufacturers test certificates (MTCS) and laboratory test results by TEPL	B
vi	Chemical Composition of Cement	One sample per lot of 100 MT or part thereof from each source fro MTCs.	IS:456, IS:269, IS:8112, IS:12269, IS: 4489 & TEPL Specification	Manufacturer	Review of manufacturers test certificates by TEPL	B
B.	COARSE AGGREGATES					
i. ii iii iv v vi vii viii ix	Determination of Particle size (Sieve Analysis) Flakiness Index Crushing Value Specific Gravity Bulk Density Absorption Valve Moisture Content Soundness of Aggregate Presence of detections materials	One sample per lot of 100 cubic meter or part thereof from each source for each source for each size	IS: 383, IS: 2386 and TEPL specification	TEPL approved lab. However, Moisture content test for design mix concrete shall be done on all days of concreting at site.	Each source to be approved by TEPL. Review and acceptance of test result by TEPL	B
C	FINE AGGREGATE					

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i ii iii iv v vi vii	Gradation/Determination of Particle size(Sieve Analysis) Specific Gravity and density. Moisture content* Absorption Value* Bulking Silt Content Test Presence of deleterious materials	One sample per lot of 100 cubic meter of part thereof from each source	IS:383, IS:2386, IS:456 and TEPL specification	TEPL approved lab. However, Moisture content test for design mix concrete shall be done on all days of concreting at site.	Each source to by approved by TEPL. Review and acceptance of test result by TEPL	B
D i. ii iii iv	BRICKS Dimensional tolerance Compressible Strength Water Absorption Efflorescence	As per enclosed Annexure-II	CPWD & TEPL specification	TEPL approved Lab.	Approved by TEPL	B
E i	WATER Cleanliness (Visual Check)	Random	IS: 456, IS: 3025 and TEPL specification. The water used for mixing concrete shall be fresh, clean and free from oil, acids and alkalis, organic materials, or other deleterious materials.	Contractor	Each source to be approved by TEPL	B
ii	Chemical and physical properties of water for checking its suitability for construction purposes	One sample per source	IS:456, IS:3025 and TEPL specification	Contractor/ TEPL approved lab.	Approved by TEPL	B

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2. i.	REINFORCEMENT STEEL Identification & size	Random	IS:432, IS:1139, IS:1786 & TEPL specification	Contractor	Approved by TEPL	B
ii.	Chemical Analysis Test	One sample per heat	IS:432, IS:1139, IS:1786 & TEPL specification	Manufacturer	Review of manufacturers test certificates by TEPL	B
iii iv v	Tensile Test Yield stress/ proof stress Percentage Elongation	One sample per lot of 40 MT or part thereof for each size of steel conforming to IS:1139 and 5 MT or part thereof for HDS wire for each size of steel as per IS:432. For steel as per IS:1786 under 10mm 1 sample for each 35 MT or part thereof. Over 16m , 1 sample for each 45 MT or part thereof.	IS:432, IS:1139, IS:1786 & TEPL specification	Manufacturers / TEPL approved Lab	Review of manufacturers test certificates as well as lab test result by TEPL	B
vi	Bend/Rebend Test	One sample per lot of 20 MT or part thereof for each size of steel as per IS:432, IS:1139. For steel as per IS:1786 under 10mm- 16mm, 1 sample for each 25 MT or part thereof 10mm-16mm 1 sample for each 45 MT or part thereof.	IS:432, IS:1139, IS:1786 & TEPL specification	Manufacturers / TEPL approved Lab	Review of manufacturers test certificates as well as lab test result by TEPL	

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vii	Reverse Bend Test for HDS wire.	One sample per lot of 5 MT or part thereof for each size	IS:432, TEPL specification	Manufacturer/ TEPL approved lab.	Review of manufacturers test certificates as well as lab test result by TEPL	
3.	STRUCTURAL STEEL USED IN CABLE TRENCHES & FOUNDATIONS					
i.	Dimensional Check	Random	TEPL specification & approved drawing	Contractor	Checklist to be prepared and signed jointly.	B
ii.	Visual Check for damages, resting, pitting etc.	100%	TEPL specification & approved drawing	Contractor	Checklist to be prepared and signed jointly.	C
iii	Visual Check for welding, defects, primer coating and painting/ galvanizing as applicable	Sample per lot of 40 MT or part thereof for tensile tests and 1 sample per lot of 20 MT or part thereof for bend test for each size.	IS:2062, TEPL Specification & approved drawings	Manufacturer/ TEPL approved lab	Review of Mtgs test certificates as well as lab test results by TEPL	C
iv	Physical properties of structural steel	One sample per lot of 40 T or part thereof for tensile tests and 1 sample per lot of 20 T	IS 2062 ,TEPL Specifications and approved drawings	Manufacturer/ TEPL approved lab	Review of Mtgs test certificates as well as lab test results by	B

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		or part thereof for bend test.			TEPL	
4.	EQUIPMENT FOUNDATION/ CABLE TRENCH					
A	BEFORE EXCAVATION					
i	Checking of pegs condition as per line and alignment	100% on each location	IS:4091, IS:3764 & TEPL approved drawing/ specification	Contractor	Approved by TEPL	C
ii.	Checking of pit making as per drawing & RL.	100% on each location	IS:4091, IS:3764 & TEPL approved drawing/ specification.	Contractor	Approved by TEPL	C
B	EXCAVATION					
i.	Dimensional conformity	Each location	IS:4091, IS:3764 & TEPL approved drawing/ specification.	Contractor	Approved by TEPL	B
ii	Verticality/slopes & Square ness of each pit	Each location	IS:4091, IS:3764 & TEPL approved drawing/ specification.	Contractor	Approved by TEPL	B
iii	Vertification & classification of foundation wherever application.	Each location	IS:4091, IS:3764 & TEPL approved drawing/ specification.	Contractor	Approved by TEPL	B
C	**FOUNDATION BOLTS/ MATALLIC INSERTS**					

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i.	Check for proper identification foundation bolts w.r.t. type of foundation	100%	TEPL specification & approved drawings	Contractor	Checklist to be prepared & signed jointly.	C
ii.	Visual check for mechanical damage and galvanizing/ painting it applicable for metallic insert	100%	TEPL specification & approved drawings	Contractor	Checklist to be prepared & signed jointly.	C
iii.	Alignment & Level	100%	TEPL specification & approved drawings	Contractor	Checklist to be prepared & signed jointly.	B
iv	Grouting/ Underpinning of foundation base plate.	100%	TEPL specification & approved drawings.	Contractor	Checklist to be prepared & signed jointly.	C
D.	P.C.C. PADDING	For all locations	IS:456 and TEPL approved foundation drawings & Specification	Joint Inspection by TEPL and Contractor.	Approval by TEPL	B
E.	SHUTTERING (Formwork)					
i.	Check for materials, breakage or damage.	100%	IS: 456, TEPL specification / approved drawings.	Joint Inspection by TEPL and contractor	Approval by TEPL	C
ii.	Check for plumb, alignment parallelism, squareness and equidistance from	100% casting	IS:456, TEPL Specification/ approved drawings.	Joint Inspection by TEPL and	Approval by TEPL	B

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	stub.			contractor.		
iii.	Dimensional check	100% before casting	TEPL Specification/ approved drawings	Joint Inspection by TEPL and contractor	Approval by TEPL	B
iv	Check for level & height.	100% before casting	TEPL Specification/ approved drawings	Joint Inspection by TEPL and contractor	Approval by TEPL	B
v.	Check for rigidity of frame/ tightness	100%	TEPL Specification/ approved drawings	Joint Inspection by TEPL and contractor	Approval by TEPL	B
vi	Cleaning and oiling	100%	TEPL Specification/ approved drawings	Joint Inspection by TEPL and contractor	Approval by TEPL	B
vii	Diagonal bracing if required as per drawings/ site conditions	100%	TEPL Specification/ approved drawings	Joint Inspection by TEPL and contractor	Approval by TEPL	C
viii	Checking of joints to avoid undue loss of cement slurry.	100%	TEPL Specification/ approved drawings	Joint Inspection by TEPL and contractor	Approval by TEPL	C
F.	PLACEMENT OF REINFORCEMENT STEEL					
i.	Check the steel bars for rust, cracks, surface flaws, laminate etc. (Visual check)	100%	IS:456 and TEPL Specification/ approved drawings	Joint Inspection by TEPL and contractor	Approval by TEPL	C
ii.	Check as per the bar bending schedule before placement of concrete.	For all locations	IS:456 IS:2502 and TEPL Specification/ approved drawings	Joint Inspection by TEPL and contractor	Approval by TEPL	C

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iii	Checking cutting tolerance for bars as per check list/ drawings. Check whether all the bent bars and lap lengths are as per approved bar bending schedule.	For all locations	IS:456 , IS:2502 and TEPL Specification/ approved drawings	Joint Inspection by TEPL and contractor	Approval by TEPL	B
iv	Check whether all joints & crossing of bars are tied properly with right guage & annealed wire as per specification	100%	IS:456 , and TEPL Specification/ approved drawings	Joint Inspection by TEPL and contractor	Approval by TEPL	C
v.	Check for proper cover distance spacing of bars, spacers & chairs after the reinforcement cage has been put inside the formwork.	100%	IS:456 , and TEPL Specification/ approved drawings	Joint Inspection by TEPL and contractor	Approval by TEPL	C
vi.	Check whether tapping of bars are tied properly with right guage and annealed wire as per specification.	100%	IS:456 , and TEPL Specification/ approved drawings	Joint Inspection by TEPL and contractor.	Approval by TEPL	B
viii	Anchor bolts if applicable					
a)	Level, center-to-center distance of bolts.	100% on each location	TEPL approved pile foundation drawings/ specification.	Joint Inspection by TEPL and contractor.	Checklist to be prepared and signed jointly.	B
b)	Visual check for galvanizing.	100% on each location.	TEPL approved pile foundation	Joint Inspection by	Checklist to be	B

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	CONCRETING		drawings/ specification.	TEPL and contractor.	prepared and signed jointly.	
5.	APPROVAL OF MIX DESIGN		IS:456 & TEPL drawings/ specification.			
a)		Each Mix.		TEPL approved by Lab	Approved by TEPL	A
B)	BATCHING, MIXING & PLACING OF CONCRETE AND COMPACTING.	100%	IS:456 & TEPL approved pile foundation drawings/ specification	Joint Inspection by TEPL and contractor.	Approved by TEPL	B
C)	PLACING CONCRETE AND COMPACTING.	100%	IS:456 & TEPL approved pile foundation drawings/ specification	Joint Inspection by TEPL and contractor.	Min gap between boxes and reinforcement bars should be maintained. Approved by TEPL.	B
D)	CONCRETE TESTING					
i.	Slump Test	One sample per casting	IS:456, IS 516, IS: 1199 and TEPL specification.	Contractor	Approved by TEPL	B
ii	Check for quantities for cement, fine aggregate, coarse aggregate and water while batching	100% on all locations	IS:456, IS 516, IS: 1199 and TEPL specification.	Contractor	Checklist to be prepared and signed jointly.	B
E.	CONCRETE CUBE TESTING					

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i.	Compressive Strength	One sample for every 20 Cum of concreting or part thereof for each days concreting (one sample consists of min. 3 test cubes for 28 days strength)	IS:456, IS 516, IS: 1199 and TEPL specification.	TEPL approved lab	Approval by TEPL Cubes must be tested within a week after 28 days curing period and test results should be approved.	A
F.	CHECK FINISHING, DIMENSIONAL CONFORMITY AND WORKMANSHIP BEFORE & AFTER BOX REMOVAL.	100%	IS:456, IS 516, IA: 1199 and TEPL specification.	Contractor	Approval by TEPL	B
6.	BACKFILLING					
i.	Check for thickness of layer & watering	100%	TEPL specification and approved drawings.	Contractor	Approved by TEPL	C
ii.	Visual check for correction/ ramming.	100%	TEPL specification and approved drawings.	Contractor	Approved by TEPL	C
iii.	Compaction test (percentage of max. dry density)	Samples for each pit. Equipment & other foundation 20% at random	TEPL Specification	TEPL approved lab	Review of lab test results by TEPL. Elevation for testing to be decided by TEPL.	B

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6.	BRICK-WORK & TILING WORK					
i.	Mortar mix/ proportion	Random	IS:2250, TEPL specification & CPWD specification.	Contractor	Approval by TEPL	B
ii.	Plumb & Alignment	Random	TEPL specification & CPWD Specification	Contractor	Approval by TEPL	B
iii	Joints	Random	TEPL specification & CPWD Specification	Contractor	Approval by TEPL	B
iv	Water absorption Test	Random	TEPL specification & CPWD Specification	Contractor	Approval by TEPL	B
7.	PLASTERING					
i.	Plastering thickness and evenness	Random	TEPL specification & CPWD Specification	Contractor	Approval by TEPL	B
ii.	Mortar mix./ proportion	Random	TEPL specification & CPWD Specification	Contractor	Approval by TEPL	B
8.	SITE SURFACING					
i.	Levelling	100%	TEPL specification & CPWD Specification	Contractor	Checklist to be prepared and signed jointly	B

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1. Details of categories of check codes A,B &C including accepting and deviation dispositioning authorities are indicated at Annexure-1.

2. TEPL specification shall mean TEPL technical specification, approved drawings/ data sheets and LOA provisions applicable for the specific contract.

3. Accepting criteria and permissible limits for certain tests are indicated at Annexure-II. For balance tests, site to verify the same with respect to TECPL specification, relevant Indian Standards and/or prevalent code of practice.

4. It is clarified that the tests indicated at column 2 of this F.Q.P. i. e. against column " Component Operation & Description of Test," are only generally required to be conducted. However, TEPL reserves the right to carryout any additional tests at any stage if the situation so warrants.

5. TEPL site representative shall witness all the tests conducted by the contractor as mentioned in this F.Q.P. However, in case of tests conducted in the TEPL approved lab, it is preferred to witness the tests in the lab itself, if possible.

6. TEPL shall approve testing laboratory before accepting the test results from the lab.

7. TEPL shall approve the sources for cement, coarse aggregate, fine aggregate & water before actual utilization.

8. All the testing & measuring equipment used by the contractor for testing are required to be calibrated. A copy of valid calibration report shall be retained by TEPL as records.

9. Classification of foundations shall be approved by TEPL based on the Joint Inspection Report & Soil investigation reports.

10. Curing of concrete work should be continued for a minimum period of 10 days.

11. ZONE-IV FINE AGGREGATE.

a. Zone-IV line aggregate shall be used for nominal mix. Reinforced cement concreting work.

b. Zone-IV line aggregate shall be avoided for design mix. Reinforced cement concreting work unless tests have been done to ascertain the suitability of proposed mix proportion with the prior approval TEPL site.

12. Bricks shall be free from cracks, flaws and modules of free lime. They should have smooth rectangular faces with sharp corners and should be uniform in colour.

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13. CEMENT

a. In case supply of cement is in the scope of the contractor, the same shall be procured from sources approved by TEPL site and got tested at site on sample basis for specified acceptance tests as specified in the F.Q.P. at a reputed Third Party Lab approved by TEPL site.

b. The samples of cement for site testing shall be taken within three weeks of the delivery and all the tests shall be commenced within one week of sampling, if the cement remains in store for a period of more than six month. All the site tests are required to be repeated before usage.

14. REINFORCEMENT STEEL & STRUCTURAL STEEL USED IN CABLE TRENCHES AND FOUNDATIONS.

a. In case supply of steel is in the scope of the contractor, the same shall be procured from the main producers i.e. SAIL, TISCO, IISCO or Rashitriya Ispat Nigam or the rerollers approved by main producers. The steel shall be got tested at site on sample basis of specified acceptance tests as specified in this F.Q.P. at a reputed Third Party Lab approved by TEPL site.

b. The results of the testing of cement and reinforcement steel referred to in 13.a and 14.a above shall be got approved from TEPL site before cement and reinforcement steel are put to use. However, in exceptional cases due to exigencies of work. TEPL site may authorize the contractor to use Cement and Reinforcement Steel even before the test results are received. However, in all such cases, if the test results subsequently received are found to be not complying with the specified acceptance criteria, the contractor shall have to dismantle and recast all such foundations cast with such non-conforming materials at his own cost. Confirmation to this effect shall be obtained from the contractor by the Project authorities beforehand in all such cases.

15. The contractor shall submit welding procedure specification (WPS) including the type of electrode used for approval of TEPL site before starting the welding work.

16. Approval/ acceptance of individual test results by TEPL in the course of execution of contract will not relieve the contractor of his contractual obligations and responsibilities, nor does it limit the Owner's right under the contract.

17. In case, requirement of special items like Super Sulphated Cement, Corrosive Resistant Reinforcement Steel (CRRS) etc arise due to site conditions, the specific approved of TEPL may be obtained before using the same and all the tests as per relevant standards shall be carried out.

18. All the materials shall be stored by the contractor in a manner affording convenient access for identification and inspection at all times. Storage of material shall be in accordance with IS:4032 (Latest Edition).

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ANNEXURE -1

ACCEPTING AND DEVIATION DISPOSITION AUTHORITIES FOR DIFFERENT CATEGORIES OF CHECKS AS ENVISAGED IN FIELD QUALITY PLAN

Category	**Type of Check**	**100% Checking/ Witnessing by**	**Counter Check/ Surveillance check by**	**Accepting Authority, it Test Results are within permissible limits**	**Deviation Dispositoning Authority.**
'A'	Critical	Executing Deptt. Plus F.Q.A. Representative	F.Q.A Representative	TEPL site office Head	TEPL Site Head required.
'B'	Major	Executing Deptt.	F.Q.A. Representative	TEPL site office Head	TEPL Site Head required.
'C'	Minor	Contractors Representative	Executing Deptt.	TEPL site office Head	TEPL Site Head required.

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ANNEXURE-2

ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR FOUNDATION MATERIALS & CONCRETE.

A. CEMENT

Description of the Test	**33 Grade OPC as per IS:269**	**43 Grade cement as per IS:8112**	**PPC as per IS:1489**	**Low Heat Cement**
i) Fineness (min)	225 m^2/Kg	225 m^2/Kg	300 m^2/Kg	225 m^2/Kg
ii) Compressive Strength (min) 72 ± 1 hours 168 ± 2 hours 672 ± 4 hours	 160 kgf/cm^2 220 kgf/cm^2 -	 23 MPa 33 MPa 43 MPa	 16 Mpa 22 Mpa 33 Mpa	 100 kgf/cm^2 160 kgf/cm^2 350 kgf/cm^2
iii) Initial Setting Time (Min)	30 Minutes	30 Minutes	30 Minutes	30 Minutes
iv) Final Setting Time (Max.)	600 Minutes	600 Minutes	600 Minutes	600 Minutes
v) Soundness (Le chatelier Method)	Max 10 mm expansion	Max 10 mm expansion	Max 10 mm expansion	Max 10 mm expansion
vi) Heat of hydration (Max.)	-	-	-	Max. 65 cal/gm for 7 days cal/gm for 28 days
vii) Chemical Composition	As per IS	As per IS	As per IS	As per IS

B. COARSE AGGREGATE

(i) Sieve Analysis

IS SIEVE Designation	Percentage passing for Graded aggregate of nominal size		Percentage passing for single sized aggregate of nominal size	
	40 mm	20 mm	40 mm	20 mm
63 mm	-	-	100	-
40 mm	95 to 100	100	85-100	100
20 mm	30 to 70	95 to 100	0-20	85-100
10 mm	10 to 35	25 to 55	0-5	0-20
4.75 mm	0 to 5	0 to 10	-	0-5

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(ii)	Flakiness Index	Not to exceed 25%
(iii)	Crushing Value	Not exceed 45%
(vi)	Soundness of aggregate applicable for concrete works subject to froast action	Loss of weight after 5 cycle to exceed 12% when tested with Sodium sulphate and 18% when tested with magnesium sulphate.
(v)	Deleterious material	Not to exceed 5% of the weight of aggregate when tested as per IS:2386 Part-II (1963)

C. FINE AGGREGATE

(i) Sieve Analysis — Shall confirm to Zone II or Zone III.

IS Sieve designation	Percentage Passing for			
	Grading zone-I	Grading zone-II	Grading zone-III	Grading zone-IV
10 mm	100	100	100	100
4.75 mm	90-100	90-100	90-100	95-100
2.35 mm	60-95	75-100	85-100	95-100
1.18 mm	30-70	55 – 90	75 – 100	90- 100
600 Micron	15-34	35-59	60-79	60-100
300 Micron	15-20	8-30	12-40	15-50
150 Micron	0-10	0-10	0-10	0-15

(ii) For guidance of adjusting sound in mix of concrete, the following table may be used.

Moisture Content %	Building % by volume
2	15
3	20
4	25
5	30

(iii) Silt Content Test: Shall not exceed 4% when tested for building work and shall not exceed 10% as per procedure specified CPWD specification when tested.

(iv) Deleterious Materials: Total deleterious material shall not be more than 5% by weight.

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(D) REINFORCEMENT STEEL: As per relevant Indian Standards.

(E) CONCRETE CUBE TEST

For nominal (volumetric) concrete mixes, compressive strength for M20 (1:1½:3 (cement: sand:Coarse aggregate) concrete shall be 265 kg/ cm^2 for 28 days.

(F) ACCEPTANCE CRITERIA BASED ON 28 DAYS COMPRESSIVE STRENGTH FOR NOMINAL MIX CONCRETE.

(a) The average of the strength of three specimen be accepted as the compressive strength of the concrete, provided the strength of any individual cube shall neither be less than 70%, nor higher than 130% of the specified strength.

(b) If the actual average strength of accepted sample exceeds specified strength by more than 30%, the Engineer-in-Charge, if he so desires, may further investigate the matter. However, if the strength of any individual cube exceeds more than 30% of specified strength, it will be restricted to 30% only for computation of strength.

(c) If the actual average strength of accepted sample is equal to or higher than specified strength upto 30%, than strength of the concrete shall be considered in order and the concrete shall be accepted at full rates.

(d) If the actual average strength of accepted sample is less than specified strength but not less than 70% of the specified strength, the concrete may be accepted at reduced rate at the discretion of Engineer-in Charge.

(e) If the actual average strength of accepted sample is less than 70% of specified strength, the Engineer-in-Charge shall reject the defective portion of work represented by sample and nothing shall be paid for the rejected work. Remedial measures necessary to retain the structure shall be taken at the risk and cost of contractor. If, however, the Engineer-in-Charge so desires, he may order addition to tests to be carried out to ascertain if the structure can be retained. Al the charges in connection with these additional tests shall be borne by the Contractor.

(G) ACCEPTANCE CRITERIA FOR DESIGN MIX CONCRETE SHALL BE AS PER IS:456.

(H) SAMPLING PLAN FOR BRICK- WORK

Scale of sampling and permissible number of defectives for visual and dimensional characteristics.

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No of bricks in the lot	For Characteristics specified for individual bricks		For dimensional characteristics for group of 20 bricks. No. of bricks to be selected.
2001-10000	20	1	40
1001-35000	32	2	60
35001-50000	50	3	60

Note : In case the lot contains 2000 or less bricks the sampling shall be as per decision of the Engineer-in-Charge.

ii) Scale of sampling for physical characteristics

Lot size	Sampling size for compressive strength water absorption and efflorescence	Permissible No. of defectives for efflorescence
2001-10000	5	0
10001-35000	10	0
35001-50000	15	1

Note : In case the lot contains 2000 or less bricks, the sampling shall be as per decision of Engineer-in-Charge.

iii) Water absorption Test.
Water absorption after 24 hours immersion shall not exceed more than 22 percent by weight.

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SOIL INVESTIGATION

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1. INTRODUCTION

The specification covers the procedure for soil investigation for foundation work involves carrying out boreholes upto minimum 15 m depth or upto refusal (when N values reaches 100), collecting (disturbed/undisturbed) soil samples, and carrying out different In-Situ and lab tests as per specifications.

2. IN- SITU GEOTECHNICAL WORK EXECUTION TECHNIQUE

2.1. Work Schedule

The program of the works must comply with the site availability.

2.2. Setting Up of The In-Situ Tests

2.2.1. The contractor shall be provided with the location of the in-situ tests. He must set up the tests at site, after locating the position of the boreholes accurately.

2.2.2. If the location, azimuth or inclination of any drill holes or in- situ tests does not conform to the given indication, such holes shall be executed anew at the contractor's expenses.

2.2.3. After completion of the work, the Contractor shall provide a map with the location of in -situ tests "as built".

2.2.4. Contractor should check for the presence of underground services prior to commencing of drilling or trial excavations and will validate and confirm that no underground services are at risk of being damaged or disturbed in any way.

2.2.5. In case specifications given under are insufficient, the test and works shall comply with relevant Indian Standard Specifications, wherever applicable.

2.2.6. Contractor is responsible for supplying the work site in due time with all material required for smooth and timely execution of work.

2.3. Execution of The Bore-Holes

2.3.1. General marks

a) Boreholes of 100 mm to 150 mm internal diameter shall be sunk to the required depth with Shell and auger equipment through sand, silt and clay, but excluding rocks, pebbles or grabbers.
b) The methods and machinery must, in all cases, tend to mark the levels and confirm the nature of the crossed layers.
c) If one of the crossed layers causes landslide or soil instability, the drilling hole is to be protected by any efficient means, provided the subjacent soil is not contaminated. Bentonite slurry can be used in case of cohesionless soils.
d) The drilling machine is to be steered by a chief drilling operator with the help of at least one experienced workman.
e) The method of drilling is the responsibility of the Contractor. This method must permit to collect samples for identification and description of the crossed layers. The Contractor shall propose his method before starting the works.
f) The drilling is to be vertical.
g) During the drilling operation, all incidents are to be recorded, and in particular the losses of water, with estimates of flow and volume, possible caverns, rising of water level, alteration in type and colors of mud, etc.
h) The boreholes shall be cased throughout the depth of boring.

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i) Boreholes shall be cleaned properly before conducting any in-situ test or taking out undisturbed samples.
j) After the tests are conducted, the boreholes shall be filled with sand.

2.3.2. Description of the bore log

a) Levels survey

During the drilling, the levels of separation of the different layers and the upper and lower levels of the possible caverns are to be recorded in relation to the level of topsoil.

The location of the water table is to be determined. The dates and hours corresponding, to the end of the perforation and to the recording of levels as well as the losses of water observed during the drilling are to be noted.

b) Soil Identification

As drilling progresses, the extracted soil shall be carefully preserved to enable its identification.

However the following information must be noted immediately:

- Sampling level,
- Temporary name given to the soil by the driller,
- Colour and odour,
- Soil consistency,
- Recuperation.

2.3.3. Undisturbed Soil Samples from Boreholes

The samples shall be minimum 100 mm dia and 450 mm long. Both the area ratio of the cutting edge as well as all recovery ratio of the cutting edge and the recovery ratio of the sample shall be measured and reported.

In order to reduce wall friction, suitable precautions such as oiling inside and outside the sampling tubes shall be observed. The sampling tube shall have smooth finish.

For highly sensitive soils, piston samples shall be employed. The undisturbed samples shall be tested within a period of two weeks of taking them from the boreholes or trial pit.

After recovery of sample, all exposed faces shall be sealed with wax to prevent moisture loss and the sample shall be properly labeled and transferred to the laboratory immediately.

The undisturbed samples shall be taken at an interval of 2 m or change of stratum whichever occurs earlier.

2.3.4. Disturbed Soil Samples from Boreholes

Disturbed soil samples shall be collected at ever4y half a metre and at every change of strata. Identification labels indicating depth, borehole number and visual soil classification shall be affixed on the container.

2.3.5. Documents to be supplied by the Contractor

At each time, the contractor shall fill in a report giving details on the work executed, describing difficulties and methods used, the description of machinery, the precise depth of each operation, etc.

In addition, two weeks after the completion of boring which is covered by the contract, the Contractor hands over a provisional report in two copies including a drilling log, and in particular:

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- The reference number of the bore-hole
- The location marked on a map to a convenient scale together with the X, Y and Z co-ordinates of the bore-hole
- The point level from which depths are measured
- The diameter of the bore-holes
- The recuperation
- All observations and incidence noted by the operator concerning the boring operation
- The equipment in use and the process for drawing samples
- The levels of water at the start and at the end of each shift
- The date at which the boring starts and ends, together with a graph showing progress and effective preparation speeds
- The depths at each operation
- The reports on special tests or sampling with the numbers of the samples extracted and their position
- The sectional drawing of the bore-hole with references and symbolic representations of the nature of the crossed soils

A global report shall collect all the results and data from the various daily reports, from the dri lling logs, etc. Five copies of this global report shall be submitted two weeks after completion of the in-situ works.

The Contractor shall also submit over a reproducible original of all the maps, drilling maps, etc., which are part of his daily report and of the global report.

3. STANDARD PENETRATION TESTS IN THE BOREHOLES

3.1. Mode of Operation

Standard Penetration Tests shall be carried out during the boring in accordance with IS 2131 (latest). The depth of each test shall be correctly determined. In the event that the penetration resistance "N", determined in a test, is less than 5, the Engineer may require to clean out the borehole and to carry out another test immediately afterwards. Small-disturbed samples removed from the Standard Penetration Test split spoon sampler shall be taken in accordance with IS 2132 (latest). The Standard equipment with split spoon sampler in soil or solid cone in hard soil with 65 kgs hammer shall be used.

Unless otherwise instructed a Standard Penetration Test shall be carried out every 0.5m in the upper soft layers upto 2.0 m depth and at 1.0 m interval in the bottom layers.

3.2. Documents to be Supplied By The Contractor

The information on the Standard Penetration Test to be submitted by the Contractor consists of the following:

- Penetration resistance (Nblows/300 mm) or the Penetration (mm) for 50 blows. The procedure of testing and determination of N value shall be as per IS:2131 (latest).
- Depths (m) between which penetrations resistance is measured.
- Depth of casing and size at time of test.
- Before start of test depth SPT tools sunk under own weight from base of borehole.
- Number of blows for each 75 mm of Penetration including seating blows.
- Type of equipment
- Weight of hammer.
- Height of drop.
- Method of release.
- Use of drilling mud or casing.

Disturbed samples resulting from SPT shall be taken for classification purposes.

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3.3. Document And Report

At the end of the investigation and on completion of all the tests, the contractor shall submit a report consisting of the following documents and recommendations.

3.3.1 All computations leading to the logical conclusion of bearing capacities of soil, safe capacity of piles etc. shall be included in report. If references are drawn from standard test books, such references shall be clearly indicated.

3.3.2 The report shall contain recommendation about: -

a) The safe net bearing capacity of soil for isolated / strip footings and proposed depth of footings, starting from bottom level.
b) Estimated lengths, and capacities of piles of various diameters, if recommended.
c) For design of retaining walls, recommendations shall be made as to the layer of excavated Design parameters like coefficient of earth pressure at rest shall be recommended.

4. STATIC CONE PENETRATION TEST

The equipment used for this test shall conform to the requirement of IS : 4968 (Part III). The capacity of equipment to be used for test shall not be less than 10.0 tonnes capacity. The test shall not be carried out on gravely soil and soil with standard penetration value 'N' greater than 50. Location of tests shall be indicated on the drawing.

4.1. Carrying Out The Test

The procedure shall meet the requirement of IS 968 (Part III). Some of the important points of the procedure given below.

a) CPT machine, equipped with suitable core shall carry out test down to a depth of 15 m or upto refusal whichever is earlier. Test shall be performed according to codal provision IS 968 (part III) / ASTM D 3441-98 (M2 type cone)/ ASTM D 5778-95 (E1 type cone)
b) Each CPT shall be carried out with an anti-friction device, placed above the friction sleeve, in order to penetrate as deep as possible.
c) Use of mechanical cone, with electrical measurement and recording of parameters, is prohibited.
d) If a M2 type cone is used, the cone resistance and lateral skin friction shall be measured at least at each 20 cm depth.
e) If an E1 type cone is implemented, a continuous recording of cone resistance, of the lateral skin friction and of the pore pressure versus depth is required for each test.
f) The level of water table encountered is to be noted for each test.
g) Results of test shall give cone resistance q_c, the total latest friction and the f_c "Friction Ratio" versus depth.
h) The CPT refusal is characterised by a cone-resistance (q_c) value of 60 Mpa, a local skin friction (fc) one of 1 Mpa/ or a total resistance one of 20 tons. The E1 type cone may be equipped with an inclinometer device. The refusal criterion on minimum allowed inclination shall be done or equal to 10^0. CPT cones with refusal valves lower than those quoted above will not be accepted.
i) The cone is pushed through a distance in accordance with the design of the equipment and the need for the sub-strata and the cone resistance noted. The cone and the friction jacket are pushed together subsequently for a distance depending upon, the design of the cone and friction jacket assembly and the combined value of cone and friction resistance noted. This procedure is repeated at predetermined intervals.
j) Equipment shall be securely anchored to the Ground at the test point for obtaining the required reaction.
k) The rod of the Driving mechanism shall be brought to the top most position. The cone –friction jacket assembly shall be connected to the first sounding rod and the mantle tube. The assembly shall be positioned over the test point through the mantle tube guide and held vertically. The plunger of the driving mechanism shall be brought down so as to rest against the protruding sounding rod.

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l) To obtain the cone resistance this sounding rod only shall be pushed. Switching the gear clutch to the slow position, the drive handle shall be operated at a steady rate of 1 cm per sec approximately, so as to advance the cone only to a depth, witch is possible with the cone assembly available. During the pushing, the mean value of resistance as indicated by pressure gauges shall be need ignoring erratic changes.

m) For finding combined cone and friction resistance of the soil, the sounding rod shall pushed to the extent. The cone has been pushed at the rate of 1 cm per sec noting mean resistance on the gauges.

n) Above procedure shall be repeated after pushing the combined cone -friction jacket and mantle tube assembly to the next depth at the next depth at which the test is to be performed.

4.2. Reports

The CONTRACTOR fills in a daily report giving details of the tests carried out, difficulties encountered, depths achieved, resistance values measured etc.

The ENGINEER must have access to these documents at any time.

At the latest one week after the execution of each test, the CONTRACTOR submits to the ENGINEER two copies of a test report including :

- the test number,
- the execution date of the test,
- the location of tests on a map supplied by the engineer or on a sketch in comparison with known and fixed points,
- the ETM co-ordinates X, Y and Z of the test,
- the level of the point from which depths are measured,
- the level of water encountered,
- the characteristics of the equipment in use (type of cone, etc.)
- the test diagram showing the variations of the cone resistance, the local lateral friction and the “friction ratio” versus depth. The results are also supplied in the form of a table detailing the level, the depth, qc, fc and F_R. In addition, the contractor supplies a 3.5” compatible diskette (1.44 Mbytes or more). On this diskette, the results must be presented in three columns : depth, qc, fc and F_R.
- the remarks noted in the daily report;
- the calibration certificate(s) of the cone(s) used.

A global report including all the preliminary test reports shall be provided to the Engineer one week after completion of the work on site. This report must be reproducible and supplied in 5 copies.

5. DYNAMIC CONE PENETRATION TEST

The test shall be conducted by driving a standard size cone attached loosely or screwed to a string of drill rods. The driving system shall comprise of 65 Kg. weight having a free fall of 75 Cm.

5.1. Test Procedure

The method of conducting the test and details of the equipment shall conform to one of the two alternatives given below. The particular method to be followed is indicated under specific requirements.

a) The test shall be conducted in accordance with IS : 4968 (Part I). The cone size shall be 50 mm.

b) The test be conducted in accordance with IS : 4968 (Part II). A continuous flow of bentonite slurry shall be maintained through the rods and the cone so as to avoid friction between the rods and the soil. The cone size shall be 65 mm and provide with vents for flow of bentonite slurry.

The test shall be reported in a suitable tabular form giving blow counts for every 30 cm. Penetration, supplemented by a graphical plot of blow counts versus depth. The test shall be terminated when blow counts (Nc) exceeds 150 for two successive penetration of 30 cms each.

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6. PLATE LOAD TEST

6.1. Plate Size And Thickness

a) For clayey and silty soils and for loose to medium compact sandy soils (N < 15) normally met with, checkered plate of 60 cm x 60 cm shall be used. Alternatively, circular plate of equipment area also may be used.
b) For dense sandy or gravelly soils (15< 30) the smallest size shall be 30 cm square and largest 75cm square. Circular plates of equipment area may also be used.
c) The minimum thickness of the chequered plate shall be 25mm.

6.2. Test Pit

a) Test pit shall be atleast five times as wide as the test plate and the depth of the pit shall be the same as the depth of actual foundations.
b) If the test is to be done on strata water table, the water level shall be maintained at the plate level, if necessary, throughout the test by dewatering, especially in sandy soils.
c) The test shall be conducted immediately after examination of soil.

6.3. Placing Of Test Plate

Plate shall be added to the soil by spreading fine sand in a layer not exceeding 5mm carefully levelled and set horizontally at the bottom of the pit. The ground shall be protected from rain and a minimum sealing pressure of 70g/cm2 shall be applied and removed before starting the load test.

6.4. Method Of Loading

The reaction method of loading shall be employed. In this method loading is done by a jack against suitable reaction, such as, a well designed truss anchored to the ground at the two ends by soil anchors, loaded platform or any other suitable device.

6.5. Application Of Load

a) Loading shall be carried out in increments of 1/5 design load or about 0.3 kg/cm2 whoever is lower.
b) Loading shall be carried out till one of the following conditions occur:

    1) Soil under the plate fails.
    2) Total settlement of the plate exceeds 40mm.
    3) A load intensity equal to thrice the design load is reached.
    4) Load intensity 6.5 kg/cm2 is reached.

6.6. Settlement And Observation

a) Settlement shall be recorded with four dial gauges.
b) Settlement shall be observed for each increment of load after an interval of 1, 4, 9, 16, 25, 36 and 64 minutes and thereafter every one hour.
c) The next load increment shall be applied when the rate of settlement is less than 0.05 mm/hour with a minimum period of two hours. For computing the rate of settlement its extrapolation for periods less than one hour shall not be permitted.

6.7. Unloading

a) Unloading shall be done in stages in the same manner as was done during the application of load. Rebound observations during the unloading also shall be noted.
b) Rebound shall be noted during unloading stages till the readings become reasonably constant.

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6.8. Record

a) Record shall consist of the following:
   1) Load-settlement reading in tabular form.
   2) Time-Settlement curve for each load stage.
   3) Load- Settlement curve for each load stage.
   4) Load- settlement curve in natural and log-log scale.
   5) Modules of sub-grade reaction evaluated from test.

b) In addition to above the record shall also contain the following:
   1) Date
   2) List of personnel
   3) Weather conditions
   4) Irregularity in routine procedure, if any.

6.9. Post Test Requirements

a) Back filling of the pit be carried out in an approved manner and as per the directions of Engineer-in-charge on completion of test.
b) An auger bore shall be made from the depth of test extending to depth of 6.0m below test depth so as to ascertain the nature of sub-soil test depth. If required, undisturbed samples shall be obtained at suitable depths from bore hole.

7. DYNAMIC SOIL TESTS

7.1. General

The following tests shall be conducted for the determination of Elastic Modulus and Dynamic Shear modulus of the soil and their variation with confining pressure for use in the design of foundation subject to vibratory loads.

7.1.1. Wave velocity measurements

7.1.2. Resonance tests

7.1.3. Cyclic plate load test

7.1.4. Repeated triaxial shear test.

7.2. Wave Velocity Measurements

The test set up and method of conducting the tests shall conform to IS: 5249 (latest edition). Concrete block shall be cast at a minimum depth of 0.5 m in a virgin soil. Back filling of the pit shall be carried out in an approved manner and as per the directions of the Engineer-in-Charge after removing the concrete block on completion of the test.

7.3. Resonance Test

The block size and test depth be the same as laid out in 3.4.2 above. The equipment set up and method of conducting the tests shall conform to IS : 5249 (latest edition).

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7.4. Cyclic Plate Load Test

The test set up and plate size small conform to that for plate load tests. After stabilization of settlements for each load increment, load shall be removed and elastic rebound & residual settlements recorded. Where necessary, more than one cycle of loading and unloading shall be applied until a steady state of settlements is reached.

7.5. Repeated Triaxial Shear Test

The test shall be carried out for confining pressure ranging from 0.5 kg/cm^2 to 4.0 kg/cm^2.

The traixial sample shall first be subjected to an initial load equal to the anticipated static working load, which shall be indicated at the time of testing. Positive and negative values of a small increment of load shall then be applied to the sample in cycles and a graph plotted of stress against strain. E-value shall be obtained from this plot after obtaining a stable state.

8. LABORATORY TEST ON SELECTED SOIL SAMPLES

8.1. Storing Of Soil Samples In Laboratory

8.1.1. Soil samples shall be inspected and tested shortly after their arrival at the laboratory.

8.1.2. Bags of canvas and bins can be used for storing large quantities of soil. The container should have a label or tag, which gives such data as soil type, project location, boring number, depth, etc.

8.1.3. If disturbed clay samples are taken from pit, they should be covered with a protective coating. The coating shall preferably be with wax having melting point between 120ºC to 160ºF. Wax coating can be applied by either dipping the soil samples in the melted wax or using a soft brush to spread the melted wax. Wax should not be heated to more than a few degrees above its melting temperature, since heating to higher temperature tend to drive off more volatile hydrocarbons, thus making the wax more permeable and more brittle upon coating.

8.1.4. If soil samples are to be stored for more than 15 days, then a protective coating of wax, in more than one layer, is recommended with a total thickness of 12 mm to 18 mm.

8.1.5. Few selected samples shall be stored in laboratory till the soil investigation report is finalized and approved by the Engineer-In-Charge.

8.2. Handling Of Undisturbed Samples In Laboratory

8.2.1. Undisturbed samples shall be handled in laboratory with due precautions to avoid distu8rbance and loss of moisture content which may adversely affect the test results.

8.2.2. Unprotected samples shall never be handled with bare hands because hands foster disturbance and loss of moisture. Sample shall be protected by using Aluminum cellophone or wax paper.

8.2.3. When transporting a specimen it should be supported over its entire length by using a mould, plate or paper sling(s).

8.3. Procedure Of Testing

8.3.1. All apparatus used for laboratory testing shall conform to the specifications laid down in relevant Indian Standards.

8.3.2. All testing procedures shall conform to relevant Indian Standards.

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8.4. Tests To Be Performed

The following tests shall be performed on the selected soil samples (according to IS 2720) and water samples collected.

- Atterberg Limits: - Liquid limit + plastic limit shall be required for U.D. samples
- Natural Moisture: - shall be required for U.D. samples as per IS:2720, Part II.
- Particle size analysis: Sieve & hydrometer analysis as per IS:1498 on at least one sample from each stratum shall be required. Porosity of soil as well as uniformity coefficient shall be determined.
- Wet & Dry Density: for U.D. samples.
- SP Gravity: For one sample from each stratum.
- Unconfined compression Test: To be conducted at site on about 25% of U.D. Samples as per IS:2720, Part I.
- Triaxial Tests: unconsolidated undrained tests and consolidated drained tests shall be done on UD samples available at Laboratory.
- Consolidation Tests: on U.D. samples taken at least one from each stratum shall be conducted for a range of pressure from 2.7 t/sq.m to 8.6 t/sq.m as per IS:2720, Part XV.
- Chemical Tests: Sulphate & chloride contents of water samples.
- Sulphate, carbonate, chloride and organic matter, content of soil samples.
- Permeability Test :: Coefficient of permeability shall be determined as per IS:2720, Part XVII.
- Soil Resistivity :: Soil resistivity shall be carried out as per IS:3043.
- California Bearing Ratio Test :: This test shall be carried out as per IS:2720, Part XVI. Curve of load-penetration in arithmetic shall be plotted.

8.5. Report

8.5.1. The report shall state in brief the description of test procedure employed.

8.5.2. The report shall also include wherever required a sample calculation with reference to formula used to evaluate various parameters.

8.5.3. Report shall also contain the summary of various soil parameters evaluated.

8.5.4. Report shall indicate character and genesis of soil.

8.5.5. Report shall contain details of borelogs, subsoil sections, lab and field test results in tabular and graphical form and a plot plan showing locations and reduced levels of boreholes and other tests.

8.5.6. Results obtained and their interpretation shall be indicated in the report.

8.5.7. Report shall indicate type, depth, ultimate and safe bearing pressure and settlement of foundation for following structures:

8.5.7.1. Power Plant Equipments, which carry heavy unit load.

8.5.7.2. Admonish building etc. which are lightly loaded.

8.5.7.3. Storage tanks and other structures found at or near ground surface.

8.5.8. Recommendations shall also be given for allowable bearing pressure and settlements for foundations of various sizes and at different depths ranging from surface to 5 m depth.

8.5.9. Report shall indicate aggressiveness of soil and soil water to reinforced concrete and steel and other building materials.

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8.5.10. Report shall indicate suitability of soil and degree of compactness of fill for the pavement and recommendation for thickness of pavement for Class AA and Class A loadings.

8.5.11. Modules of subgrade reaction for pressure ranging upto 3 kg/cm^2 shall be indicated in the report. The recommended values shall include the effect of size, shape and depth of foundation.

8.5.12. In case of poor soil conditions recommendations are to be made for ::

a) Grand treatment method,
b) Pile foundations if considered necessary. If so, type of pile, depth of pile, safe load capacity of pile etc.

8.5.13. Upon completion of tests, the Contractor shall submit two (2) interim and five (5) final copies of the report.

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	GTS – BARRICADES	**Z/02 0067**

BARRICADES

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2. SPECIFICATION 1

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	GTS – BARRICADES	**Z/02 0067**

1. INTRODUCTION

1.1. The document covers specifications for Barricades required for barricading the work to be carried out along the roads in the city having vehicular traffic movement.

2. SPECIFICATION

2.1. Providing and installing the barricades of size 2.5 m x 2.0 m of the design and type as shown in the standard drawing No TECPL-STD-19-077 enclosed herewith.Installation plan of Barricades is to be approved by Owner's Representative. Barricades are to be firmly fixed to the ground and are to be maintained during the progress of work.

2.2. Barricades are to be painted with logo initially and repainting to be done as and when required.

2.3 Wet mopping of Barricades shall be done weekly.

2.4 Ground Space of one-meter width outside barricades shall be cleaned everyday.

2.5 Barricades shall have blinking red light for night getting power through generator or electric connection.

2.6 Dismantling of Barricades from the site and cleaning the site as per directions of Owner's Representative.

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BRICK MASONRY

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1. GENERAL

This specification establishes the materials, dressing, laying, joining, curing, workmanship etc. for brick masonry works. Brick masonry shall also comply with all the requirements of IS specification.

2. REFERENCE

2.1. BIS Codes

IS:2212, 2250.

2.1.1. Sequence

Commencement, scheduling and sequence of works shall be planed in detail and must be specifically approved by the Owner's Representative. However, the contractor shall remain fully responsible for all normal precaution and vigilance to prevent any damage to works whatsoever till handing over.

3. MATERIALS

Cement shall be ordinary Portland Cement (Grade 43) conforming to IS 8112.

Bricks of Class I shall be table moulded / machine made of uniform size, shape and sharp edges and shall have minimum compressive strength of 75 Kg/cm^2.

4. GENERAL REQUIREMENTS

4.1. Mixing Mortar

IS 2250 shall be followed as general guidance for preparation and use of mortar. Only cement – sand mortar shall be used.

Unless otherwise specified mortar for brick work having one or more brick thickness shall be 1 part cement & 6 part sand by volume and for half brick work shall be 1 part cement and 4 part sand by volume.

Mortar shall meet the compressive strength requirement as per IS 2250 and IS 1905. sand shall conform to IS 2116 and grading shall be tested as per IS 2386.

4.1.1. Proportioning

The unit of measurement for cement shall be a bag of cement weighing 50 kgs and this shall be taken as 0.035 cubic metre. Sand shall be measured in boxes of suitable size on the basis of its dry volume. In case of damp sand, its quantity shall be increased suitably to allow for bulkage.

4.2. Mixing

The mixing of mortar shall be done in a mechanical mixer operated manually or by power. The Owner's Representative may, however, permit hand-mixing as a special case, taking into account the magnitude,

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nature and location of work. The Contractor shall take the prior permission of Owner's Representative, in writing, for using hand-mixing before the commencement of work.

4.2.1.1. Mixing in Mechanical Mixer

Cement and sand in specified proportions, by volume, shall be thoroughly mixed dry in a mixer. Water shall then be added gradually and wet mixing continued for atleast one minute. Care shall be taken not to add more water than that which shall bring the mortar to the consistency of stiff paste. Wet mix from the mixer shall be unloaded on water-tight masonry platform, made adjacent to the mixer. Platform shall be atleast 150 mm above the levelled ground to avoid contact of surrounding earth with the mix. Size of the platform shall be such that it shall extend atleast 300 mm all-round the loaded wet mix area. Wet mix, so prepared, shall be utilised within initial setting time [thirty (30) minutes either for ordinary Portland cement conforming to IS:269 after addition of water. Mixer shall be cleaned with water each time before suspending the work.

4.2.1.2. Hand Mixing

The measured quantity of sand shall be levelled on a clean water-tight masonry platform and cement bags emptied on top. The cement and sand shall be thoroughly mixed dry by being turned over and over, backward and forward, several times till the mixture is of uniform colour. The quantity of dry mix which can be consumed within initial setting time of cement shall then be mixed with just sufficient quantity of water to bring the mortar to the consistency of stiff paste.

5. CONSTRUCTION PROCEDURE

5.1. Soaking of Bricks

Bricks shall be soaked in water before use for a period that is sufficient for the water to just penetrate the whole depth of bricks as well as to remove dirt, dust and sand. Proper soaking of bricks shall prevent the suction of water from the wet mortar as otherwise mortar will dry out soon and crumble before attaining any strength. The bricks shall not be too wet at the time of use as they are likely to slip on mortar bed and there will be difficulty in achieving the plumbness of wall as well as proper adhesion of bricks to mortar. The period of soaking shall be determined at site by a field test by immersing the bricks in water for different periods and then breaking the bricks to find the extent of water penetration. The least period that corresponds to complete soaking, will be the one, to be allowed for in the construction work.

The soaked bricks shall be removed from the tank, well in advance, so that at the time of laying, they are only skin dry. The soaked bricks shall be stacked over a clean place, wooden planks or masonry platforms to avoid earth, dirt being smeared on them.

5.2. Laying

5.2.1. Brick Work (one or more brick thickness)

IS:2212 shall be followed as general guidance for construction of brick masonry.

Brick work (one or more brick thickness) shall be laid in English Bond unless otherwise specified. Half or cut bricks shall not be used except when needed to complete the bond. In no case the defective bricks shall be used.

A layer of average thickness of 10 mm of cement mortar shall be spread on full width over a suitable length of lower course of the concrete surface and shall be so laid that all joints are full of mortar. In order to

check and achieve uniformity in masonry, the thickness of bed joints shall be such that four courses and three joints taken consecutively shall measure equal to four times the actual thickness of the brick plus 30

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mm. Each brick with frog upward, shall be properly bedded and set in position by gently tapping with handle of trowel or wooden mallet. Its inside faces shall be buttered with mortar before the next brick is laid and pressed against it. After completion of the course, all vertical joints shall be fully filled from top with mortar.

All brick courses shall be taken up truly plumb; if battered, the batter is to be truly maintained. All courses shall be laid truly horizontal and vertical joints shall be truly vertical. The level and verticality of work in walls shall be checked up at every one metre interval.

The masonry walls of structures shall be carried up progressively, leaving no part one metre lower than the other. If this cannot be adhered to, the brick work shall be raked back according to bond (and not left toothed) as an angle not more than 45 degrees but raking back shall not start within 60 cm of a corner. In all cases, returns, buttresses, counter forts, pillars etc. shall be built up carefully course by course, and properly bonded with the main walls. The brick work shall not be raised more than fourteen (14) courses per day.

At the junction of any two walls, the bricks shall at each alternate course, be carried into each of the respective walls so as to thoroughly unite the work.

The courses at the top of plinth and sills, at the top of the wall just below the soffit of the roof slab or roof beam and at the top of the parapet, shall be laid with bricks on edge unless specified otherwise. Brick on edge course shall be so arranged as to tightly fit under the soffit of the roof beam or roof slab, restricting the mortar layer thickness upto 12 mm, however, any gap between the finished brick work and soffit of roof slab/beam shall be suitably sealed with the mortar. Care shall be taken that the brick forming the top courses aid ends of wells are properly radiated aid keyed into position.

5.2.2. Brick Work (half brick thickness)

For brick walls of half brick thickness, all courses shall be laid in stretcher bond. Wall shall be reinforced with 2 nos. – 6 mm diameter mild steel reinforcement bars, embedded at every third course. These bars shall be securely anchored into the masonry at the ends or shall be keyed into the main brick work as the case may be. Half the mortar thickness for the bedding joint shall be laid first and mild steel reinforcement, one on each face of the wall, shall be embedded, keeping a side cover of 12 mm mortar. Subsequently, the other half of the mortar thickness shall be laid over the reinforcement covering it fully.

The reinforcement bars shall be carried at least 150 mm into the adjoining walls or RCC columns. In case the adjoining wall being of half brick thickness, the length of bars shall be achieved by bending the bars in plan. During casting of reinforced concrete columns, 6 mm dia. M.S. reinforcing bar shall be placed at every fourth course of brick masonry. At the junction of two walls, the brick shall, at each alternate course, be carried into each of the respective walls so as to thoroughly unite the work. The brick masonry work shall not be raised more than 14 courses per day.

Brick course under the soffit of beam or slab, shall be laid by restricting the mortar thickness to 12 mm. However, any gap between the finished brickwork and soffit of slab/beam, shall be suitably sealed with the mortar.

5.2.3. Cavity Walls

Brick work in cavity walls shall be included with general brickwork. It shall consist of one wall of one or more brick thickness while the other wall shall be of half brick thickness at a clear gap of 50 mm. The brick work on with side of cavity shall conform to the specifications already stated under 5.2.1 and 5.2.2. At the base of the cavity wall, the walls shall be solidly constructed upto 300 mm above the ground level. The cavity wall shall be terminated 300 mm below the soffit of roof slab/beam and the courses over this shall be continued in solid brickwork.

Cavity should be continuous and free from obstructions. Mortar droppings shall be prevented from falling down the cavity by the use of laths or by hayhands which shall be drawn up the cavity as the work proceeds. Any mortar which may unavoidably fall on the wall-ties, shall be removed daily and temporary openings shall be provided to permit the daily removal of mortar droppings from the bottom of the cavity.

The outer and inner levels shall be tied by means of wall ties. Ties shall be of mild steel round bars of 8 mm

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dia 200 mm long with hooks at both the ends. These shall be placed not more than 750 mm c/c horizontally and not more than 300 mm vertically, and staggered. Additional ties shall be provided near the openings. There shall at least, be 5 ties per square metre of surface area of the wall. Ties shall be given a bituminous coat before placement, to protect them from corrosion.

In order to keep the cavity dry, air slots shall be provided in the cavity walls at bottom as well as top to the extent of 50 sq. cm area of vents to every 2.0 sq. metre area of the wall.

5.2.4. Circular Brick Work

The specification for brick work covered under 5.2.1 and 5.2.2 shall apply, in so far as these are applicable. Bricks forming skew backs, shall be dressed or cut so as to give proper radial bearing. Defects in dressing of bricks shall not be covered up by extravagant use of mortar, nor shall the use of chips etc. be permitted.

The circular brick work shall be carried up from both ends simultaneously and keyed in the centre. The bricks shall be flushed with mortar and well pressed into their positions so as to squeeze out a part of their mortar and leave the joints thin and compact. All joints shall be full of mortar and thickness of joints shall be between 5 mm and 15 mm.

5.3. Jointing

Joints shall be restricted to a width of 10 mm with brickwork of any classification. All bed joints shall be normal to the pressure upon them i.e. horizontal in vertical walls, radial in circular brick masonry and at right angles to the face in the battered retaining walls. The vertical joints in alternate courses shall come directly one over the other and shall be truly vertical. Care shall be taken that all the joints are full of mortar, well flushed up. In case no pointing is to be done, cement mortar shall be neatly struck as the work proceeds. The joints in faces which are to be plastered or pointed shall be squarely raked out to a depth of 12 mm while the mortar is still green. The rake joints shall be brushed to remove loose particles. After the day's work, the faces of the brick work shall be cleaned on the same day with wire brush and all mortar droppings removed.

5.4. Curing

Green work shall be protected from rain or any other running water or accumulated water from any source, by suitable means. Masonry work, as it progresses, shall be kept thoroughly wet by sprinking water at regular intervals, on all faces. Curing shall be done after 24 hours of completion of day's work and shall be done for atleast 10 days after completion. Proper watering cans with spray nozzles, rubber or PVC pipes shall be used for this purpose. Brick work done during the day shall be suitably marked indicating the date on which the work is done so as to keep a watch on the curing period.

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5.5. Staging/Scaffolding

5.5.1. Staging/scaffolding shall be properly planned and designed by the Contractor. Use of only steel tubes is permitted for staging/scaffolding. Design of staging/scaffolding shall be submitted for approval of the Owner's Representative, before commencement of work.

Single scaffolding having one set of vertical support, shall be used and other end of the horizontal scaffolding member shall rest in a hole provided in the header course. The support shall be sound and strongly clamped with the horizontal pieces over which the scaffolding planks shall be fixed. The holes left in the masonry work for supporting the scaffolding shall be filled and made good with plain cement concrete of grade 1:2:4 and shall be made good before plastering. Suitable access shall be provided to the working platform area. The scaffolding shall be strong enough to withstand all loads likely to come upon it and shall also meet the requirements specified in IS:2750.

Double scaffolding shall be provided for pillars less than one metre in width or for the first class masonry or for a building having more than two storeys.

The following measures shall also be considered during erection of the scaffolding/staging.

a. Sufficient sills or underpinnings, in addition to base plates, shall be provided, particularly, where scaffoldings are erected on soft grounds.

b. Adjustable bases to compensate for uneven ground shall be used.

c. Proper anchoring of the scaffolding/staging at reasonable intervals shall be provided in each direction with the main structure wherever available.

d. Horizontal braces shall be provided to prevent the scaffolding from rocking.

e. Diagonal braces shall be provided continuously from bottom to top between two adjacent rows of uprights.

f. The scaffolding/staging shall be checked at every stage for plumb line.

g. Wherever the scaffolding/staging is found to be out of plumb line, it shall be dismantled and re-erected afresh. Efforts shall not be made to bring it in line with a physical force.

h. All nuts and bolts shall be properly tightened and care shall be taken that all the clamps/couplings are firmly tightened to avoid slippage.

i. Erection work of a scaffolding/staging, under no circumstance shall be left totally to semiskilled or skilled workmen and shall be carried out under the supervision of Contractor's technically qualified civil engineer.

5.5.2. For smaller work or work in remote areas wooden ballies may be permitted for scaffolding/staging by the Owner's Representative at his sole discretion. The Contractor must ensure the safety and suitability of such works as described under Clause 5.5.1 above.

5.6. Embedment of Fixtures

All fixtures, pipes, conduits, holdfasts of doors and windows etc. required to be built in walls, shall be embedded in plain cement concrete block of grade 1:3:6, at the required positions, as the work proceeds.

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CONTROLLED ROCK BLASTING

	GTS - CONTROLLED ROCK BLASTING	Z/02 0028

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	GTS - **CONTROLLED ROCK BLASTING**	**Z/02 0028**

1 SCOPE

L. I This specification covers the minimum requirements for materials, personnel, transportation, storage and

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use of explosives for grading of Right of Use (ROU) and excavation of trenches for the burial of pipeline in rocky terrain.

1.2 This specification does not cover the construction or operation of permanent magazines.

1.3 This specification applies to on-shore pipeline installation.

2 REFERENCE DOCUMENTS

2.1 The following National and International regulations and codes shall be used:

2.2	BS: 5607	Safe use of explosives in the construction industry.
2.3	NFPA-495	Manufacture, Transportation, Storage & Usage of Explosive Materials.

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2.4 National and Local Laws-/ Regulations

2.5 Applicable Safety Rules of Chief Inspector of Explosives, Nagpur

2.6 IS 4081 Safety Code for Blasting and related drilling operations.

3 GENERAL

3.1 The Contractor shall acquaint himself and comply with all the applicable local laws and regulations concerning storing, handling and the use of explosives. All such laws, regulations and rules etc., as enforced from time to time shall be binding upon the Contractor. National/ Local Laws and. Regulation shall take precedence over this specification in the event of conflict. All conflicts shall be brought to be notice of the Owner/ Engineer Representative.

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

3.3 The use of explosives requires an approval from the Chief Inspector of Explosives and/or his authorized Inspector. It shall be the responsibility of the Contractor obtain all such permits and observe all requirements regarding the safe storage, handling and use of explosive. All expenses incurred in this regard shall be to Contractor's account.

3.4 Contractor shall inform the Owner/ Engineer Representative m writing at least four (4) weeks prior to planned use of explosives.

3.5 Contractor shall notify the Owner/ Engineer Representative prior to any blasting in the proximity of overhead power lines, roads, communication lines, pipelines,-utility services or other services and structures above and below ground. Before starting blasting operations local authorities and owners of utilities shall be consulted to check on the presence of services which could be damaged and their approval obtained to undertake blasting operations. The distances to nearest structures (houses, offices, factories) or service shall also be taken into consideration when planning blasts so that ground vibration and air over pressure is kept within acceptable levels as given in the specification.

3.G Contractor shall prepare an Explosives Handling and usage Procedure for the information of the Owner/ Engineer Representative which shall incorporate the following:

Individual procedure and calculations

Nature of blasting operations, including hole diameter, depth and presence of cavities.

Rock characteristics

Type of explosives

Temperature likely to be encountered in use.

3.7 No blasting is allowed within 20 m of any above ground or underground structure or facilities. No blasting is allowed within 200 m of overhead power lines/ cables unless specifically approved by the Authorities having jurisdiction over it.

4 MATERIALS

4.1 All materials such as explosives, detonators, fuses, tamping materials etc. that are proposed to be used by the Contractor in blasting operations, shall be approved by Owner/ Engineer Representative.

4.2 All electric detonators used in the blast shall be of the same electrical sensitivity and be produced/ procured from the same manufacturer.

4.3 The detonators used shall be capable of giving effective blasting of the explosives. Damaged explosive materials shall be destroyed by a responsible person as per manufacturer's instructions or returned to the manufacturer.

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4.4 No explosive material shall be abandoned.

4.5 All blasting materials and testing equipment shall be regularly tested for correct performance. Guidelines/ recommendations of the manufacturer shall be adhered to.

5 PERSONNEL

5.1 Excavation by blasting wi11 be permitted only under personal supervision of competent and licensed persons and by trained workmen.

6 STORAGE OF EXPLOSIVES

6.1 The Contractor shall build a magazine for storing the explosives. The site of the magazine, its capacity and design shall be subject to approval by the Owner/ Engineer Representative and the Inspector of Explosives before the fabrication is taken up. As a rule the explosives should be stored in a clean, dry, well ventilated, bullet-proof and fireproof building, at an isolated site. Adequate security shall be provided to ensure no unauthorized entry into the magazine. A notice shall be hung next to magazine entrance prohibiting entry of unauthorized persons.

6.2 Contractor shall comply with National/ Local Regulations and specifications for truck mounted mobile explosives store. Mobile stores shall only carry ONE DA Y's Explosives requirements and shall be parked overnight inside the compound at the authorised magazine.

6.3 All safety precautions and necessary equipment for maintenance, operation of mobile stores. as required by local authorities or regulatory bodies shall also be installed/ provided on the Mobile Store.

6.4 A careful and day-to-day account of all explosives shall be kept by the Contractor in a register and in a approved manner. The register shall be produced by the Contractor, for the inspection of the Owner/ Engineer Representative/ Inspector of Explosives when so required by the later.

Any loss, damage or theft shall be reported immediately to the necessary local authorities and to the Owner/ Engineer Representative.

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6.5 Themagazine shall on no account be opened during or on the approach of a thunderstorm and no person shal I remain in the vicinity of the magazine during such period.

6.6 Magazine shoes without nails shall, al all times, be kept in the magazine, and a wood-tub or cement trough , filled with water shall be fixed near the door of the magazine.

6.7 Persons entering the magazine must put on the magazine shoes. They should also following instructions:

i. Not to put their feet on the clean floor unless they have magazine shoes on.

11. Not to allow the magazine shoes to touch the ground outside the clean floor.

111. Not to allow any dirt or grit to fall on the clean floor.

6.8 No matches or inflammable material shall be allowed in the magazine. Light shall be obtained from an electric storage battery lamps

6.9 No person having articles of steel or iron on him shal.1 be allowed to enter the magazine. No tools or implements other than those of copper, brass, brass, gun metal or wood shall be allowed inside the magazine.

Only cotton, rags, waste and a1tides liable lo spontaneous ignition shall not be allowed inside the magazine.

6.10 Boxes of explosives shall not be thrown down or dragged along the floor and shall be stacked on wooden trestles. Open boxes of explosives shall never be exposed to the direct rays of the sun. Empty boxes or loose packing materials shall not be kept inside the magazine.

6.11 The magazine shall have a lighting conductor, which shall be got tested at least periodically, by an officer authorized by the Owner/ Engineer Representative, the testing fee shall be to the Contractor's account.

6.12 The magazine• shall be inspected periodically by an officer representing the Owner/ Engineer Representative, who will see that all the rules are strictly complied with. He will notify all omission etc to the Contractor who will rectify the defects within a period of 3 days from the date of receipt of the notice, failing which the Owner/ Engineer Representative may take whatever actions it consider suitable.

7 PREPARATION OF EXPLOSIVES

7.1 Contractor shall submit the following procedure for information of the Owner/ Engineer Representative as a mmunum.

Loading of explosives

Drilling of new holes and extending existing holes

Handling of explosives at site

Tamping explosives into holes

Machines: tools and cables required

Initiation of blasting

Safety of personnel

Vibration control

Blast pattern and shot size establishment

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Misfires

Emergency procedures.

7.2 Trial blasts in conjunction with vibration recording shall be carried out for each rock and trench type, in order to assess rock breakability and vibration levels. These trial blast shall be carried out prior to actual trench blasting of the pipeline route. Contractor shall conduct trial digs as directed by Owner/ Engineer Representative in order to check suitability of the blasting pattern and to measure vibration levels to ensure vibration levels are below.the allowable maximum.

7.3 "Weight per Distance Tables" shall be drawn up from these trials.

7.4 • The detonators shall never be forced into the primer cartridge. It shall be inserted in a hole made by a wooden, copper, brass or aluminium pricker. The detonator shall be firmly embedded in the primer so that it is not pulled out of place during loading.

7.5 Detonators shall be activated electrically. In proximity of electric over head power lines, Contractor may use non-electric system with the approval of Owner/ Engineer Representative. Fly rock shall be minimized by the use of approved blast mats and by careful selection of sot size and drill hole configuration.

7.6 Use of explosives is prohibited in areas exposed to flammable gasses or dust.

7.7 Explosives shall be stored and used chronologically to el}sure that the ones received earlier are being used first.

7.8 A make-up house shall be provided at each working place in which cartridges shall be made up by experienced men as required. The make-up house shall be separated from other buildings. Only electric storage battery lamps sha!I be used in this house.

7.9 No smoking shall be allowed in the make-up house.

8 PREPARATION OF PRIMERS

8.1 The primers shall not be prepared near open flames or fires. The work of preparation of primers shall always be entrusted to the qualified and approved personnel. Primers shall be used as soon as possible after they arc ready.

9 CHARGING OF HOLES

9.1 The work of charging shall not commence before all the drilling work at the site is completed and the Owner/ Engineer Representative has satisfied itself to that effect by actual inspection.

9.2 The lead wires shall be kept away from conductors or sources of stray current, open lamp/flames shall be kept away.

9.3 Only wooden Lamping rods without any kind of metal on them shall be used.

9.4 Only one cartridge shall be inserted at a time and gently inserted to the required depth with the tamping rod. The sand, clay or other tamping material used for filling the hole completely shall not be tamped too hard.

9.5 Blasting shall not take place after sunset or before sunrise unless specific approval is first obtained by Contractor from local authorities and the Owner/ Engineer Representative.

9.6 The site of blasting operations shall be prominently demarcated by red danger flags. The order of fire shall be given only by the supervisor-in-charge of the work and this order shall be given only after giving the

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warning three times. *So* as to enable all the labour, watchmen etc. to reach safe shelter and after having ascertained that nobody is within the danger zone.

9.7 A buegle with a distinctive note shall be used to give the warning signals. The buegle shall not be used for any other purpose. All the labour shall be made acquainted with the sound of the buegle and shall be strictly warned to leave their work immediately at the first warning signal and to take safe shelters, and not to leave the shelters until the all clear signal have been given.

9.8 All the roads and footpaths leading to the blasting area shall be watched.

10 ELECTRICAL FIRING

10.1 Only the Supervisor-in-charge shall keep the key of the firing apparatus and shall keep it always with himself.

10.2 Special apparatus shall be used as source of current for the firing operations. Power lines shall not be tapped for the purpose.

l0.3 The firing cable shall have a proper insulating cover so as to avoid short-circuiting due to contact with water, metallic parts or rock.

l0:4 The use of earth as a return line shall not be permitted.

10.5 The firing cable shall be connected tQ the source of current only after ascertaining that nobody is in the area of blasting.

10.6 Before firing, the circuit shall be checked by a suitable apparatus.

l0.7 After .firing, whether with or without an actual blast, the contact between the firing cable and the source of current shall be cut off before any person is allowed to leave the shelter.

l0.8 During storms, charging with electrical detonators shall be suspended. The charges already placed into the holes shall be blasted as quickly as possible after taking all the safety precautions and giving ne cessary warning signals. If this is not possible, the site shall be abandoned till the storm has passed.

1.1 -VIBRATION RECORDING

I l. I Contractor shall use Company approved vibration recording system capable of measurement in three axes (tri-axial). The device shall have an accuracy of 0.0025 mm and a resonance of 2 Hz.

The device shall measure both frequency and amplitude of vibration.

11.2 All the measurement devices shall be calibrated by an APPROVED certification body.

_J1.3 Particle velocity shall not exceed the following:

11.4 Areas not with 500 m of existing facilities.

50 mm/sec at a surface measured distance of 15 m from trench centreline.

11.5 Areas with existing buried or above ground facilities within 500 m

20 mm/sec. At a surface measured distance from the trench center line towards the nearest existing facilities.

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11.6 The particle velocity levels are provided for the guidance only, Contractor shall be responsible and liable for any injury to life or damage to property/ facilities.

11.7 Air over pressure/ sound levels shall be limited to 100 db in inhabitated areas.

12 MISFIRES

12.1 If it is suspected that part of the blast has failed to fire, or is delayed, sufficient time shall be allowed to lapse before entering the danager zone. When fuse and blasting caps are used, a safe time should be allowed and then the Supervisor alone shall leave the shelter to see the misfire.

12.2 Drilling near the hole that has misfired shall not be permitted until one of the two following operations have been carried out by the Supervisor:

i) The Supervisor should very carefully (when the tamping is of damp clay) extract the tamping with a wooden scraper or jet of water or compressed air (using a pipe of soft material) and withdraw the fuse with the primer and detonator attached. A fresh primer and detonator with fuse shall then be placed in this hole and fired.

ii) The Supervisor shall get one foot of the tamping cleaned off and indicate the direction by placing a stick in the hole. Another hole may then be drilled at least 9" away and parallel to it, this hole should then be charged and fired. The balance of the cartridges and detonators found in the muck shall be removed.

12.3 The Supervisor shall at once report to the office al cases of misfire, the cause of the misfire and the steps taken in connection therewith.

12.4 If a misfire has been found to be due to defective detonator, or explosive, the whole quantity from the box fro·m which the defective articles were taken must be returned to the manufacturer for inspection to ascertain whether the whole box contains defective materials.

12.5 Re-drilling the holes that have misfired either wholly or partly shall not be permitted.

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DEMOLITION AND DISMANTLING

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1. SCOPE

This specification covers the procedure and safety requirements for demolition and dismantling of masonry (Brick & Stone), concrete (Plain/Reinforced), structural steel (sheeted / unsheeted) works.

2. GENERAL

2.1. Apart from this specification, the demolition and dismantling of structures (part or whole) shall be in compliance with all statutory safety regulations and any other special requirement as shown/noted on the drawings. Prior consent and approval of the Owner's Representative shall be obtained in writing before starting any dismantling works. Any restrictions imposed regarding working hours shall also be strictly followed by the Contractor.

2.2. All materials obtained from dismantling/demolition operations shall be the property of the Owner unless otherwise specified and shall be kept in safe custody until handed over to the Owner's Representative.

2.3. Where it becomes necessary to disconnect any existing service line(s) (such as electrical, piping etc.) during dismantling/demolishing operation and where so required by the Owner's Representative, suitable alternate arrangement shall be made by the Contractor to maintain the continuity and proper functioning of the affected service line(s) with the approval of Owner's Representative at no extra cost to the Owner.

3. SAFETY PRECAUTIONS

3.1. The Contractor shall adhere to safe demolishing/dismantling practices at all stages of work to guard against accidents, hazardous and unsafe working procedures.

3.2. Necessary propping, shoring, strutting and/or underpinning shall be done for the safety of all surrounding structures (whose safety is likely to be endangered) before taking up the demolishing and dismantling work.

3.3. Temporary enclosures made out of GI sheets, fencings, danger lights etc. shall be provided by the Contractor and got approved by the Owner's Representative before start of work to prevent accidents.

3.4. Contractor must ensure the availability of adequate fire fighting equipment / arrangements before starting actual demolishing/dismantling works. These facilities shall be made available throughout the entire operation of demolition and dismantling of structures.

3.5. All equipments, pipes, fittings and instruments, underground utilities etc. located in the vicinity shall be protected by suitable means, as decided by the Owner's Representative, during demolishing, dismantling operations.

3.6. Roads and working spaces shall be kept free of any debris/dismantled materials at the end of day's work.

3.7. Necessary measures shall be taken to keep the dust and noise nuisance to minimum levels.

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3.8. Dismantled elements/components shall not be dropped from a height or thrown from a distance. Dismantling of elements fixed by screws/bolts/hooks etc. shall be done by taking out the fixtures with proper tools only. Such fixtures may be allowed to be cut by sawing or flame cutting, in the event of their being struckup due to corrosion etc. however the decision of Owner's Representative in this regard shall be final and binding. Welds shall be removed by flame cutting. Tearing or ripping of elements shall not be resorted to under any condition.

4. PROCEDURE

4.1. Entire work of demolishing and dismantling shall be meticulously planned. Prior to start of work, the Contractor shall thoroughly understand the scope and nature of the work, and then prepare and submit the proposed work execution plan of demolishing and dismantling to the Owner's Representative for his review. Comments, if any, shall be taken care by the Contractor and execution of the work shall be done based on the revised execution plan.

4.2. Demolition and dismantling shall be restricted to the extent shown on drawings and as directed by the Owner's Representative.

4.3. Demolition of any structure shall be carried out in the sequence reverse to that followed at the time of its construction.

4.4. Dismantling shall be done in a systematic manner. All elements shall be carefully removed without causing any damage.

4.5. Blasting in any form shall not be permitted.

4.6. Chipping of concrete/grout shall be done with precision by chiselling. The finished surfaces shall be made true to the requisite size and shape.

4.7. Pockets/holes of specified size shall be made/cut by drilling/chiselling.

5. CLEANING AND STACKING

5.1. All demolished/dismantled serviceable materials such as bricks, stones, reinforcement bars, structural steel, sheeting etc. shall be separated out, cleaned and stacked in separate lots within the plant boundary as directed by the Owner's Representative.

6. DISPOSAL

All unserviceable materials shall be disposed off in spoil heaps within or outside the plant boundary as per the directions of the owner's Representative. Areas required outside the plant boundary for dumping of disposed material shall be arranged by the Contractor and got approved by the Owner's Representative.

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7. PAYMENT

7.1. General

Measurement of all works shall be taken prior to start of demolishing / chipping / dismantling works.

7.2. Masonry/Concrete works (Demolition)

7.2.1. Payment shall be made on the basis of actual volume in cubic metres (cu.m.) of masonry/concrete works demolished. The thickness of plaster/bitumen felt shall be included in measurements.

The rate for demolishing shall include supply of labour, tools & tackles, necessary safety measures, propping, underpinning, scaffolding, handling, cutting, straightening, scraping and cleaning of reinforcement bars and other embedments (in case of reinforced concrete works), sorting out and stacking of all serviceable materials, disposal of all unserviceable material, clearing the site, etc. all complete as specified and directed by the Owner's Representative.

7.3. Excavation & Backfilling

7.3.1. Excavation and backfilling shall be paid separately as per relevant clauses of specification of Earthworks.

7.4. Chipping of Concrete Works

Payment shall be made on the basis of admissible area in square metres (sq.m.) of concrete surfaces chipped, pertaining to the different categories of thicknesses specified in the schedule of items.

The rate for chipping shall include supply of labour, tools and tackles, necessary safety measures, scaffolding, chiselling, handling exposing, cutting, straightening, scraping, clearing the reinforcement bars (in case of reinforced concrete works), wire brushing and washing the exposed surfaces, disposal of all unserviceable material etc. all complete as directed.

7.5. Making Pockets/Holes in Concrete Works

Payment shall be made on the basis of number (Each) of pockets/holes of sizes upto and inclusive of 200x200x500 mm, made or cut in the concrete works.

The rate for making pockets/holes shall include supply of labour, tools & tackles, necessary safety measures, scaffolding, chiselling, drilling, handling, cutting or relocating reinforcement bars, cleaning, disposal of all unserviceable material etc. all complete as directed.

7.6. Dismantling of Structural Steel Works

Payment shall be made on the basis of weight (MT) of the structure/components being dismantled. Assessment of weight shall be done as per the specifications or as per the direction of Owner's Representative.

The rate for dismantling shall include supply of labour, tools and tackles, equipment, consumables, necessary safety measures, scaffolding, propping, handling, unbolting, cutting (by sawing or flame cutting) of gussets/plates/bolts/hooks/welds, cleaning, sorting out and stacking of all serviceable materials, disposal of all unserviceable material, etc. all complete as specified and directed.

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7.7. Dismantling of Roof & Wall Sheeting

Payment shall be made on the basis of dismantled sheeted area in square metres (sq.m.) of plan area in case of roof sheeting and area in elevation in case of side and louver sheeting.

The rate for dismantling shall include supply of labour, tools and tackles, equipments, consumables, necessary safety measures, handling, scaffolding, unbolting, cutting (by saw or flame cutting) of hook bolts, removal of ridges, gutters, flashings, transporting, stacking of all serviceable materials, disposal of all unserviceable material, etc. all complete as directed.

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1. DRAINAGE AND EROSION CONTROL

The control of surface and sub-surface drainage within a pipeline right-of-way is an important aspect of pipeline design. Severe right-of-way erosion, pipeline exposure and slope instability can, in many cases, be avoided with the incorporation of suitable drainage and erosion-control measures. Diversion berms, gabions, ditch plugs/subdrains are generally installed for this purpose.

2. DIVERSION BERMS

2.1. DEFINITION

Diversion berms consist of shallow earth-filled dikes, which are placed at intervals on a slope to collect and direct surface flow-off the right-of-way and away from the pipeline.

The use of diversion berms to control surface water within a pipeline right-of-way has been standard practice in the pipeline industry.

2.2. TYPES OF DIVERSION BERMS

Diversion berms may be constructed in a herringbone or diagonal pattern (refer attached drawing).

Diagonal diversion berms are used in situations where the existing topography and slope drainage suggests a preferred direction of runoff.

Berms constructed in a ***herringbone pattern*** are used in situations where there is no preferred direction of runoff, or where the berms are located across the slope with side cuts on both ends of the right-of-way. This pattern is preferred since it diverts the water away from the ditch and does not concentrate on just one side of the right-of-way.

2.3. DIVERSION BERM SPACING

	Soil Erosion Potential		
Slope ↓	High (Fine sands & silts)	Moderate(Clays & coarse sands)	Low (Gravel & exposed bedrock)
Gentle(<5%)	45 mtr.	50mtr.	Not necessary
Moderate(5-10%)	30 mtr.	45mtr.	50mtr.
Steep(>10%)	305 / %grade (mtr.)	305x1.5%(mtr.)	305x2%(mtr.)

2.4. GENERAL CONSTRUCTION GUIDELINE FOR DIVERSION BERMS

Some general construction guidelines that would help in improving the long-term performance of diversion berms are mentioned below –

- Berms should be constructed with mineral soils, with every effort made to minimise organics being mixed in.

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- The top width and height of berms should be approximately 0.8 mtr.
- Nominal compaction of berm material in lifts will increase its resistance to erosion.
- The downslope gradient of berm should be approximately 5% to limit erosion from surface runoffs.
- The berms should extend across the full width of the right-of-way to prevent the flow of water back onto the right-of-way.
- To a large extent, the spacing of the berms depends on the local topography and drainage. Berm spacing should be reduced as the slope increases.

3. GABIONS

Areas subjected to severe erosion by stream flow or concentrated surface drainage may require a more robust type of erosion protection. If the sloping side of the water crossing & embankments is equal to 45º or more, Gabion wall will be constructed. Procedure for constructing Gabions will be as follows:-

- Fabricate hexagonal mesh of opening size 60 mm x 80 mm made of 3.0 mm dia galvanised steel wires with selvedges finished with 4.0 mm dia galvanised wire.
- Gabion unit of 2.0 m x 1.0 m x 1.0 m size to be fabricated packed inside with solid hard rock boulders graded from 75 mm to 150 mm voids to be overfilled excess upto 40 mm to allow for settlement.
- Mesh must have a overlapping of 150 mm allround.
- Lacing, bracing, lying at corners and placement at site shall be as per detailed approved drawing.
- Staking of Gabions shall be done by using 1.8 m, 32 mm galvanised round bars @ 500 c/c to be driven into the embankment.

If the sloping side of the water crossing embankment is between 10° and 45°, gabions mattresses will be constructed. Procedure for constructing Gabions mattresses will be as follows:

- Fabricate hexagonal mesh of opening of size 60 mm x 80 mm made of 3.0 mm dia galvanised steel wires with all selvedges finished with 4.0 mm dia galvanised wires.
- Gabions mattresses unit i.e. diaphragms of size 2 m x 25 cm thick with length varying from 4.0 m to 6.0 m as per site requirements. In any case, mattresses length will not be more than 60 m. Mattresses shall be filled using solid hard rock boulders (grade from 75 mm to 150 mm) overfilling upto 40 mm will have to be done to allow for settlement.
- Gabions mattresses diaphragms shall be laced, laid and placed at required locations as per detailed approved drawing.

Gabions are used along banks of streams and rivers to prevent toe erosion. Generally gabions are used to adequately protect the bank or diversion berm when available stones are too small for use as riprap. A gravel blanket or filter cloth is typically laid under the gabions to create a flat surface for tying the baskets together and as a filter medium to prevent loss underlying fines.

4. GEOLOG SACK BREAKER

When designing a pipeline in sloping terrain, the potential of surface and sub surface seepage to collect and

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flow within the loose pipe backfill must be recognised. If the seepage is not controlled, it can lead to backfill erosion and pipe exposure. The installation of impervious seepage barriers at intervals along the pipe ditch will effectively block subsurface seepage within the pipe backfill and force it to the surface, where it can be diverted off the right-of-way by a diversion berm.

It has been a common practice in the industry to use sack breakers to control seepage within the pipe ditch. These are of sand-filled jute sacks keyed into the pipe ditch walls and hand-placed in the form of a pyramid.

To ensure that the sack breaker effectively impedes the flow of water down the ditchline, it is essential that the sacks be carefully keyed into the ditch walls and ditch bottom, with the bags placed to interlock with one another. This is necessary to ensure that there are no short-circuit seepage paths through the sack breaker.

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EXCAVATION, BACKFILLING, COMPACTION

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1. GENERAL

1.1. Scope

This SPECIFICATION covers the excavation and backfilling of pits and trenches for the foundations of structures and the compacting of the backfill material.

It also covers the excavating and backfilling of trenches for drainage pipes, utilities pipes, ducts and cables and the excavating and backfilling of pits for manholes and alike.
The following definitions shall apply :

AGREEMENT	Designates the agreement concluded between the OWNER and the CONTRACTOR, under which the latter undertakes to the former the GOODS and/or SERVICES according to the stipulations which are agreed and specified in the form of an order.
OWNER	Designates the purchaser of the GOODS and/or SERVICES which are the subject of the AGREEMENT.
CODE	Designates a set of systems and Indian rules or international standardization documents for design, materials, tests, etc.
CONTRACTOR	Designates the individual or legal entity with whom the order has been concluded by the OWNER. The term "CONTRACTOR" may be used indifferently for a supplier, a manufacturer, an erection CONTRACTOR, etc.
DAYS - WEEKS - MONTHS	Specify the number of calendar days, weeks or months and not of working days, weeks or months.
OWNER'S REPRESENTATIVE	Designates the individual or legal entity to which the OWNER has entrusted various tasks in relation with the carrying out of his PROJECT.
GOODS and/or SERVICES	Designate, depending on the case, all or part of the drawings or documents, substances, materials, materiel, equipment, structures, plant, tools, machinery,... to be studied, designed, manufactured, supplied, erected, built, assembled, adapted, arranged or put into service by the CONTRACTOR under the AGREEMENT, including all the studies, tasks, works and services specified by the order. The terms GOODS or SERVICES may be indifferently used one for the other as required by the context.
PROJECT	Designates the aggregate of GOODS and/or SERVICES to be provided by one or more CONTRACTORS.
STANDARD	Designates a set of models or references, corresponding to common practice and generally used by the OWNER'S REPRESENTATIVE. This can be : typical standard drawings or documents.
SPECIFICATION	Designates a document describing in some details general or particular requirements for specific type of works.

1.2. References

The standards referred to in this section are as follows :

[As per Indian Labour Laws]

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1.3. Submittals

1.3.1. Construction and method drawings

The CONTRACTOR shall submit the following drawings and details :

a) the results of the survey specified in paragraph 3.1.

b) construction drawings, method diagrams and plant details for each major excavation in close proximity to an existing structure showing in full detail, with appropriate supporting calculations, the CONTRACTOR'S proposals for carrying out the excavation, for shoring the sides of the excavation, for shoring and underpinning the existing structure if necessary, for controlling and recording all movements which could affect the structure, for compacting the backfill material and, if necessary, for dewatering the excavation or lowering the level of the groundwater in the vicinity of the excavation to enable the whole of the work to be executed in the dry and the stability and condition of the adjoining structure to be preserved.

1.4. Site Conditions

1.4.1. Existing conditions

The attention of the CONTRACTOR is drawn to the fact that, at certain locations, excavation for the foundations of structures will have to be carried out in close proximity to existing structures and to the requirements of this SPECIFICATION in this respect.

2. MATERIALS

2.1. Backfill Material

Only suitable material as defined below and approved by the OWNER'S REPRESENTATIVE shall be used for backfilling.

Suitable material shall comprise all materials which are acceptable in accordance with the Contract for use in the Works and which are capable of being compacted in the manner and to the specified density.

Unsuitable material shall mean other than suitable material and, unless instructed otherwise by the OWNER'S REPRESENTATIVE, it shall include :

i. material from swamps, marshes or bogs and soil containing more than 10% organic matter;

ii. peat, logs, stumps and perishable material;

iii. clay of liquid limit exceeding 70 and/or plasticity index exceeding 45;

iv. soils containing soluble salts other than calcium sulphate in quantities exceeding the relevant percentages by weight given in the following table :

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pH value of soil	Total soluble salts excluding $Ca SO_4$	Sulphates $Na SO_4$ + $Mg SO_4$	Chlorides
over 6	as e)	-	-
5 - 6	0,5 %	-	-
under 5	0,5 %	0,05 %	0,45 %

v. salty of gypsiferous soils containing more than 10 % soluble salts.

3. EXECUTION

3.1. Preparation

Before any major excavation work is undertaken, the CONTRACTOR shall carry out an adequate survey of all existing structures in close proximity which could be affected by the intended work. The survey shall include the establishment of the following data regarding each structure:

a) type of construction, structural condition and any defects;

b) limits and levels of foundations;

c) type and quality of foundation;

d) extent of vaults, tunnels and similar underground structures;

e) locations of utilities in the vicinity.

The CONTRACTOR shall provide all shoring and underpinning of existing structures, required to ensure their stability and safety during the excavation work. Shoring and underpinning shall comply with the requirements of :

[As per Indian Labour Laws]

Before starting the excavation of trenches etc. and if the presence of existing underground utilities is known or suspected, the CONTRACTOR shall establish the exact location of these by means of carefully excavated trial pits, using hand methods in the immediate vicinity of the pipe, duct or cable, and shall carry out such diversion or protection of these as is shown on the drawings or directed by the OWNER'S REPRESENTATIVE.

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3.2. Excavation, Backfilling And Compacting Of Foundation Pits And Trenches

3.2.1. Excavation of foundation Pits and Trenches

Depth and dimensions of footings

Pits and trenches for foundations of structures and buildings shall be excavated to the levels and dimensions shown on the drawings or to such other levels and dimensions as directed by the OWNER'S REPRESENTATIVE. The OWNER'S REPRESENTATIVE may require from the CONTRACTOR to excavate below the foundation levels shown on the drawings or he may order him to stop when suitable foundation material is encountered.

Bottom of the excavation

The bottom of all excavation shall be carefully graded and if required by the OWNER'S REPRESENTATIVE stepped or benched horizontally.

All excavations shall be taken out as nearly as possible to the exact dimensions of the foundations to minimise backfilling.

In excavations for foundations of structures and buildings a bottom layer of soil shall be left in place temporarily and subsequently removed only when the concrete is about to be placed, in order to avoid, as far as possible, softening or deterioration of the surface of the bottom of the excavations by exposure.

The thickness of the layer will depend on the type of soil and will be determined by the OWNER'S REPRESENTATIVE. Any pockets of soft material in the bottom of pits and trenches shall be removed as directed and the cavities so formed filled with concrete Grade M15. Where, after grading of the bottom, any volumes of material become puddled, softened or loosened, the disturbed or damaged material shall be removed as directed and the cavities so formed filled with concrete Grade M15, at the CONTRACTOR'S expense.

After the completion of placing of any blinding concrete required by the Contract, no trimming of the side faces shall be carried out for 24 hours.

When any excavation has been taken out and trimmed to the levels and dimensions shown on the drawings or directed by the OWNER'S REPRESENTATIVE, the OWNER'S REPRESENTATIVE shall be informed accordingly so that he may inspect the completed pit or trench.

Excavated materials

Excavated materials from excavations which are suitable and required for backfilling shall be stockp iled clear of the excavation works. The stockpiles shall be shaped and graded to permit proper drainage.

Excavated materials from excavations which are suitable but superfluous to the needs for backfilling shall be utilised by the CONTRACTOR where suitable filling material is required elsewhere in the Works or, if superfluous to all the requirements for backfilling or filling, it shall be removed from the site by the CONTRACTOR.

If the CONTRACTOR allows material which, on excavation is suitable for re-use, to become unsuitable and it is in this condition when required for backfilling or filling, he shall make good by running in to spoil and replacing with other suitable material, or when directed by the OWNER'S REPRESENTATIVE, the moisture content of the material shall be adjusted before deposition, to facilitate the compaction in a way as specified by this SPECIFICATION.

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Excavated materials from excavations which are unsuitable for use as backfilling shall be run to spoil off the Project Site, selected by and at the CONTRACTOR expense or to a dumping place as directed by the OWNER (as defined by the agreement constituent documents).

Excavation greater than necessary

Excavation to a depth greater than specified shall be corrected by the CONTRACTOR at his own expense by concrete Grade M15.

Excavation to a width greater than specified shall be corrected by the CONTRACTOR at his own expense and to the satisfaction of the OWNER'S REPRESENTATIVE by completely filling the excess volume of excavation against the completed foundation either with concrete Grade M12/15 or if agreed by the OWNER'S REPRESENTATIVE with approved material compacted in a way as specified in paragraph 3.2.5 of this SPECIFICATION.

Shoring to excavations

The sides of all excavations shall be shored adequately at all times to the satisfaction of the OWNER'S REPRESENTATIVE.

The submission by the CONTRACTOR of the details of his proposals for such work and the OWNER'S REPRESENTATIVE'S agreement thereto, shall not relieve the CONTRACTOR of any responsibility for the safety of the work.

Timber or other shoring materials shall be removed as the work proceeds unless otherwise directed or permitted by the OWNER'S REPRESENTATIVE. The OWNER'S REPRESENTATIVE may direct shoring materials other than timber to be left behind in trenches or other excavations.

In placing, altering or removing shoring to the sides of excavations, care shall be taken to avoid pressure being brought to bear on the permanent work before it is capable of withstanding such pressure.

3.2.2. Excavation of Trenches

Excavation of trenches

Excavation for pipes, ducts and cables shall be carried out in trenches and shall be conform to the lines and levels shown on the drawings or to any specified gentle curve in plan. Except where any greater width is shown on the drawings all trenches shall be excavated to such a width as will give adequate room in the trench for the proper support of the trench, and shall be excavated to a sufficient depth and width to enable the pipe, duct or cable and any specified or agreed joint, bedding, haunching and surround to be accommodated.

Trenches for sub-soil drains and land drains shall be of the minimum width capable of accommodating the pipes in order to ensure good alignment of the pipes as laid and shall be excavated to uniform gradients in straight lines or specified gentle curves.

Trenches for French drains having pipes up to 150 mm in diameter shall be excavated to a width of at least four times the nominal diameter of the pipes; for pipes over 150 mm in diameter the width shall be the diameter plus 450 mm.

The excavation of trenches at or near the toes of cutting or embankment slopes shall be carried out in such a manner that there is no excavation into the slope for working space.

Where a trench is adjacent to an existing or a new structure or building, and the bottom of the trench is lower than the foundation of the structure or building, the pipe or duct shall be bedded and surrounded in

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concrete Grade C12/15 and the trench shall be filled in with concrete up to the level of the top of the foundation.

When constructing new structures and buildings and laying adjacent pipes or ducts the item, requiring the deepest excavation, shall be executed first.

Bottom of the trench

Before any pipes, ducts or cables are laid or concrete or other bed placed in the trench, the base of the excavation shall be trimmed true in cross-section and gradient and rammed by hand solid to afford a firm and uniform bearing throughout the entire length of the trench. Where, after trimming of the base of the excavation, any volumes of material become puddled, softened or loosened, the disturbed or damaged material shall be excavated to such additional depth as may be required by the OWNER'S REPRESENTATIVE, to the full width of the trench, and be replaced up to the proper level with sand, gravel or pipe bedding material properly compacted or with concrete of the same grade as the bed, as the OWNER'S REPRESENTATIVE may direct, at the CONTRACTOR'S expense.

Where a firm foundation is not encountered, due to soft, spongy or other unsuitable material, all such unsuitable material under the pipe, duct or cable shall be removed over the full width of the trench and the space shall be backfilled with sand, gravel or pipe bedding material properly compacted or with concrete of the same grade as the bed, to provide adequate support for the pipe, duct or cable.

Excavated materials

Excavated materials from trench excavations which are suitable for the purpose shall be set aside for use as backfill.

Excavated materials from excavations which are unsuitable for use as backfilling shall be run to spoil off the Project Site, selected by and at the CONTRACTOR expense or to a dumping place as directed by the OWNER (as defined by the agreement constituent documents).

Excavation greater than specified

Excavations taken out to a greater depth than specified shall be filled in to the required level with compacted suitable material or with the specified pipe bedding material properly compacted.

Where pipes or ducts are to be bedded on a concrete bed, any such additional excavation shall be filled in to the required level with concrete of the same grade.

Where pipes or ducts are to be bedded on, haunched or surrounded with concrete, any additional lateral excavation beyond the specified overall dimensions of the concrete bed, haunch or surround shall, except where such additional lateral excavation is shown on the drawings, be filled in to the level of the top of the specified concrete with concrete of the same grade. No payment will be allowed for any of the filling in of additional excavation specified in this paragraph.

Supporting of sides of trenches

The sides of the trenches shall be supported adequately at all times by means of walling, struts and runners or sheet piling of sufficient numbers and dimensions to prevent the falling in, movement or slipping of the ground, injury to workmen and damage to the Works or adjacent property.

3.2.3. Excavation around existing structures

Should the results of the survey specified above, indicate that an existing structure would be affected by the intended excavation work, the CONTRACTOR shall design and employ a temporary support system for

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the excavation, of sufficient strength to preserve the stability of the structure, and of sufficient rigidity to prevent any movement of the soil which could cause significant damage to the structure. The CONTRACTOR shall include in his design calculations for temporary support systems a reliable estimate of the expected settlement of each existing structure affected.

In all cases where for any reason (e.g. due to the close proximity of the excavation to an existing structure, the conditions of the soil, changes in ground water level due to de-watering, etc.) the displacement of any part of a temporary support system of an excavation could cause movement or settlement of an existing structure, the CONTRACTOR shall provide and monitor adequate reference marks and instrumentation for controlling and recording all movements which could affect the structure.

Should the movement of any part of a temporary support system of an excavation or of any existing structure exceed the amount of movement or settlement estimated for that particular stage of the excavation work, the work shall be discontinued and the OWNER'S REPRESENTATIVE shall be notified immediately. In such cases the CONTRACTOR shall carry out to the approval of the OWNER'S REPRESENTATIVE all measures necessary to prevent further movement or settlement.

The methods used for constructing temporary support systems and for excavating in close proximity of an existing structure shall be compatible with the condition and use of the concerned structure. No equipment shall be used which could cause damage to the structure, for example due to static loading, vibration or shock waves.

Equipment used close to occupied building shall be of a type which causes the least disturbance to the occupants in respect of noise, vibration, shock waves, dust and mud.

Where necessary, walkways, building entrances and façades shall be protected adequately from damage or soiling from debris, dust or alike.

3.2.4. Excavations to be kept free from water

The CONTRACTOR shall keep all excavations quite free from water, whether affected by floods, storms or otherwise, so that the works may be constructed in dry conditions. He shall construct, as may be required by the OWNER'S REPRESENTATIVE, grips or channels or sub-drains at levels lower than the bottom of the permanent works to convey the water to sumps which he shall construct in positions convenient for the disposal of the liquid drained thereto. The grips, channels, sub-drains and sumps shall, where possible, be constructed clear of the permanent works and shall be filled as the permanent work proceeds to the satisfaction of, and as may be ordered by, the OWNER'S REPRESENTATIVE.

The sub-drains shall be formed with pipes of adequate diameter. Trenches shall be excavated to the minimum width capable of accommodating the pipes, their inverts shall be graded to outfall and approval clay tile pipes shall be laid open-jointed in the trenches which shall then be backfilled carefully with granular filter material. The grading of the filter material used in the sub-drain shall, where necessary, be such that the ground below foundation level is in no way weakened by the washing out of any of its finer particles. Where sub-drains are located directly below any part of the permanent concrete works, the trenches shall, immediately before the construction of the permanent work is started, be covered with approved waterproof sheets which shall lap both sides of such trenches by at least 150 mm.

The CONTRACTOR shall also provide, fix, maintain and work such engines, pumps, hoses, chutes and other appliances as are necessary to keep the sub-soil or accumulated water at a level 300 mm lower than the bottom of the permanent works (or at a lower level as the OWNER'S REPRESENTATIVE may direct) for such periods as the OWNER'S REPRESENTATIVE shall direct. After raising the water herein referred to, the CONTRACTOR shall immediately convey it away from the Works. When practical the water shall be discharged into the permanent outfall for the pipe drainage system.

Foundation pits and trenches shall be kept free from water during the time that excavation is being carried out and until, according to the OWNER'S REPRESENTATIVE, any concrete therein is sufficiently set and all constructional works therein can suffer no damage from flooding, hydrostatic pressure, flotation or other cause. They shall be kept free from water during the period that backfilling is being carried out.

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Precautions shall be taken to prevent piping uplift of the bottom of excavations either by the use of cut-off walling or sheeting by lowering the water table or by other means and all such precautions shall, prior to adoption, be subject to the approval of the OWNER'S REPRESENTATIVE.

The CONTRACTOR shall take care to avoid undermining any part of the Works or other properties by pumping, but should the undermining or other damage occur due to prolonged or excessive pumping he shall immediately make good this at his own expense, to the satisfaction of the OWNER'S REPRESENTATIVE.

3.2.5. Backfilling and compacting of foundation pits and trenches

Backfilling of Foundation Pits and Trenches

Backfilling of foundation pits and trenches shall be carried out as soon as the foundations and structural works therein have acquired adequate strength as specified by the OWNER'S REPRESENTATIVE.

The timing and rate of placing backfill material around or upon any completed or partially completed structure shall be arranged in such a way that no part of the work is over-stressed, weakened, damaged or endangered. In particular the placing of backfill material against walls designed to be restrained by structural elements, located above or below finished ground level, shall not be started until such structural elements have been installed and, if made of concrete, have attained their full specified strength and have had their temporary supports removed.

Backfill material shall be placed in layers of uniform thickness and shall be brought up uniformly on all sides of the foundation or structure being backfilled. Each layer shall be so placed as to maintain adequate drainage and to prevent accumulation of water.

Timber sheeting and other excavation supports shall be removed carefull y as the filling proceeds except as otherwise specified or ordered, but the removal of such supports will not relieve the CONTRACTOR of his responsibility for the stability of the works. No timber supporting member shall be left behind in pits or trenches. Care shall be taken to maintain the integrity of the sides of the excavation and to fill all spaces left by the withdrawn supporting members.

Compacting of Backfill Material

The backfill material shall be compacted in layers not exceeding 150 mm in depth when compacted, to a dry density not less than that obtaining in the adjacent undisturbed soil and not less than 95 % of the maximum dry density. Cohesive materials shall be compacted at a moisture content within 2 % of the optimum moisture content on the wet side.

Full compaction shall be achieved throughout every layer, up to the edges of the pits or trenches and up to the faces of the foundations or structural works therein.

- Unless other compacting equipment is required or agreed on, compaction shall be carried out by power rammers, vibrating plate compactors or lightweight vibratory rollers.
- Power rammers are machines which are actuated by explosions in an internal combustion cylinder, each explosion being controlled manually by the operator.

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- Vibrating plate compactors are machines having a base plate to which is attached a source of vibration consisting of one or two eccentrically-weighted shafts. Vibrating-plate compactors shall be operated at the frequency of vibration recommended by the manufacturer and shall normally be operated at travelling speeds of less than 15 m per minute.

- Vibratory rollers are self propelled or towed rollers having means of applying mechanical vibration to one or more rolls. Vibratory rollers shall be operated with their vibration mechanism operating only at the frequency of vibration recommended by the manufacturer.

- All such rollers shall be equipped with a device which indicates automatically the frequency at which the mechanism is operating.

- Compacting equipment or methods which transmit excessive pressure to foundations or structural works in the pits or trenches shall not be used.

3.2.6. Backfilling and compacting of trenches

Backfilling of Trenches

Backfill material shall be approved by the OWNER'S REPRESENTATIVE and shall be free from stones or lumps exceeding 40 mm in largest dimension, vegetable matter and other unsatisfactory material.

If the CONTRACTOR allows material which, on excavation is suitable for re-use, to become unsuitable and it is in this condition when required for backfilling, he shall make good by running it to spoil and replacing with other suitable material, or when directed by the OWNER'S REPRESENTATIVE, the moisture content of the material shall be adjusted before deposition in the trench, to facilitate compaction in the manner specified in this paragraph.

Backfilling shall wherever practical be undertaken immediately after the preceding specified operations have been completed, and the works have been inspected and approved by the OWNER'S REPRESENTATIVE, so as to reduce the lengths of trenches open at any one time.

When concrete beds, haunches or surrounds have been placed, compaction by mechanical means shall not be started until at least four days have elapsed from the time of placing of the last concrete.

Where no haunch or surround of concrete or surround of pipe bedding material is specified, backfill material shall be brought up equally on both sides of the pipe or duct, first to the level of the centre of the pipeline and then to a height of 300 mm above the top of the pipe barrel or duct. The backfill material shall be placed in layers, each of them not exceeding 150 mm in loose depth and each of them compacted carefully and thoroughly for the full width of the trench with hand tools not driven by an engine. During the placing of backfill material below the level of the top of the pipe barrel or duct, the backfill material shall be placed in layers on alternate sides of the pipe or duct so that at no time the difference in level between the top surfaces of the compacted material on either side of the pipe or duct shall be greater than 150 mm.

Where a surround of concrete or surround of pipe bedding material is specified, backfill material placed above the surround up to a height of 300 mm (or a greater height as may be shown on the drawings) above the top of the pipe barrel or duct shall be placed in layers, each of them not exceeding 150 mm in loose depth and each of them compacted carefully and thoroughly for the full width of the trench with hand tools not driven by an engine.

Where, in wide trenches, backfilling is necessary at the sides of a haunch or surround of concrete or a surround of pipe bedding material as well as above them, the backfill material placed at the sides of, and above, the haunch or surround up to a height of 300 mm (or a greater height as may be shown on the drawings) above the top of the pipe barrel or duct shall be placed in layers each of them not exceeding 150mm in loose depth and each of them compacted carefully and thoroughly for the full width of the trench with hand tools not driven by an engine. During the placing of backfill material below the level of the top of the

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pipe barrel or duct (where the pipe or duct is haunched) or below the level of the top of the surround the backfill material shall be placed in layers on alternate sides of the pipe, duct or surround so that at no time the difference in level between the top surfaces of the compacted material on eit her side of the pipe, duct or surround shall be greater than 150 mm.

In no case, the backfill material shall be thrown directly on to exposed pipes or ducts.

Care shall be taken not to disturb the pipes, ducts, haunch or surround during the placing and compacting of the backfill material.

The backfill material placed above the upper level of material compacted by hand specified in the preceding paragraphs shall be deposited in layers each of them not exceeding 150 mm in depth when compacted and each of them compacted in a way as specified in this paragraph.

Timber sheeting and other excavation supports shall be removed carefully as the filling proceeds except as otherwise specified or ordered, but the removal of such supports will not relieve the CONTRACTOR of his responsibility for the stability of the works. No timber supporting members shall be left behind in trenches. Care shall be taken to keep the sides of the trench solid and to fill all spaces left by the withdrawn supporting members.

Regardless of the method of compaction, no traffic or heavy loads shall be allowed over the backfilled surface until the four days for setting of the last concrete have elapsed.

Compacting of Backfill Material

The backfill material shall be compacted in accordance with the requirements of paragraph 3.2.5 of this SPECIFICATION.

3.3. Field Quality Control

Tests of compacted backfill material will be made as often as the OWNER'S REPRESENTATIVE shall deem necessary to ensure compliance with the requirements of this SPECIFICATION.

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FALSE CEILING, FALSE FLOORING, UNDERDECK INSULATION AND PARTITIONING

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1. FALSE CEILING GRID SYSTEMS

1.1. Galvanised Steel Grid System

Galvanised Steel grid system shall be erected for the purpose of supporting Mineral fibre false ceiling tiles.

1.1.1. Material

a. Main Runner

Main runner shall be of hot dipped galvanised steel and 'T' shaped of 24 mm x 38 mm size and 0.33 mm thickness with double rotary stitching.

b. Cross Runner

Cross runner shall be of hot dipped galvanised steel and 'T' shaped of 24 mm x 30 mm size, 0.25 mm thickness, 1200 mm long and 24 mm x 25 mm size, 0.25 mm thickness, 600 mm long with double rotary stitching.

c. Perimeter Section

Material shall be same as runners. Sections shall be 22 mm x 22 mm size of 0.45 mm thickness. Exposed areas of all the metallic members shall be powder coated (25 micron).

1.1.2. Erection

Main Runners shall be placed at the spacing of maximum 1200 mm c/c. Cross runners shall be fixed @ maximum 600 mm c/c to obtain a grid of 600 mm x 600 mm.

The grid shall be suspended by means of 4 mm dia MS wire, 6 mm thick MS cleat of 25 mm x 25 mm section, dash fasteners and level adjustors.

The overall grid system shall be rigid by self locking joints, in accordance with false ceiling patterns, perfectly levelled and aligned at desirable height as per drawings.

1.2. Aluminium Grid System

Aluminium grid system for supporting false ceiling tiles shall be of approved make and shall be perfectly levelled, aligned at desired height and in accordance with the false ceiling pattern as per drawings.

1.2.1. Material

a) Main Runner

Main runner shall be of extruded anodised (25 micron) aluminium Tee Sections of 25 mm x 35 mm size (approved make), 2.5 mm thick

b) Cross Runner

Cross runner shall be of extruded anodised (25 micron) aluminium Tee Sections of 25 mm x 25 mm size (approved make), 2.5 mm thick.

c) Perimeter Section

Material shall be of extruded anodised (25 micron) aluminium angle Sections of required size.

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1.2.2. Erection

The grid system shall be assembled by interlocking the main and cross runners @ 600 mm maximum bothways by mans of Aluminium angle cleats. The main runners shall be suspended from the ceiling by means of 3 mm thick MS flat clamp fixed to main runner @ 1200 mm maximum and fixed to 6 mm dia MS hook which again is fixed to the ceiling. 3 mm thick MS flat clamp shall be connected to main runner with 25 mm long MS clamp with levelling nut and @ 1200 mm maximum. The MS hooks shall be suspended from the ceiling by means of slotting in 25 mm x 25 mm hooks shall be suspended from the ceiling by means of slotting in 25 mm and 25 mm x 3 mm thick MS angle, fixed to the stab by 12 mm dia Dash fasteners @ 1200 mm c/c.

The overall grid system shall be rigid, in accordance with false ceiling pattern, perfectly levelled and aligned at desirable height.

1.3. GI Grid System

1.3.1. Material and Workmanship

a) Wall Channels

Wall channels shall be made of 0.5 mm thick GI of size 27 mm, one flange 20 mm and the other 30 mm. Wall channels shall be fixed to peripheral walls by rawl plugs/dash fasteners @ 450 mm c/c.

b) Intermediate Channels (main runners)

GI intermediate channels shall be 0.9 mm thick, of size 45 mm and with two flanges of 15 mm each. The intermediate channels shall be suspended from the ceiling @ 1200 mm with 25 mm x 0.5 mm GI hanger bolted to the channel and fixed to the ceiling (by means of bolting to GI cleat fixed to the ceiling with dash fasteners).

c) Ceiling Sections (Cross runners)

GI channel shaped ceiling sections shall be 0.5 mm thick having a knurled Web of 51.1 mm and two flanges of 26 mm each with lips of 10.5 mm. The ceiling sections shall be fixed to the intermediate channels in perpendicular direction at 450 mm C/C with the help of connecting clips.

GI grid system for supporting false ceiling tiles shall be perfectly levelled, aligned at desired height in accordance with false ceiling pattern.

2. FALSE CEILING TILES

The tiles shall be placed in position over the supporting grid system by means of hold down clips at four corners of each tiles and one in Centre of each side. The finished false ceiling shall be perfectly levelled and aligned, at desired height as per drawings.

Necessary Electrical and Ac and other fixtures shall be provided as per drawing and in coordination with relevant construction activities.

2.1. Mineral Fibre Tiles

Mineral fibre false ceiling tiles shall be with durable tegular edging having NRC value of minimum 0.50, Light reflectance value of minimum 80%, K value of 0.052 to 0.057 w/m deg. C and fire performance conforming to class I as per BS:476. The tiles shall be of 600 mm x 600 m x 15 mm size. The tiles shall have fissured or granulated texture on the front side as specified. Back side shall be provided with protective coating.

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2.2. Particle Board Tiles

Particle board tiles shall be made of teakwood particle board conforming to IS:3087 (3 layer flat pressed particle board bonded with BWP type phenol formaldehyde Synthetic resin as per IS:848, categorised as Class-I for 'Surface of very low flame spread' as per IS:1642, treated with antifungus chemicals).

The tiles shall either be painted or laminated as specified. Lamination shall be 0.5 mm thick and of approved quality, shade and texture fixed by hot press method and shall conform to BS:476, Part -7. The tiles shall be painted at the bottom surface (facing the floor) with two coats of approve d colour acrylic emulsion paint (of approved make) after sanding off the surface with 120 grit sand paper and applying particle board primer. The other surfaces shall be painted with 2 coats of linseed oil varnish.

Tile sizes shall be 600 mm x 600 mm x 12 mm and all four edges of the tiles shall be painted with a coat of approved quality primer.

2.3. Gypsum Board Tiles

Gypsum board shall conform to IS:2095. The Gypsum boards used for false ceiling shall have following properties.

a. Thermal Conductivity - 0.16 W/mk

b. Thermal Resistance

- For 9.5 mm thick board - 0.06 Sq. MK/W
- For 12.5 mm thick board - 0.08 Sq. MK/W
- For 15 mm thick board - 0.09 Sq. MK/W

c. Fire Propagation

- Fire Propagation

Index of performance - Not exceeding 12 and a sub index not exceeding

- Surface spread of flame - Class 1 (both sides) as per test to BS:476, Part-7)

Gypsum boards shall be of specified thickness, and of specified finish (painted with Plastic Emulsion Paint / Laminated with 0.5 mm thick lamination). The Gypsum board shall be screw fixed to the under side of false ceiling grid system with 12.5 mm dia dry wall screw @ 230 mm C/C by drilling machine, Joints in the board shall be finished flush with fillers, finisher and primer as per manufacturer's recommendation to give a seamless finish.

These boards shall be of make Armstrong / Nittobo / Libsom or equivalent with necessary provision for electric fixtures, A.C. Ducts, Smoke Detectors etc.

3. UNDERDECK INSULATION

3.1. Material

Underdeck insulation shall be of phenolic foam rigid slab of 25 mm thickness and approximately 1000 mm x 500 mm size as specified and shall conform to IS:13204. It shall have density of 32 kg / M^3 and K Value 0.016 Kcal/hr M°C as per BS:4370, Part-2. The insulation shall be classified as 'Non Combustible' as per BS:476, Part-5 and 'Class 1' for surface spread of flame as per BS:476, Part-7. It shall be prelaminated on both sides with kraft paper.

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3.2. Workmanship

The entire soffit of slab and beams shall be thoroughly cleaned. Bituminous primer or zinc chromate primer shall be applied evenly @ 0.5 kg/m^2 over the entire surface. Hot bitumen or CPRX adhesive shall then be applied on the insulation panel @ 1.5 kg/Sq.M. The panels shall be pressed in position and further secured by dash fasteners.

The under deck insulation shall be fixed only after all fixtures like hooks, clamps, cleats etc. for light fixtures, ducts etc. have been fixed in the ceiling.

4. CAVITY (FALSE FLOORING (WITH METAL TRAY)

4.1. Material

4.1.1. Pedestal Base Plate

Pedestal base plate shall be made of galvanised Mild steel and shall be of 100 mm x 100 mm size and 3 mm thick. It shall have stiffening folds as per drawing.

4.1.2. Pedestal Stud

Pedestal stud of 19 mm I.D. and 3 mm thickness shall be made of galvanised mild steel seamless pipe.

4.1.3. Top-Head Attachments

Top head attachments shall be made of pressure die cast aluminium alloy disc of 2.5 mm thickness, having channel shaped projects in al 4 directions and 4 pin heads on top as per drawing to receive panels. A fully threaded bright red of 19 mm I.D. shall be fitted to underside of top head and inserted into base pipe stud.

4.1.4. Channel Stringers

Channel stringers shall be galvanised, machine cut, cold rolled mild steel channels of size 18.5 mm x 18.5 mm and 2.5 mm thickness.

4.1.5. MDF Board Floor Panels

Floor panels shall be of dense, homogeneous, medium density fibre boards manufactured from agro based lignocellulosic fibres conforming to IS:848, BWP type and categorised as Class-1 for 'Surfaces of very low flame spread' as per IS:1642. It shall be of 18 mm thickness and of size 610 mm x 610p mm in general.

The floor panels shall be fixed with screws onto MS bottom tray of 1.2 mm thickness die formed to shape as per drawing.

The floor panels shall be finished on top with antistatic type PVC tiles or laminate as specified and along four sides with hard PVC lipping as per drawing.

4.2. Workmanship

False flooring pattern shall be as per approved drawing. Pedestal base plates shall be fixed to the base floor by dash fasteners as per the grid.

The pedestal stud locations shall ensure the grid work as per flooring pattern which in general shall be of 610 mm x 610 mm dimension. The length of the pedestal studs shall be such that clear cavity between false flooring and base flooring is of desired depth.

The threaded bright rod with the top head attachments shall be inserted into the studs and shall be adjusted to obtain proper level of the finished floor panels by means of the adjustment nuts.

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Stringer channels then shall be fitted onto the top heads in position to form the supporting grid work for the floor panels checking the level once again by adjusting the nut position if necessary. Now the check nut shall be finally tightened to secure the final level. Floor panels as specified shall be placed over the stringer channels and top head disc in such a manner that the holes in MS tray fit into the pin heads on discs.

Each floor panel shall be marked with positional numbering on the underneath. The finished floor panels shall be perfectly levelled, aligned without any gaps in between the panels.

Each individual panel shall be removable for the purpose of maintenance of the cavity.

Necessary cut-outs shall be made in the panels for cable routing, control panel fixation etc. as per drawing. Necessary ramps, slopes, steps etc. shall be also provided for as per drawing.

Around a control panel/rack, the residual space left out shall be filled up with cut panels of uniform size as required to fully close the gap between the adjacent full panel and the control panel base channel. In this case the part floor panel shall extend upto the full width of the base channel and the cut size shall be determined accordingly. An additional row of jack pedestals shall be provided along the cut out on which the edge of the floor panel shall rest and over which the base channel of control panel shall be placed. It shall not directly rest on the jack head pedestal or grid channels.

The cavity between false flooring and base floor shall be properly cleaned and made dust free. The floor shall be finally coated with polyurethane based coating. The finished false flooring shall be able to serve for a distributed load of 1250 kg/Sq.M.

5. CAVITY (FALSE FLOORING (WITH PARTICLE BOARD)

5.1. Material

5.1.1. Pedestal Base Plate

Pedestal base plate shall be made of galvanised Mild steel and shall be of 100 mm x 100 mm size and 8 mm thick.

5.1.2. Pedestal Stud

Pedestal stud of 30 mm dia shall be made of galvanised mild steel seamless pipe. The stud shall have threadings at top and bottom for attaching the top head attachment and fixing to base plate.

5.1.3. Top-Head Attachments

Top head attachments shall be made of pressure die cast aluminium alloy of shape and thickness as per drawing. The top head attachment shall be provided with check nuts at bottom portion for attaching the top head threadings in the stud allowing for adjustment upto 25 mm up and down.

5.1.4. Channel Stringers

Channel stringers shall be galvanised, machine cut, cold rolled mild steel channels of size 40 mm x 40 mm and 3.15 mm thickness.

5.1.5. Particle Board Floor Panels

Floor panels shall be of unveneered, 3 layer flat pressed, teakwood particle board conforming to IS:3087 bonded with BWP type phenol formaldehyde synthetic resin conforming to IS:848 and categorised as Class-1 for 'Surfaces of very low flame spread' as per IS:1642. It shall be of 35 mm thickness and of size 610 mm x 610 mm in general.

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The floor panels shall be finished on the underneath side with 0.05 mm thick Aluminium foil turned up and extended by minimum 12 mm along the perimeter.

The floor panels shall be finished on top with antistatic type PVC tiles or high pressure laminate as specified and along four sides with hard PVC lipping as per drawing.

12 mm x 12 mm x 75 mm long, 2 mm thick Aluminium channel cleats shall be provided on middle of four sides of the panels for lateral stability.

5.2. Workmanship

False flooring pattern shall be as pr approved drawing. Pedestal base plates shall be fixed to the base floor by 6 mm dia, 40 mm long dash fasteners as per the grid.

The pedestal stud locations shall ensure the grid work as per flooring pattern which in general shall be of 610 mm x 610 mm dimension. The length of the pedestal studs shall be such that clear cavity between false flooring and base flooring is of desired depth.

The top head attachments shall be inserted into the studs and shall be adjusted to obtain proper level of the finished floor panels by means of the adjustment nuts.

Stringer channels then shall be fitted onto the top heads in position to form the supporting grid work for the floor panels checking the level once again by adjusting the nut position if necessary. Now the check nut shall be finally tightened to secure the final level. Floor panels as specified shall be placed over the stringer channels.

Each floor panel shall be marked with positional numbering on the underneath. The finished floor panels shall be perfectly levelled, aligned without any gaps in between the panels.

Each individual panel shall be removable for the purpose of maintenance of the cavity.

Necessary cut-outs shall be made in the panels for cable routing, control panel fixation etc. as per drawing.

Necessary ramps, slopes, steps etc. shall be also provided for as per drawing. Around a control panel/rack, the residual space left out shall be filled up with cut panels of uniform size channel. In this case the part floor panel shall extend upto the full width of the base channel and the cut size shall be determined accordingly. An additional row of jack pedestals shall be provided along the cut out on which the edge of the floor panel shall rest and over which the base channel of control panel shall be placed. It shall not directly rest on the jack head pedestal or grid channels.

The cavity between false flooring and base floor shall be properly cleaned and made dust free. The floor shall be finally coated with polyurethane based coating. The finished false flooring shall be able to serve for a distributed load of 1250 kg/Sq.M.

6. PARTITIONING AND PANELLING

6.1. MS Frame

MS frame for Partitioning and Panelling shall consist of horizontal and vertical members of 18 SWG 52 mm x 38 mm MS sections. The members shall be welded to each other at maximum 600 mm c/c both ways. The frame shall be fixed to the floor/ceiling/wall with GI roullete plug, screw and washers and 300 mm maximum c/c. The members shall be provided with one coat of red oxide zinc chromate primer.

The frame-work arrangement shall be in accordance with the pattern for partition including doors/windows etc.

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6.2. Gypsum Board for Partitioning and Panelling

Gypsum boards for partitioning and panelling shall be 12.5 mm thick and same as specified in clause no. 2.3.

Number of Gypsum board layers (single skin or double skin) shall be as specified and with finishing (painting or lamination) as specified.

Frame work along the edges shall be concealed with partition/panel boards. Necessary cutouts for electrical, AC, return air etc. and other fixtures shall be provided in the boards. Glazing if any shall be fixed with putty and wooden beadings.

6.3. Laminated Particle Board for Partitioning and Panelling

Particle board for partitioning/panelling shall be 12 mm thick and shall be same as in clause no. 2.2.

Number of Particle board layers (single sin or double skin) shall be as specified and with finishing (painting or lamination) as specified.

Frame work along the edges shall be concealed with partition/panel boards. Necessary cutouts for electrical, Ac, return air etc. and other fixtures shall be provided in the boards. Glazing if any shall be fixed with putty and wooden beadings.

7. MEASUREMENT AND RATES

For item rate tenders, False ceiling/flooring, Insulation, Partition, Panelling shall be measured in Sq.M. correct upto two places of decimal. Dimensions shall be measured correct upto 0.01M.

No deduction shall be done for cut outs for fixtures, cables, etc. upto 0.18 Sq. M. in area. No extra shall be paid for providing such cutouts.

Rate for item rate tenders shall include all materials, labour, transport, conveyance, erection, storage, other incidental expenditures involved in carrying out the items.

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FLOOR FINISHING

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1.0 GENERAL

Reference shall be made to the following Indian Standards for any further information etc. not covered in the specification. In case of any conflict/contradiction, provision of this specification shall override.

IS:4971 Recommendations for selection of Industrial floor finishes.

IS:2114 Code of practice for laying in situ terrazzo floor finish.

IS:1237 Specification for Cement concrete flooring tiles.

IS:777 Specification for glazed earthenware wall tiles.

IS:2571 Code of practice for laying in situ cement concrete flooring.

IS:4631 Code of practice for laying of epoxy resin floor toppings.

IS:3462 Code of practice for unbaked flexible PVC flooring.

IS:5318 Code of practice for laying of flexible PVC sheet and tile flooring.

IS:3461 Specification for PVC asbestos floor tiles.

IS:1443 Code of practice for laying in situ granolithic concrete floor topping. IS:5491

Code of practice for laying in situ granolithic concrete floor topping. IS:4441 Code

of practice for use of silicate type Chemical resistance mortarts. IS:4443 Code of

practice for use of resin type chemical resistant mortar.

IS:1196 Code of practice for laying Bitumen Mastic flooring.

2.0 CEMENT CONCRETE FLOORING

2.1. Workmanship

2.1.1. Sub-base

The sub-base which shall be laid on the prepared bed shall be of specified thickness and as per structural drawings and specifications.

The sub-base shall be of boulders/gravel/broken bricks/sand/cement concrete as per drawings. In case of upper floors, the structural RCC slab shall be treated as sub-base.

2.1.2. Base Course

Base course shall be 25 mm thick M-15 grade concrete and shall generally conform to Civil structural specification.

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The floor space on which base course is to be laid shall be divided into square/rectangular or as per designed panels to prevent cracks in the floor finish. No dimensions of the panels shall exceed 2M and length of the panel shall not exceed 1.5 times its breadth. Base course shall be laid on alternate panels. The borders of the panels shall have mitred joints at the corners of the room and intermediate joints shall be in straight line with panel joints.

The panels shall be bound by glass/PVC/stainless steel strips etc. as specified. These shall be fixed in position with their top at proper level, giving slope wherever required.

The flooring shall butt against masonry of wall which shall not be plastered. When the base course is to be laid on hardened base, the sub-base shall be roughened by steel wire brushing and cleaned. Before laying the base course, neat cement slurry @ 2.75 kg of cement per Sq. M. of area shall be brushed into the prepared sub base surface.

Cement concrete shall be placed in position and beaten with trowel and finished smooth. Beating shall cease as soon as surface is found covered with cream of mortar. Necessary slope shall be provided.

2.1.3. Floor Finishing

Finishing of the surface shall follow immediately after the completion of base course. The base course shall be free of excessive moisture before starting the floor finishing. Use of dry cement, cement sand mixture sprinkled on the surface to stiffen the concrete or absorb excessive moisture shall not be permitted.

While the concrete is still green, cement @ 2.75 kg per Sq.M. of floor area shall be mixed with water to form a thick slurry and spread over the surface. It shall be pressed twice by means of iron floats, once when the slurry is applied and second time when the cement starts setting.

The junction of floor with wall plaster, cladding, skirting shall be rounded off uniformly upto a radius of 25 mm unless otherwise mentioned.

2.1.4. Curing

Each finished portion of floor, on completion shall be kept wet with ponding for a minimum period of 7 days.

3.0 CEMENT CONCRETE GRANOLITHIC FLOORING

3.1. General

Cement concrete granolithic flooring shall consist of a sub-base, a base course and finishing layer of floor finish. Workmanship shall in general be same as for cement concrete flooring, unless otherwise mentioned.

3.2. Workmanship

Workmanship shall in general conform to IS:5491.

3.2.1. Sub-base

The sub-base which shall be laid on the prepared bed shall be of specified thickness and as per structural drawings and specifications.

The sub-base shall be of boulders/gravel/broken bricks/sand/cement concrete as per drawings. In case of upper floors, the structural RCC slab shall be treated as sub-base.

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3.2.2. Base Course (Under Layer)

Base course shall be M-15 grade concrete and shall generally conform to Civil Structural Specification.

The floor space on which base course is to be laid shall be divided into square/ rectangular or as per designed panels to prevent cracks in the floor finish. No dimension of the panels shall exceed 2M and length of the panel shall not exceed 1.5 times its breadth. Base course shall be laid on alternate panels. The borders of the panels shall have mitred joints at the corners of the room and intermediate joints shall be in straight line with panel joints.

The panels shall be bound by glass/PVC/stainless steel strips etc. as specified. These shall be fixed in position with their top at proper level, giving slope wherever required.

The flooring shall butt against masonry of wall which shall not be plastered.

When the base course is to be laid on hardened base, the sub-base shall be roughened by steel wire brushing and cleaned. Before laying the base course, neat cement slurry @ 2.75 kg of cement per Sq.M. of area shall be brushed into the prepared sub base surface.

Cement concrete shall be placed in position and beaten with trowel and finished smooth. Beating shall cease as soon as surface is found covered with cream of mortar. Necessary slope shall be provided.

Thickness of base course shall be as follows for different thickness of floorings:

- 40 mm thick flooring = 25 mm thick
- 50 mm thick flooring = 35 mm thick

3.2.3. Wearing Top Layer

The tope layer shall be laid over first layer within 15 minutes of laying the first layer. The cement and aggregates for the top layer shall be mixed dry. After mixing, sufficient quantity of washed sand and water shall be added to make the mix plastic but not flowing. The top and bottom layer shall firmly grip together.

3.2.4. Floor Finishing

Finishing of the surface shall follow immediately after the completion of base course. The base course shall be free of excessive moisture before starting the floor finishing. Use of dry cement, cement sand mixture sprinkled on the surface to stiffen the concrete or absorb excessive moisture shall not be permitted.

While the concrete is still green, cement @ 2.75 kg per Sq.M. of floor area shall be mixed with water to form a thick slurry and spread over the surface. It shall be pressed twice by means of iron floats, once when the slurry is applied and second time when the cement starts settings.

The junction of floor with wall plaster, cladding, skirting shall be rounded off uniformly upto a radius of 25 mm unless otherwise mentioned.

3.2.5. Curing

Each finished portion of floor, on completion shall be kept wet with ponding for a minimum period of 7 days.

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4.0 HEAVY DUTY FLOORING

4.1. General

Heavy duty flooring shall consist of a sub-base, a base course and a finishing layer of floor finish.

4.2. Workmanship

4.2.1. Sub-base

The sub-base which shall be laid on the prepared bed shall be of specified thickness and as per structural drawings and specifications.

The sub-base shall be of boulders/gravel/broken bricks/sand/cement concrete as per drawings. In case of upper floors, the structural RCC slab shall be treated as sub-base.

4.2.2. Base Course

Base course shall consist of one layer of 35 mm thick cement concrete (1 cement : 1.5 Coarse sand : 3.5 stone aggregates of 10 mm to 6 mm size by volume) laid on sub-base in panels in accordance with clause no. 2.2.2.

4.2.3. Floor Finish

Finishing layer shall be of cement, hardener and stone aggregate mix of 15 mm thickness laid over the base course. Unless otherwise mentioned, one part of approved quality hardener and four parts of cement by weight shall be mixed dry. They dry mixture shall be mixed with stone grit of 6 mm and down size in the ratio of 1 hardener and cement mixture : 2 stone grit by volume. Just enough water shall then be added to the mix.

The mixture so obtained shall then be laid on the base course within 2 to 4 hours of latter's laying. It shall be firmly pressed into bottom concrete so as to have a good bond with it. After the starting of initial setting, the surface shall be finished smooth and true with steel floats.

5.0 PRECAST HYDRAULICALLY PRESSED CEMENT TILES

5.1. Materials

5.1.1. Cement Concrete Tiles

Cement concrete tiles shall conform to IS:1237 and shall be of approved shade, with 10 mm down size stone aggregates and using a 1:6 or as directed mixture of white and ordinary cement and shall be of 20 mm thickness and approved shade.

5.1.2. Piagments

Pigments to be admixed with mortar or for grouting the joints shall conform to Table-1 of IS:2114.

5.1.3. Cement Mortar

Cement mortar shall be in accordance with civil structural specification and following schedule.

- For flooring : 20 mm thick, cement mortar (1 cement : 4 coarse sand by volume)
- For skirting/dado/riser : 12 mm thick, cement mortar (1 cement : 3 coarse sand by volume).

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5.2. Workmanship

Workmanship shall in general conform to IS:1443. The base The base on which tiles are to be laid shall be cleaned of all dust, dirt and properly wetted by applying neat cement slurry @ 2.75 kg. Of cement per Sq.M. of area without allowing water pools. Cement mortar of specified thickness shall then be spread over the base for two rows of tiles and 3-5 metres in length. The mortar shall be laid in slope as per requirements and thickness of mortar shall not be less than 10 mm at any place. The top of the mortar shall be kept rough so that cement slurry can be absorbed. Laying shall be from centre and proceed outwards in two directions at 90o. Cut tiles of uniform sizes shall be laid along periphery, if necessary. Neat cement slurry @ 2.75 kg. Of cement per Sq.M. shall be spread over the mortar bed for laying 20 tiles at a time. The tile shall then be fixed in this grout one after the other, each tile being gently tapped and properly bedded in line and level. The Joints shall not exceed 1.5 mm in width. After the day's work, the excess cement slurry on top and the joints shall be cleaned with broom stick and washed before the slurry sets hard. Next day, the joints shall be filled with the cement grout to match the shade of the tile.

Tiles along the periphery shall be continued by average 12 mm under the wall plaster, skirting or dado.

For skirting/dado/risers on the brick masonry wall, the joints shall be raked out to a depth of at least 15 mm while the masonry is being laid. In case of concrete work, the surface shall be hauled and roughened with wire brushes. The wall surface shall be uniformly and evenly covered with backing of cement mortar 1:3 (1 cement : 3 coarse sand by volume) of specified thickness. Before hardening of the cushioning mortar, back of each tile shall be covered with a neat layer of cement slurry @ 4.4 kg of cement per Sq.M. and edges with white cement with or without pigment to match the shade of tiles and the tiles then shall be pressed on the backing and tapped.

The tiles shall be corrected to proper planes with joints truly vertical in required pattern and butt jointed. The fixing shall be done from bottom upward. The top of skirting and dado shall be truly horizontal.

5.3. Curing

The flooring shall be cured for 7 days by keeping it wet with ponding. Heavy traffic on the flooring shall be permitted only after 14 days.

5.4. Grinding and Poloshing

Grinding shall be commenced after 14 days when the tiles and the joints are properly set. Grinding shall be done by machines except for skirting and small areas. First grinding shall be done with carborundum stones of 48 to 60 grade grit fitted in the machine. Water shall be properly used during grinding. When the chips show up and the floor has been uniformly rubbed, it shall be cleaned with water baring al pin holes. It shall then be covered with a thin coat of grey/white cement mixed with pigments to match with colour of the flooring. This grout shall be kept moist for a week. Thereafter the second grinding shall be started with carborundum stone of 120 grit. Grinding and curing shall follow again. Final grinding shall be with carborundum of grade 220 to 350 grit using water in abundance. The floor shall be washed clean with water, oxalic acid powder shall then be dusted at 35 gms./sq.m. on the surface rubbed with machine fitted hessian bobs or rubbed hard with woollen rags. The floor shal then be washed clean and dried with a soft cloth or linen. If any tile is disturbed or damaged, it shall be refitted or replaced and properly jointed and polished.

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6.0 CEMENT PLASTER SKIRTING

6.1. Material

Cement plaster skirting shall be laid with cement mortar (1 cement : 3 coarse sand by volume) as per clause no. 5.1.3 and shall be of specified thickness (6 mm / 12 mm / 18 mm) as per item description.

6.2. Workmanship

The surface on which the skirting is to be applied shall be prepared and skirting of specified thickness shall be laid. The junction between flooring and wall shall be rounded off to a radius of 25 mm if not otherwise mentioned.

While the mortar is still green, cement @ 2.75 kg per square metre shall be mixed with water to form a thick slurry and applied over the mortar. It shall be pressed twice by means of iron floats, once when the slurry is applied and second time when the cement starts setting.

7.0 CAST IN-SITU TERRAZZO FINISH

7.1. Materials

7.1.1. Base Course (Under Layer)

Base Course for Cast-in-Situ terrazzo flooring shall be 25 mm thick cement concrete (1 cement : 2 coarse sand : 4 stone aggregate, 10 mm nominal size by volume).

In case of vertical surfaces, the base course shall be 13 mm thick cement mortar (1 cement : 3 coarse sand by volume).

7.1.2. Aggregates for terrazzo topping

The aggregate to be used in topping shall be marble chips of plain White/Pink Makrana/ Baroda green etc. all grade-1 as specified which shall be of 10 mm nominal size. Marble powder to be used to terrazzo topping shall pass through IS Sieve Terrazzo. Marble chips shall be hard, sound, dense and homogenous in texture with crystalline and coarse grains. It shall be uniform in colour and free from stains, cracks, decay and weathering. All proportions of materials used should be as directed by the Owner's Representative / as specified.

7.1.3. Pigments

Pigments to be used in terrazzo shall be permanent colour and shall conform to IS:2114, Table-1.

7.2. Workmanship

Workmanship shall in general conform to IS:2114. Terrazzo flooring shall be of specified thickness and shall be laid in two layers and in panels. Under layer or base course shall be of cement concrete laid over sub base and top layer shall be of terrazzo floor finish. Details of panels shall as per drawing. The thickness of Terrazzo finish shall be 15 mm.

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Top layer shall consist of mix of white cement, marble powder, marble chips, water and pigments. Cement and marble powder mix proportion shall be 3:1 by weight. Cement, marble powder mix shall be mixed with marble chips in the proportion of 4:7 by volume. Quality and shade of chips and powder shall be as specified with a view to avoid variation in colour. Sufficent quantity of white cement shall be added in the cement mix to obtain the desired shade. Mixing shall be done in a trough or tub and complete quantities of white cement and pigment for a particular unit of job shall be dry mixed with aggregates. Water shall be added in small quantities to this dry mix to get a proper consistency. The mix shall be plastic but not so wet as to flow. The mix shall be used within 30 minutes of its preparation.

The base course/under layer shall be divided in panels with dividing strips (glass/PVC/ stainless steel strips) upto the finished surface levels in accordance with clause no. 2.2.2. The sub-base shall be cleaned of all dust, dirt or any loose material. It shall then be wetted with water, mopped and smeared with neat cement slurry.

Terrazzo topping shall be laid while the under layer is still plastic but has hardened enough which is normally achieved between 18-24 hours after laying the under layer. A cement slurry @ 2.75 kg of cement per Sq.M. of area pigmented with the same colour as the topping be brushed on the surface immediately before laying the topping. The terrazzo mix shall be laid to a uniform thickness and be compacted thoroughly by tamping or rolling and trowelled and brought true to required level by a straight edge and steel floats so that the maximum amount of marble chips come up and spreaded uniformly over the surface and no part of the surface is left without the chips.

7.3. Curing

The surface shall be left dry for air curing for a period of 12-18 hours. Thereafter water shall be allowed to stand overnight in pools for a period of minimum four days.

7.4. Grinding and Finishing

Grinding and polishing shall be done with machines and shall start after 7 days of laying. First grinding shall be done with carborundum stone of 60 grit size. The surface shall then be washed clean and grouted with a grout of cement and/or colouring matter in same mix and proportion as the topping in order to fill any pin holes that appear. It shall then be allowed to dry for 24 hours and wet cured in the same manner as in clause no. 5.3. The second grinding shall be done with carborundum stone of 80 grit size. The surface shall then be prepared as after first grinding.

The third grinding shall be done with carborundum stone of 120 to 150 grit size. The surface shall then be prepared again as after first grinding.

The fourth grinding shall be done with carborundum stone of 320 to 400 grit size. The surface shall then be washed clean and rubbed hard with felt and slightly moistened oxalic acid powder @ 35 gms. Per square metre of floor surface. After the finishing works are over, the surface shall be washed with dilute oxalic add solution and dried. Floor polishing machine fitted with felt on hessain bobs shall then be run over it until the floor shines.

In case of polishing, was polish shall be applied on the surface with the help of soft linen over a clean and dry surface. Then the polishing machine fitted with bobs shall be run over it. Clean saw dust shall be spread over the floor surface and polishing machine again operated to remove excess wax.

Cast-in-Site Terrazzo in skirting, dado and risers shall be of specified thickness and of same shade as that of the flooring.

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Underlayer for terrazzo on vertical surfaces shall be of stiff cement mortar 1:3 (1 cement : 3 coarse sand by volume) finished rough so as to give a good bond to the topping. Terrazzo topping shall be average 12 mm thick and under layer shall be 13 mm thick. Terrazzo topping shall be laid on the under layer in accordance with clause no. 7.2. Other details shall be same as for flooring excepting grinding which shall be manual and panels dividers are required.

8.0 PRECAST HYDRAULICALLY PRESSED TERRAZZO TILES

8.1. Materials

8.1.1. Terrazzo Tiles

Terrazzo tiles shall be of specified thickness and shade and shall generally conform in al respects to IS:1237. The tiles shall be made with 10 mm down size stone aggregates, white and ordinary cement mix (1 white cement : 6 ordinary cement by volume) and pigments conforming to IS:2114, Table-1.

8.1.2. Pigments

Pigments to be admixed with mortar or for grouting the joints shall conform to Table-1 of IS:2114.

8.1.3. Cement Mortar

Cement mortar shall be in accordance with civil structural specification and following schedule.

- For flooring - 20 mm thick cement mortar (1 cement : 4 coarse sand by volume)
- For skirting/dado/riser - 12 mm thick cement mortar (1 cement : 3 coarse sand by volume).

8.2. Workmanship

Workmanship shall in general conform to IS:1443. The base on which tiles are to be laid shall be cleaned of all dust, dirt and properly wetted by applying neat cement slurry @ 2.75 kg. Of cement per Sq.M. of area without allowing water pools. Cement mortar of specified thickness shall then be spread over the base for two rows of tiles and 3-5 metres in length. The mortar shall be laid in slope as per requirements and thickness of mortar shall not be less than 10 mm at any place. The tope of the mortar shall be kept rough so that cement slurry can be absorbed. Laying shall be from centre and proceed outwards in two directions at 90o. Cut tiles of uniform sizes shall be laid along periphery, if necessary. Neat cement slurry @ 4.4 kg. Of cement per Sq.M. shall be spread over the mortar bed for laying 20 tiles at a time. The tiles shall then be fixed in this grout one after the other, each tile being gently tapped and properly bedded in line and level. The Joints shall not exceed 1.5 mm in width. After the day's work, the excess cement slurry on top and the joints shall be cleaned with broom stick and washed before the slurry sets hard. Next day, the joints shall be filled with the cement grout to match the shade of the tile.

Tiles along the periphery shall be continued by average 12 mm under the wall plaster, skirting or dado.

For skirting/dado/risers on the brick masonry wall, the joints shall be raked out to a depth of at least 15 mm while the masonry is being laid. In case of concrete work, the surface shll be hauled and roughened with wire brushes. The wall surface shall be uniformly and evenly covered with backing of cement mortar 1:3 (1 cement : e coarse sand by volume) of specified thickness. Before hardening of the cushioning mortar, back of each tile shall be covered with a neat layer of cement slurry @ 4.4 kg of cement per Sq.M. and edges with white cement with or without pigment to match the shade of tiles and the tiles then shall be pressed on the backing and tapped.

The tiles shall be corrected to proper planes with joints truly vertical in required pattern and butt jointed. The fixing shall be done from bottom upward. The top of skirting and dado shall be truly horizontal.

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8.3. Curing

The flooring shall be cured for 7 days by keeping it wet with ponding. Heavy traffic on the flooring shall be permitted only after 14 days.

8.4. Grinding and Polishing

Grinding shall be commenced after 14 days when the tiles and the joints are properly set. Grinding shall be done by machines except for skirting and small areas. First grinding shall be done with carborundum stones of 48 to 60 grade grit fitted in the machine. Water shall be properly used during grinding. When the chips show up and the floor has been uniformly rubbed, it shall be cleaned with water baring all pin holes. It shall then be covered with a thin coat of grey/white cement mixed with pigments to match with colour of the flooring. This grout shall be kept moist for a week. Thereafter the second grinding shall be started with carborundum stone of 120 grit. Grinding and curing shall follow again. Final grinding shall be with carborundum of grade 220 to 350 grit using water in abundance. The floor shall be washed clean with water, oxalic acid powder shall then be dusted at 35 gms/sq.m. on the surface rubbed with machine fitted hessian bobs or rubbed hard with woollen rags. The floor shall then be washed clean and dried with a soft cloth or linen. If any tile is disturbed or damaged, it shall be refited or replaced and properly jointed and polished.

9.0 TILE WORK

9.1. Materials

9.1.1. Tiles

Glazed (vitreous and ceramic tiles shall conform to IS:777 and shall be of specified shade, size and of approved manufacturer. Ceramic tiles shall be matt finished and non slip type.

The size shall be as per following:

White/coloured glazed vitreous tiles

200 mm x 100 mm x 6 mm
200 mm x 150 mm x 6 mm
200 mm x 300 mm x 6 mm
300 mm x 300 mm x 8 mm /5.5 mm / 7.3 mm (± 5%)
Ceramic Tiles
300 mm x 300 mm x 8 mm /5.5 mm / 7.3 mm (± 5%)
200 mm x 100 mm x 6 mm

9.1.2. Pigments

Pigments to be admixed with mortar or for grouting the joints shall conform to Table-1 of IS:2114.

9.1.3. Cement Mortar

Cement mortar shall be in accordance with civil structural specification and following schedule

- For flooring : 20 mm thick, cement mortar (1 cement : 4coarse sand by volume)
- For skirting/dado/riser : 12 mm thick, cement mortar (1 cement : 3 coarse sand by volume)

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9.2. Workmanship

The tiles shall be laid over a coating of specified adhesive (as per approved manufacturer's specification) laid on base floor/wall plaster. The Joints of the tiles shall be flush pointed with cement paste (white cement and pigment conforming to IS:2114, Table-1) matching the shade of colours.

9.2.1. Curing

The flooring shall be cured for 7 days by keeping it wet with ponding. Heavy traffic on the flooring shall be permitted only after 14 days.

10.0 KOTA STONE FINISH

10.1. Materials

The Kota Stone slabs shall be of selected quality and shade, hard, sound, dense, homogenous in texture, free from cracks, decay, weathering and flakes. These shall be machine cut to the requisite size and thickness and chisel dressed. Floor flooring and skirting/dado/riser the thickness of the stone slabs shall be 25 mm and 18 mm respectively.

The slabs shall have the top (exposed) face polished before being brought to site. Before starting the work, the Contractor shall get the samples of slabs approved by Owner's Representative.

10.2. Workmanship

10.2.1. Dressing of Slabs

Each slab shall be machine cut to the required size and shape and fine chisel dressed at all edges to full depth and machine rubbed to a smooth surface finish. All angles and edges of the slabs shall be true square and free from chippings giving a plane and smooth surface.

10.2.2. Preparation of Surface

Cement mortar of specified thickness and mix and shall be laid over the base after making it rough, cleaning thoroughly and applying neat cement slurry @ 2.75 kg of cement per Sq.M. of area to receive the mortar.

The mortar shall be laid for fixing one slab at a time. Cement mortar shall be 15 mm thick (1 cement : 4 coarse sand by volume) for flooring and 12 mm thick (1 cement : 3 coarse sand by volume) for skirting/dado/riser.

10.2.3. Laying

The slab shall be washed clean before laying. It shall be laid over cement mortar bedding on top, pressed, tapped gently to bring it in level. It shall be then lifted and laid aside. Top surface of the mortar then shall be corrected by adding fresh mortar at hollows and depressions. The mortar then shall be allowed to harden and cement slurry of honey like consistency @ 4.4 kg of cement per Sq.M. shall be spread over the mortar. The edges of the slabs shall be buttered with white cement with or without pigment grout to match the shade of the slabs. The slabs shall then be gently placed in position and tapped with wooden mallets till it is properly bedded in level. The joints shall be as fine as possible. Surplus cement on the surface of the slab shall be removed. The slabs in flooring shall continue for not less than 10 mm under the plaster/skirting. The finished surface shall be true to levels and slopes as instructed by the Owner's Representative.

The slabs shall be laid in patterns as per drawings and size shall not be less than 310 mm x 310 mm which shall be uniform. Cut size may be used along periphery as required.

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10.3. Curing

The floor shall be cured for a minimum period of 7 days by wetting.

10.4. Polishing and Finishing

Unevenness at the meeting edges of slabs shall be removed by fine chiselling. Polishing etc. shall be done, except that cement slurry shall not be applied on the surface before each polishing.

11.0 MARBLE STONE FLOORING / GRANITE FLOORING AND FACIA

11.1. Materials

11.1.1. Marble slabs

The marble slabs shall be 20 mm thick and grade-I Makrana White or Makrana plain Pink or Abu Green or Baroda Green as specified. The marble from which the slabs are made shall be of selected quality, hard, sound, dense, homogenous in texture, free from cracks, decay, weathering and flakes. The sample of Marble stone slabs shall be got approved from the Owner's Representative. For granite slab thickness shall be 20 mm for floors and facia and the sample shall be got approved by Owner's Representative.

Fixing of granite slab on facia should be with the help of gun metal dowels.

The slabs shall be machine cut to the requisite dimensions.

11.1.2. Pigments

Pigments to be admixed with mortar or for grouting the joints shall conform to Table-1 of IS:2114.

11.1.3. Cement Mortar

Cement mortar shall be in accordance with civil structural specification and following schedule:

- For flooring/slabs: 20 mm thick, cement mortar (1 cement : 4 coarse sand by volume)
- For skirting/dado/riser : 12 mm thick, cement mortar (1 cement : 3 coarse sand by volume).

11.2. Workmanship

Same as clause no. 10.2 except that cement mortar shall be 20 mm thick (1 cement : 6 coarse sand by volume) for flooring.

11.3. Curing

The floor shall be cured for a minimum period of 7 days by wetting.

11.4. Polishing and Finishing

Unevenness at the meeting edges of slabs shall be removed by fine chiselling. Polishing etc. shall be done in accordance with clause no. 5.4, except that cement slurry shall not be applied on the surface before each polishing.

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12.0 P.V.C. FINISH

12.1. Materials

12.1.1. PVC Roll/Tiles

PVC roll/Tile shall be 2 mm thick homogenous, unbacked, flexible type of approved texture, colour and pattern, conforming to IS;3462/3461.

12.1.2. Antistatic PVC Roll/Tile

Antistatic PVC roll/tile shall conform to BS:2050, Table-2 in addition to IS:3462.

12.1.3. Adhesive

Adhesive shall be neoprene based rubber adhesive of approved make.

12.2. Workmanship

The base course shall be Cement Concrete flooring/Cement Concrete granolithic flooring for flooring and Cement plaster for skirting thoroughly dried and cleaned well before the laying of PVC rolls/tiles.

PVC rolls/tiles shall be brought to the temperature of the area in which it is to be laid and staked suitably near the site for a period of about 24 hours.

The layout of PVC flooring shall first be marked with guidelines on the base course to required pattern without adhesive. The adhesive then shall be applied by spatula to the base floor and back of the PVC roll/tile. PVC rolls shall be placed in position from one end onwards slowly without creation on any air pockets between roll and the base course. PVC rolls/tiles shall be placed only when the adhesive is set sufficiently for laying. When set sufficiently for laying, the adhesive will be sticky to the touch but shall not mark the fingers. After placing, the roll shall be pressed suitably with a wooden roller weighing about 5 kg. The joint between adjacent rolls shall be thin hairline type. For PVC tiles laying shall start from centre and proceed outwards in two right angle direction till the periphery of the room/area is reached. Fractional tiles of uniform cut sizes may be laid only along the peripheral border is so required owing to size of the room area.

PVC rolls in flooring shall be continued for 100 mm high skirting without any joints and with 50 mm radius rounded corner at the junction of skirting and flooring. Any excess adhesive squeezing out of the surface shall be wiped off immediately with a wet cloth. In case of such excess adhesive becoming hard, it shall be removed with a solution of one part of commercial Butyle Acetate and three parts of turpentine oil or any other solution as advised by the manufacturer of the roll.

After a minimum period of 24 hours after laying the rolls/tiles, the finished floor shall be cleaned with a wet cloth soaked in warm soap solution of 2 spoons of soft soap powder in 5 litres of warm water or detergent as per approved manufacturers specifications.

13.0 ACID RESISTANT TILES

13.1. Material

The tiles shall be vitrified ceramic tiles of approved size as per approved manufacturer's specification and shall be homogeneous. They shall have the following properties.

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S.No.	Property	Values	Norms
	Water Absorptions	± 0.5%	ASTM C 373
	Scratch Resistance	6	ASTM C 373
	Chemical Resistance	Unaffected	ASTM C 650
	Abrasion Resistance	100	ASTM C 510
	Breaking Strength	1400 kg/sq.cm.	ASTM C 648
	Density	2.0 Gm/CC	

13.2. Workmanship

The base course shall be Cement Concrete flooring/Cement Concrete granolithic flooring for flooring and Cement plaster for skirting/dado and background surface shall be prepared.

Tiles shall be fixed on the prepared surface over a bitumen priming layer, bitumen mastic layer and resign type chemical resistant mortar. The bitumen shall conform to IS:702 and laying of bitumen mastic shall conform to IS:1196.

Joints shall be allowed to set for 24 hours. The floor shall then be washed as per manufacturer's specifications to totally remove all marks from tile surface.

14.0 EPOXY COATING

14.1. General

Epoxy floor coating shall be pigmented (approved shade) and consist of a solvent based, two pack system with epoxy resins and amine curing agents, chosen to withstand high degrees of chemical and abrasive action as per approved manufacturer's specification.

14.2. Materials

14.2.1. Screed

The screed shall be provided in flooring and shall consist of a solvent free combination of epoxy resin, modified amine hardeners filled with specially graded and selected chemically inert aggregates of high strength. The system shall include an epoxy resign primer and screed which are both supplied in pre-weighed units ready for on-site mixing and application. The thickness of screed shall be minimum 3 mm thick.

14.2.2. Finishing Coat

An epoxy resin sealing coat in two coats @ 125 gms/sq.m. (minimum) per coat shall form the topping coat over the screed in case of flooring and over plastering in case of vertical surfaces.

14.3. Workmanship

14.3.1. Preparation of Surface

The surface shall be sound, clean and dry in order to achieve maximum adhesion with the primer coating of epoxy resin as per approved manufacturer's specification.

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14.3.2. Laying

The primer shall be applied by brush and shall be allowed to become tacky. The screed shall be prepared as per manufacturers specification and laid in specified thickness evenly over the base floor by trowel. In case of flooring, the finished, cured screed shall have a slightly granular texture.

The epoxy resign topping shall be applied at least 24 hours after the laying of the screed. This topping shall be applied by brush or sprayed to a specified thickness in two coats with 3 -5 hours interval between them. Care shall be taken to finish the topping perfectly smooth and devoid of any bubbles and unevenness. The newly laid floor shall be protected from dust or moisture and allowed to be used only after a minimum lapse of 48 hours.

15.0 MEASUREMENT AND RATE

Measurement and rate for flooring for item rate tenders shall be in Sq.M. in general unless otherwise mentioned.

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MISC. CIVIL AND STRUCTURAL WORKS FOR UNDERGROUND PIPING AND OTHER CIVIL WORKS

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1. SCOPE

This specification covers the material and construction details for various civil works as given below:

a) All Earthwork except for Site Grading and Underground Piping.

b) Plain and reinforced cement concrete work in catch pits clean outs manholes, pipe supports, water monitors, hydrant pedestals, thrust block etc.

c) Brick work for various structures such as Manholes, Catch basins, Valve Chambers, instrument tapping chambers, flushing chambers etc.

d) Plastering for the above structures as applicable.

e) Manhole frames, manhole covers, ladder rungs etc. for the above structures as applicable.

f) Miscellaneous structure steel work such as ladders, platforms, chequered plate covers, gratings etc.

The work shall include supply of various materials as per relevant standards, required for the execution of work except for those items designated as Owner's scope of supply in the special conditions of contract or elsewhere in the contract documents. Contractor shall transport from Owner's stores those materials which are a part of Owner's supply.

All materials not fully specified herein and which may be used in the work shall be of quality approved by the Owner's Representative and he shall have the right to determine whether all or any of the materials offered or delivered for use in the work are suitable for the purpose. Contractor shall give the samples of material to the Owner's Representative and shall get it approved before procurement and use.

2. EARTHWORK AND BACKFILLING

2.1. Refer TECPL's Specification no. Z/02/0006 – 'Excavation, Backfilling, Compaction'.

3. PLAIN AND REINFORCED CEMENT CONCRETE

3.1. Refer TECPL's Specification no. Z/02/0004 – 'Structural Concrete'.

4. BRICK WORK

4.1. Refer TECPL's Specification no. Z/02/0026 – 'Brick Masonry'.

5. CEMENT PLASTERING

5.1. Materials

The specifications for cement, sand and water shall be given in TECPL's Specification no. Z/02/0001 - 'Materials'.

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5.2. Cement mortar shall be of grade and thickness specified in drawing or as directed by the Owner's Representative, if not specified. The surface on which plastering is to be done shall be thoroughly cleaned from dust, dirt, oil, etc. It should be washed properly and watered for 4 hours before plastering. The joints of brick work shall be raked out to a depth of at least 12 mm when plastering has to be done. On cement concrete surface, the surface shall be scarified by lines with trowel when it is still green or hacked if concrete is hard as driected by Owner's Representative.

5.3. Plaster shall not in any case, be thinner than specified. It shall have uniform specified thickness. Any extra thickness of plaster done by Contractor will not be paid for. When smooth finishing is required the cement plaster shall be floated over with neat cement within 15 minutes of the application of the final coat.

During the process of plastering all corners shall be rounded to a radius of 25 mm unless otherwise specified.

5.4. The plaster shall be protected from sun and rain by such means as the Owner's Representative may approve. The plaster shll be cured for 7 days.

5.5. Construction joint shall be kept in plastering work at places approved by Owner's Representative.

5.6. Payment

5.6.1. Payment for plastering shall be made on the basis of the area of surface plastered, measured before plastering. All measurements shall be separately made for each face of walls.

5.6.2. The rate of plastering shall include cost of scaffolding, swings, cleaning the surface, raking out joints, hacking concrete surfaces, etc. needed for carrying the work and shall cover the extra labour for plastering the jambs, sills, and soffits or opening except for plastering bands, cornices and skirting upto 30 cm width.

6. M.S. RUNGS / C.I. STEPS

The rungs for valve pits/manholes shall be of M.S. conforming to Indian Standard and to the shape and size as shown in drawings. C.I. steps for manholes if used shall be as per IS:5455. M.S. Rungs or CI Steps shall be coated with 2 coats approved bituminous paint.

Payment for steps/rungs shall be made per number and the rate shall include supply and fixing, finishing the wall etc. complete.

7. CHEQUERED PLATES AND STRUCTURAL STEEL WORKS

Chequered plates shall be 6 mm (7 mm moreover chequers and shall conform to IS:3502). Steel for chequered plate shall conform to IS:2062 and shall be clearly rolled and free from harmful surface defects such as crack surface flaws etc. The plate shall be cut to shape and fixed to the bearing members as shown in relevant drawings and as direction by Owner's Representative. The edges shall be made smooth, no burrs or gaged ends shall be left. The plates may be spliced with prior consent of the Owner's Representative. But in that case care should be taken so that there is continuity in the pattern of the plates between the portions. Lifting arrangements shall be provided including lifting rods.

Grating shall be fabricated out of MS flats, angles and rounds etc., as per drawings and as approved by Owner's Representative. Steel for grating plates shall conform to IS:2062 of general Weldable quality and shall be clearly rolled and shall be free from harmful surface defects.

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Payment shall be made on the basis of weight of M.S. Gratings/chequered plate and supporting frame actually laid. The rate shall include supply of all necessary, steel materials cutting to size, fabricating, smoothening edge if necessary, transporting and fixing at all positions and providing lifting arrangements. Full deductions shall be made for all opening above 30 mm square and the rate shall include making of opening of all sizes and supply and painting 2 coats of anticorrosive paint over a coat of red oxide zinc chromate primer. The exposed surface of grating and frame shall be painted with two thick coats of coal tar. The rate shall include providing and laying M.S. grating and frame, breaking and making good existing concrete/brick masonry surface if necessary finishing, painting etc. complete with all labour and materials. Payment shall be on number basis.

8. C.I. MANHOLE FRAME AND COVER

C. I. Manhole frame and covers shall conform to IS:1726 with size and grade as shown in drawings.

9. VENT PIPES

These shall be M.S. Black Steel Tube conforming to IS:1239 medium grade or as specified in drawings. The pipe bends shall be embedded in 1:3:6 grade cement concrete or as shown in drawing.

All pipes shall be 25 mm clear of wall or column with M.S. holder bat clamp as per instructions of the Owner's Representative. All holes in walls and column shall be made good by 1:2:4 grade cement concrete. All pipes and clamps shall be painted with two coats of paints of approved make.

Payment shall be made on running meter basis and the rate shall include supply of all materials, cutting, edge preparation, jointing by welding, fixing in concrete block, cutting of walls or concrete and making good the same, painting with 2 coats of anticorrosive paint necessary scaffolding etc. complete.

The rate shall also include excavation and backfilling, if any.

10. FUNNELS, CLEAN OUTS, PLUGS

These shall be fabricated from M.S. Plates, pipes chequered Plates, rounds, angles etc., to be supplied by the Contractor. The fabrication shall be in accordance with the approved drawings.

Payment for these items shall be made on weight basis and rate shall include fabrication, erection, welding jointing and painting etc. all complete.

11. BRICK BAT FILL

11.1. The brick bats used for filling in valve pits shall be from common burnt clay building bricks. A sample of brickbats used shall be got approved from Owners' Representative.

11.2. The compaction of the layer of brick bats shall be proper so that brickbats are not disturbed and do not sink in the soil.

11.3. The payment for brick-bat fill shall be made on MZ basis as shown in drawing and the rate shall include supply, laying, compacting etc. complete with all mterials and labour.

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MISCELLANEOUS ITEMS

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1. SCOPE

The scope shall be as specified separately for different items below.

2. REFERENCES

2.1. BIS Codes

IS:73, IS:383 and IS:6613

2.2. TECPL's Specifications

Z/02/0001 Materials

Z/02/0004 Structural Concrete

3. MATERIALS

The materials shall be as specified separately for different items below.

4. GENERAL REQUIREMENTS

4.1. The Contractor shall test the materials, where applicable, in approved laboratory as required by the Owner's Representative and furnish test certificates for materials and obtain the approval of the Owner's Representative prior to the use of such materials in the works. All tests shall be in accordance with relevant Indian Standards.

5. PRE-CONSTRUCTIONAL ANTI-TERMITE TREATMENT

5.1. Scope

This specification establishes the materials and method of accomplishing pre-constructional anti-termite treatment of soil for protection of buildings against attack by subterranean termites with the usage of chemical emulsions in accordance with the procedure laid down.

5.2. Materials

Refer TECPL's specification no. Z/02/0001.

5.3. Procedure for Treatment

5.3.1. The treatment shall be carried out by an approved agency specialised In the field. Apart from this specification, the work shall be carried out in compliance with IS:6313. In case of any contradiction, this specification shall govern.

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5.3.2. Site Preparation

Prior to start of chemical treatment, area(s), shall be made free from logs, stumps, timber offcuts, levelling pegs, roots of plants/trees etc. Soil treatment shall start when foundation trenches/pits are ready to take concrete masonry in foundations and plinth area ready for laying the subgrade. Treatment shall not be carried out when it is raining or the subsoil water level is at the same or higher than the level of treatment. In the event of water-logging of foundations, the water shall be pumped out and the chemical emulsion applied when the soil is absorbent.

5.3.3. Treatment of the excavated pits/trenches and backfill for Foundations

a) The bottom surface and the lower 300 mm side surfaces of the excavated pits/trenches for foundations of masonry works and RCC plinth beams supporting such masonry works, shall be treated with specified chemical emulsion @ 5 litres/m^2 of the surface area. However, no such treatment shall be required in case of pits/trenches made for RCC foundations supporting RCC walls and/or columns.

b) On completion of construction of masonry foundations, the backfill in immediate contact with the substructure shall be treated in layers of 300 mm with emulsion @ 7.5 litres/m^2 of the vertical surface of the substructure (i.e. 7.5 x 0.300 = 2.25 litres/meter of perimeter) for each side. The treatment shall be given after ramming of each layer of soil, by rodding the earth at 150 mm centres close to the wall surface and working the rod backward and forward (parallel to the wall s urface) and then spraying the specified dosage of emulsion. The emulsion shall be directed towards the masonry surfaces so that the soil in contact with these surfaces is well treated with the chemical. After the treatment, the soil shall be tamped back into place. This shall be done for full depth of the fill.

c) For RCC walls and columns, the treatment as specified in (b) shall start from a depth 500 mm below the finished ground level and shall be done upto the FGL.

5.3.4. Treatment of Plinth/Basement and Apron

a) The top surface of the consolidated earth below the non-suspended floor slabs and the peripheral aprons of widths upto 750 mm, the bottom surface and side surfaces of the excavated pits for the basements shall be treated with chemical emulsion @ 5 litres/m^2 of the surface area. Holes 50 to 75 mm deep at 150 mm centres, both ways, shall be made on the surface with 12 mm diameter mild steel rod and then emulsion shall be sprayed uniformly over the area. At expansion joint locations, anti-termite treatment shall be supplemented by treating through the expansion joint @ 2.0 litres per linear metre of joint after the subgrade has been laid.

b) Treatment of Junctions of plinth filling and wall/column faces shall be done after making a small channel 30 mm x 30 mm, by making rod holes 150 mm apart (upto the ground level) in the channel and then by moving the rod backward and forward @ 7.5 litres/m^2 of the vertical wall/column surface so as to soak the soil right to the bottom. The soil shall be tamped back into place after the treatment.

5.3.5. Treatment of Soil along External Perimeter of Building

After the building is complete, the earth along the external perimeter shall be rodded at intervals of 150 mm and to depth of 300 mm. The rod shall be moved backward and forward parallel to the wall to break up the earth and chemical emulsion poured along the wall @ 7.5 litres/m^2 of vertical surface (i.e. 7.5 x 0.300 = 2.25 litres/metre of perimeter). After the treatment, the earth shall be tamped back into place.

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6. ANTI-CORROSIVE LAYER

6.1. Scope

This specification covers the requirement of materials, method of preparation and procedure for laying an anticorrosive layer over top surface of tank foundations for protection of bottom plates of steel tanks against corrosion attack.

6.2. Materials

6.2.1. Sand shall be clean, dry, coarse, hard, angular, free from coatings of clay, dust and mix of vegetable and organic matter and shall conform to IS:383 – Grade III.

6.2.2. Bitumen shall be of grade A 90 conforming to IS:73.

6.3. Mixing and Laying

The bitumen shall be heated to a temperature of 175°C to 190°C with 3% kerosene if required and sand (8 to 10% by volume) shall be thoroughly mixed with it in a mixing drum to give a uniform mixture and shall be laid over clean and dry surface of tank foundation to line, grade and levels as shown on the drawings and directed by the Owner's Representative. Bitumen shall not be heated beyond the specified temperature limits. The layer shall be tamped to form hard mass of specified compacted thickness.

7. DRESSING AND TRIMMING

7.1. Scope

This specification covers the procedure for dressing, trimming and paving with earth the peripheral area around the completed building/structure.

7.2. Procedure

The ground all around the completed building/structure for 3 metres width or as specified by the Owner's Representative, shall be cleaned and dressed to suitable slope. Over the prepared ground a layer of approved earth shall be spread, watered and well consolidated so as to achieve an average thickness of 75 mm.

8. HARD CORE

8.1. Scope

This specification covers the requirements of materials and procedure for laying of hard core.

8.2. Materials

Hard core shall consist of broken/crushed stones of 150 mm and down size. Stones shall be sound, angular, hard and free from flakes, dust and other impurities.

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8.3. Procedure

Hard core shall be laid to the grade, level and thickness as shown on the drawing. Broken stones of required height shall be vertically placed and blinded with approved murrum/sand and consolidated with roller including watering, dressing etc. However, areas inaccessible by roller may be compacted by hand rammer.

9. SAND FILLING IN PLINTH/FOUNDATIONS

9.1. The specification of sand is to be used for filling.

9.2. Filling shall be carried out in layers not exceeding 15 cms and shall be compacted mechanically or by saturation to specified grade and level and to obtain 90% laboratory maximum dry density or as specified in schedule of rates.

9.3. Compaction by flooding may be accepted at the discretion of the Owner's Representative, provided the required compaction is achieved.

9.4. The Contractor shall not commence filling in and around any work until it has been permitted by the Owner's Representative.

10. DAMP PROOF COURSE - {DPC)

10.1. All materials used for Damp Proof Course shall comply with TECPL's relevant specification.

10.2. The 40 mm thick Damp Proof Course shall consist of plain cement concrete of grade M-20, unless otherwise specified.

10.3. The Damp Proof Course shall be laid at plinth level of masonry walls, flush with the floor surface and shall not be carried across doorways.

10.4. Before laying, the top surface of wall shall be thoroughly cleaned and watered. The DPC shall be laid in layers of 20 mm thickness retaining the edges by necessary form work and shall be well tamped and troweled to smooth finish. The layer shall be cured by keeping the surface wet for 40 hours and after it has dried, two coats of hot bitumen of grade A120/S120 conforming to IS:73 shall be applied over it at the rate of 1.7 Kg./m^2. Over this, the second layer of 20 mm thick concrete shall be laid and cured as described in case of the first layer and two coats of hot bitumen at the rate of 1.7 kg./m^2 shall be applied again in a similar manner. Over this, dry sharp sand shall be sprinkled evenly before hardening of second coat of bitumen paint.

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MISCELLANEOUS STEEL WORKS

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1. GENERAL

1.1. All materials supplied by the Contractor shall conform to their respective specifications.

1.2. The Contractor shal furnish test certificates for all materials prior to their use in the works.

1.3. Other requirements not covered under this specification shall be in accordance with the specification no. Z/02/0023 – Structural Steel Works.

2. REFERENCES

As mentioned in the respective clauses.

3. MATERIAL

As mentioned in the respective clauses.

4. ANCHOR BOLTS

4.1. Material

Materials for anchor bolts, nuts, locknuts, washers, pipe sleeves and anchor plates shall conform to their respective specifications.

4.2. Fabrication

Fabrication of anchor bolts and their complete assemblies shall be strictly in compliance with the specifications and drawings/standards. Anchor bolts shall have coarse type threads conforming to IS:4218.

4.3. Placement

Anchor bolt assemblies shall be placed in position strictly as per drawings and securely held during pouring and vibrating of concrete with necessary templates and other dummy structures to prevent their dislocation.

4.4. Tolerances

Tolerances allowed for anchor bolts positioning shall be:

For sleeved bolts, one tenth of the bolt nominal diameter.

For bolts without sleeves, one twentieth of the bolt nominal diameter.

4.5. Protection

The exposed surfaces of bolts shall be properly covered (after greasing of bolts and packing of sleeves) with jute cloth so as to protect them from damage till final erection of structure/equipment is over.

4.6. Payment

This clause shall apply to Item Rate tender only.

4.6.1. Payment shall be made on the basis of actual weight in metric tons of the anchor bolt/anchor bolt assembly. The rate shall include supply (as per scope of supply conditions given in the tender) of all materials,

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handling, transporting, fabrication, turning from available size MS round to required diameter, threading, welding, fixing in position, at all levels and locations, providing necessary templates, greasing, packing of sleeves, covering with jute cloth and other protective measures etc. all complete.

4.6.2. The rate shall cover bolt of any diameter and nomenclature.

4.6.3. Payment for fixing in position anchor bolt assembly (already fabricated and supplied by the Owner as free issue) shall be made on the basis of actual weight of anchor bolts/bolt assemblies in metric tons. The rate shall include handling, transporting, fixing in position, welding if required, providing necessary templates, greasing, packing of sleeves, covering with jute cloth and other protective measures etc. all complete.

4.6.4. No separate payment shall be made for templates, dummy structures, supports etc. and the rate quoted shall be inclusive of all cost related to such provision required for correct and accurate installatioln of anchor bolts/assembly.

5. METAL INSERTS

5.1. Material

Materials required for fabricating metal inserts shall conform to TECPL's Specification no. Z/02/0023 – Structural Steel Works.

5.2. Fabrication

Fabrication of inserts shall be done strictly as per drawings/standards and in compliance with the requirements of TECPL's Specification no. Z/02/0023 – Structural Steel Works.

5.3. Placement

Metal inserts shall be correctly embedded (in plain concrete/reinforced concrete) as per their location shown on the drawings. Care shall be taken that these are securely held in position and do not get disturbed during concreting. Where necessary, these may be welded to the reinforcement bars. Suitable templates, spacers, dummy structures and temporary staging shall be provided. Necessary cutting in the formwork and adjustment of reinforcement bars shall be done for the placement of metal inserts where required.

5.4. Painting

The exposed surfaces of metal inserts shall be cleaned with wire brush and given one coat of red oxide zinc chromate primer (conforming to IS:2074) or any other primer as specified in other specifications, after fabrication.

5.5. Payment

This clause shall apply to Item Rate tender only.

5.5.1. Payment shall be made on the basis of actual weight in metric tons of the metal inserts. The rate shall include supply (as per supply conditions given in the tender) of all materials, handling, transporting, fabrication, welding, fxing in position, at all levels and locations, providing necessary templates, spacers, dummy structures, adjusting the formwork and reinforcement, staging, preparation of surface for painting, applying one coat of red oxide zinc chromate primer or any other primer, as specified, etc. all complete.

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6. CHEQUERED PLATES

6.1. Material

Chequered plates shall be of mild steel and conforming to IS:3502. Chequering shall be closed or open-ended or of any other pattern as shown on drawings.

6.2. Fabrication Drawings

Refer TECPL's Specification no. Z/02/0023 – Structural Steel Works.

6.3. Fabrication

Chequered plates shall be fabricated as per the "Approved for Construction" fabrication drawings (prepared by the Contractor based on design drawings). These shall be perfectly flat and without any dents/deformations and shall be cut to the required size and shape. Holes/notches/openings of the required size, if any, shown on drawings shall be made. Nosing for staircase treads shall be made by cold bending of chequered plates. All edges shall be made smooth and even. All chequered plate units shall be given distinct erection marks in accordance with the marking drawings. Stiffeners of any description shall be welded wit the chequered plates where shown on drawings.

6.4. Erection/Fixing

Chequered plates shall be fixed to the bearing members by welding/ bolting/ screwing as shown on drawings. All bolts/screws shall be of counter-sunk type so that the heads remain flush with the top of plate. Where welding is used for fixing, stitch welds of minimum 50 mm length with a pitch of 150 mm shall be used. Continuous sealing run of weld shall be provided along the junction of two consecutive chequered plates parallel to the span. For removeable flooring, details as shown on drawings shall be followed.

6.5. Painting

Chequered plates shall be cleaned (both the surfaces) with wire brush and given one coat of red oxide zinc chromate primer (conforming to IS:2704) or any other primer as specified in specifications, on both surfaces.

6.6. Payment

This clause shall apply to Item Rate tender only

6.6.1. Payment shall be made on the basis of admissible weight in metric tons (determined as described in clause 6.6.2) of the chequered plates accepted by the Owner's Representative. Where stiffeners are used, weight of the same shall be included in arriving at admissible weight.

The rate shall include supplying (as per supply conditions given in the tender), fabricating, erecting M.S. chequered plates including transporting, handling, straightening if required, cutting to required size and shape, making holes/notches/opening of required size and nosing, smoothening the edges, fixing by welding/bolting/screwing, at al levels and locations, preparing detailed fabrication drawings, surface cleaning, removal of rust, scale, grease and applying one coat of red oxide zinc chromate primer or any other primer as specified, etc. all complete.

In any stiffening sections are provided below the chequered plates for strengthening, the same shall be separately measured and paid under Structural Steel Work (TECPL's Specification no. Z/02/0023).

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6.6.2. The weight for payment shall be determined from the fabrication drawings and respective bill of materials prepared by the Contractor. The bill of materials shall be checked and approved by the Owner's Representative before making the payment. The weight shall be calculated on the basis of BIS Handbook. No allowance in weight shall be made for rolling tolerances.

6.6.3. Welds, bolts, nuts, screws, washers, clips shall not be measured. The quoted rate shall be deemed to include the same.

7. GRATINGS

7.1. Categories

The gratings shall be of two categories:

1) Category 'A' - Fabricated by the Contractor as per deisgn/drawings/standards.

2) Category 'B' - Ready made bought out from an approved manufacturer.

7.2. Material

Materials for fabrication and fixing of Gratings shall conform to their respective specification.

7.3. Fabrication Drawings

Refer TECPL's Specification no. Z/02/0023 – Structural Steel Works.

7.4. Fabrication

7.4.1. Category 'A' Gratings

These shall be fabricated strictly as per the "Approved for Construction" fabrication drawings prepared by the Contractor based on design drawings and standards. All units shall be given distinct erection marks in accordance with the marking drawing. All notchings in the flats shall be punched and not flame-cut. Continuous alround welding shall be done along the contact -lines between two flats on both the surfaces. All fabrication shall be done in a shop under strict supervision. Clamps shall be fabricated as shown on drawing/standard.

7.4.2. Category 'B' Gratings

These shall be as per manufacturer's details designed to carry loads as specified on the design drawing supplied to the Contractor. The deflection shall not exceed span/200 or 6 mm whichever is minimum. The maximum clear size of voids in the grating shall be limited to 30 mm x 55 mm. Thickness of grating shall be 25 mm. The Contractor shall make necessary notches/opening in the gratings as shown in the drawings. All edges affected by such notches/openings shall be suitably stiffened by welding additional flats of the requisite size. All units shall be given distinct erection marks in accordance with the marking drawings. Before procurement the Contractor shall submit the design calculations, drawings and manufacturer's literature/catalogues and get the same reviewed by the Owner's Representative. The contractor shall submit sample gratings for inspection and approval by Owner's Representative whenever asked for.

7.5. Erection/Fixing

Gratings shall be fixed to the bearing members by welding/clamping and bolting as indicated in the drawings. Minimum length and maximum pitch of welds shall be 50 mm and 150 mm respectively where

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stitch welding is used for fixing along the lines of supports. The edges of two consecutive grating s shall be bolted with minimum two bolts on each side of the grating panel.

7.6. Galvanising

Gratings and the fixing clamps, bolts, nuts shall be cleaned with wire brush and galvanisation shall be done in accordance with IS:2629 and tested as per IS:2633 and IS:6745. Quantity of zinc coating shall be minimum 900 gms/sq.m. of surface area (0.12 mm uniform thickness).

7.7. Payment

This clause shall apply to Item Rate tender only.

7.7.1. Payment shall be made on the basis of admissible weight in metric tons of the gratings accepted by the Owner's Representative.

The rate shall include supplying, fabricating, erecting MS gratings (of the specified category) including transporting, handling, cutting to required size and shape, making holes/notches/openings, smoothening the edges, fabricating clamps, fixing by welding/clamping/bolting, at all levels and locations, preparing detailed fabrication drawings, surface cleaning, removal of rust, scale, grease and applying one coat of red oxide zinc chromate primer or any other primer as specified, or galvanising as required, all complete.

7.7.2. The weight for payment shall be determined from the fabrication drawings and respective bill of materials prepared by the Contractor. The bill of materials shall be checked and approved by the Owner's Representative before making the payment. The weight, shall be calculated on the basis of BIS Handbook as mentioned above. No allowance in weight shall be made for rolling tolerances.

7.7.3. Welds, bolts, clamps, nuts and washers shall not be measured. The quoted rate shall be deemed to include the same.

8. TUBULAR HAND RAILING

8.1. Material

Materials for fabrication and fixing of Tubular Hand Railing shall confirm to their respective specification.

8.2. Fabrication Drawings

Refer TECPL's Specification no. Z/02/0023 – Structural Steel Works.

8.3. Fabrication

Handrailing shall be fabricated strictly as per the "Approved for Construction" fabrication drawings prepared by the Contractor based on design drawings and standards. All tubes shall be straight and without any dents/deformations. Tubes shall be cut and ends shall be prepared to a neat and workman -like finish. All elements shall be directly welded. All welded joints shall be cleaned and filed or ground smooth, if required, to have a smooth surface and aesthetically pleasant appearance. Splicing of top rail shall not be allowed. Tubes shall be coldbent to shape and curvature in case of discontinuous ends of handrails. Ripples, kinks and/or dents at bends shall not be accepted.

Lower ends of vertical posts shall be cut and splayed (for grouting in pockets in the concrete members). For removable type of hand railing, suitable base plates (with provision for bolting) shall be welded to the lower

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end of vertical posts. All units shall be given distinct erection marks in accordance with the marking drawing.

8.4. Erection/Fixing

Hand railing, shall be fixed to the bearing members by welding/bolting/grouting as indicated on the drawings. Local notching shall be made in the floor plate/grating to accommodate vertical posts/their base plates which shall always be welded to the main supporting member. When the posts are to be fixed in concrete members, suitable pockets shall be made in concrete for grouting as shown on drawings/standards.

8.5. Painting

Tubes shall be cleaned with wire brush and given one coat of red oxide zinc chromate primer (conforming to IS:2074) or any other primer as specified, after fabrication.

8.6. Payment

This clause shall apply to Item Rate tender only.

8.6.1. Payment shall be made on the basis of measured length in meters (m) of top rail only (Horizontal and/or inclined lengths). The rate shall include preparation of fabrication drawings, supply of all materials, handling, transporting, straightening if required, cutting to required size, bending, welding, bolting, fixing in position at all levels and locations, grouting with 1:2 (cement:sand) mortar, surface cleaning, removal of rust, scale grease and applying one coat of red oxide zinc chromate primer (conforming to IS:2074) or any other primer as specified, after fabrication etc. all complete.

8.6.2. The rate shall include making suitable notches in floor plates/gratings and pockets in concrete structures for fixing the vertical posts.

9. MILD STEEL RUNGS

9.1. Material

All materials shall conform to their respective specifications.

9.2. Fabrication

Rungs shall be fabricated as specified in TECPL's standards/drawings. Mild steel bars shall be straightened if required, cut, bent to shape and given one coat of red oxide zinc chromate primer on exposed portions.

9.3. Fixing

Rungs shall be fixed in position as per detailed drawing and firmly tied/welded with reinforcement to prevent their displacement during vibrating of concrete.

9.4. Payment

This clause shall apply to Item Rate tender only.

9.4.1. Payment shall be made on the basis of actual weight in kilograms (Kgs.) of the M.S. rungs. The rate shal include supply of all materials handling, transporting, straightening if rquired, cutting to required size, bending to shape, tying/welding with reinforcement bars, fixing at all levels and locations, adjustment of

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formwork, applying one coat of red oxide zinc chromate primer (conforming to IS:2074) or any other primer as specified, and two coats of anti-corrosive paint or any other paint, as specified, on the exposed portion of rungs etc. all complete.

10. LIGHT GAUGE STEEL STRUCTURAL SECTIONS

10.1. Material

All materials required for fabrication and fixing in position of Light Gauge Steel Structural Sections shall conform to their respective specification.

10.2. Fabrication Drawings

Refer TECPL's Specification no. Z/02/0023 – Structural Steel Works.

10.3. Fabrication

Fabrication of members shall be done strictly as per the "Approved for Construction" fabrication drawings prepared by the Contractor based on the latest design drawings and in accordance with IS:800, IS:801 and other relevant BIS Codes.

All members shall be straight and free from any dents/deformations/twists. Members shall be cut to the required sizes and ends prepared to a neat and workman like finish. Holes (for sag rods and cleat bolts) of appropriate size shall be drilled and all members/ components shall be given distinct erection marks in accordance with the marking drawings. Holes shall not be formed by gas cutting process.

10.4. Erection

Structural members shall be erected in proper sequence and aligned properly without causing any twist. Permanent bolting/welding shall be done only after proper alignment has been achieved. Proper access, working platforms and safety arrangements shall be provided by the Contractor for working and inspection.

10.5. Painting

All structural components shall be cleaned thoroughly and given one coat of red oxide zinc chromate primer (conforming to IS:2074) or any other primer as specified, after fabrication.

10.6. Payment

This clause shall apply to Item Rate tender only.

10.6.1. Payment shall be made on the basis of admissible weight in metric tons (determined as described in clause10.6.2) of the structure accepted by the Owner's Represenative. The rate shall include supplying, fabricating, erecting, at al levels and locations, testing of bolted and/or welded Light Gauge structural steel works including cleats, crook bolts, splices/sleeves, all other fixtures and accessories, straightening if required, cutting, edge preparation, welding and bolting of joints, fixing in line and level with temporary staging and removal of the same after final alignment, handling, transporting, storage, preparation of detailed fabrication drawings and getting them reviewed by the Owner's Representative, surface cleaning, wire brushing, removal of scale, rust, oil or grease and painting as per 8.5 above etc., all complete.

10.6.2. The weight for payment shall include all structural members, cleats, splices, gussets and sag rods and s hall be determined from the fabrication drawings along with respective bill of materials prepared by the Contractor. The bill of materials shall be checked and approved by the Owner's Representative before making the payment. The weight shall be calculated on the basis of BIS Handbook. Manufacturer's catalogues/charts shall be adopted in case relevant weighs of sections used are not covered I BIS Handbook. No allowance in weight shal be made for rolling tolerances.

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10.6.3. All welds, bolts, nuts washers, fixtures and accessories shall not be measured. The quoted rate shall be deemed to include the same.

10.6.4. The rate shall be applicable to all cleats, splices, sleeves and gussets. Sag rods, however, shall be separately measured and paid under structural steel item (viz. TECPL's Specification No. Z/02/0023).

11. EXPANSION FASTENERS

11.1. Material

Expansion fasteners (medium and heavy duty) shall be of mild steel / high tensile steel with rust proof coating including both mechanical and chemical fasteners.

11.2. Classification

The expansion fasteners shall be designated as medium and heavy duty depending on their usage. The broad classification is given below for general guidance.

11.2.1. Medium Duty (Mild Steel/ High Tensile Steel)

- Ladders and stairs supports.
- Cables and cable trays supports.
- Electrical panels and fixtures.
- Hangers for pipes and cable trays.
- Pipe supports.

11.2.2. heavy Duty (Mild Steel / High Tensile Steel)

- Platform support (beam and columns)
- Knee brackets for pipes/multi tiers cable trays/walkways etc.

Note:- Expansion fasteners shall not be used for:

1) Members supporting equipment and pipes subjected to vibrations.
2) Cantilever connections designed to cater for effective cantilever spans greater than 1000 mm and 1000 Kgs. Of concentracted load at the free end.

11.3. Selection

The Contractor shall submit to the Owner's Representative manufacturer's catalogues along with the specimens of expansion fasteners (proposed to be used for the job) for his selection and approval. Selected fasteners shall be capable to carry the specified loads.

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11.4. Testing

If so desired by the owner's Representative, the Contractor shall carry out all the requisite tests (pullout test, torque test etc.) of specimen expansion fasteners (representative of those to be used) from approved laboratory/test house and submit the report to him for approval. The decision of the Owner's Representative regarding the adequacy of strength and load carrying capacity of the expansion fastener shall be final and binding to all. The cost of all such tests shall be borne by the Contractor.

11.5. Installation

The Contractor shall install the expansion fasteners at their correct location (to suit the requirement of fixtures as shown in drawings) as per the procedure laid down by the manufacturer. Location of all holes shall be premarked on the concrete surfaces and then holes drilled carefully with an electric drill to the correct recommended size and depth. Holes shall be exactly round and true perpendicular to the concrete surface. Edge distance and pitch of fasteners shall be as recommended by the manufacturer. The Contractor shall suitably shift the hole with the approval of the Owner's Representative in case any reinforcement bar is met with while drilling the hole in RCC structure. Necessary staging shall be provided for working and the Contractor shall take requisite safety precautions so as not to cause any damage to the existing structure/equipment. Any damage done while executing the job shall be made good by the Contractor at his cost.

11.6. Protection

The exposed surfaces of expansion fasteners shall be properly greased and covered with jut cloth so as to protect them from damage.

11.7. Payment

This clause shall apply to Item Rate tender only.

11.7.1. Payment for instaling rust prof expansion fasteners shal be made on number basis (each). The rate shal include supply of complete assembly, hanlding transporting, providing necessary temporary staging, installing (as per manufacturer's specifications) in PCC/RCC structures, at all levels and locations, testing, drilling, cleaning, covering with jute cloth, relocating and redrilling in case of any obstruction, making good any damage done t the structure, grouting the abandoned holes and any gap left between the contact surfaces of PCC/RCC and fixtures to be added, etc. all complete.

12. BITUMEN/BITUMINOUS MATERIALS

Bitumen to be used for various types of work shall meet all the requirements of relevant BIS Codes as given below:

Specification of Paving Bitumen. IS:73

Specification of bitumen mastic for flooring. IS:1195

Specification for Bitumen felts for water proofing and and damp proofing. IS:1322

Specification for Bituminous compounds for water proofing and caulking purposes. IS:1834

Specification for preformed fillers for expansion joint in concrete pavements and structures. IS:1838

Specification for bitumen mastic for use in water proofing of roofs IS:3037

Specification for bitumen primer for use in water proofing and damp proofing. IS:3384

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Specification for Bitumen Mastic for Tanking and Damp proofing. IS:5871

Specification for Glass fibre base coal tar pitch and bitumen felts. IS:7193

Code of practise of damp proofing using bitumen mastic. IS:7198

Specification for bitumen Mastic, Anti Static and electrically conducting grade., IS:8374

The type and grade shall be as shown on the drawings or as indicated in schedule of quantities or as directed by Owner's Representative. Tests and acceptable criteria shall be as per relevant BIS Codes.

13. PVC PIPES

PVC Pipes shall conform to the requirements of IS:4985.

14. WOOD/TIMBER

14.1. Wood recommended for platforms of cold vessels or below cold vessels/exchangers shall be hard and shall be of Group A, Grade I and shall have safe permissible stress of 7N/mm in compression, perpendicular to grains on outside location as per IS:883. General characteristics like durability, treatability etc. shall conform to IS:883 and IS:3629.

14.2. Timber required to be used for form work shall be fairly dry before use. It should maintain its shape during the use and even when it comes into contact with moisture from the conrete. Storage of Wod/Timber shall be as per the requirements of IS:4082.

For proper identification and selection of suitable timber for form work, following codes shall be referred.

Classification of commercial timbers and their zonal distribution IS:399

Specification for ballies for general purposes. IS:3337

Specification for Ply wood for concrete shuttering work. IS:4990

15. EPOXY COMPOUNDS

Refer TECPL's relevant General Technical Specification (GTS).

16. PAINT

Refer TECPL's relevant General Technical Specification (GTS).

17. ANTITERMITE COMPOUNDS

17.1. Chloropyrifos emulsifiable concentrates (1%) conforming to IS:8944 shall be used for treatment of soil for protection of buildings against attack by subterranean termites.

18. POLYSULPHIDE SEALANTS

18.1. Polysulphide Sealants shall conform to IS:12118 and be of approved make. Test conditions and requirements shall be as given in the above referred BIS Code.

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PILING

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1. GENERAL

1.1. Scope

This General Technical SPECIFICATION covers the materials, fabrication and installation of the following types of piles :

- precast concrete piles;
- driven cast-in-place piles;
- bored cast-in-place piles.

1.2. References

CODES & STANDARDS and regulations applicable and referred to in this SPECIFICATION are: BIS

Standards

IS:800-1984	:	Code of practice for general construction in steel
IS:383-1999	:	Specification for coarse and fine aggregates from natural sources for concrete
IS:269-1989	:	Specification for 33 grade ordinary Portland cement
IS:8112-1989	:	Specification for 43 grade ordinary Portland cement
IS:456-2000	:	Plain and reinforced concrete
IS:2116-1980	:	Specification for sand for masonry mortars
IS:4926-1976	:	Specification for ready mixed concrete

Regulations

As per Indian Labour Laws.	:	General Regulation for the protection of Work

1.3. Quality Assurance

The materials such as cement, steel reinforcement, aggregates and water shall be tested in accordance with the requirements of GTS - Structural Concrete.

Manufacturers of precast reinforced concrete piles shall have previous experience of manufacturing similar items.

All materials shall be tested at the place of manufacture (or elsewhere if convenient and appropriate) by an approved testing agency to ensure that they comply with the requirements of this section.

The Owner’s Representative may agree that routine tests carried out by the Manufacturers cover all or part of the requirements of paragraph 3 below, provided that he is satisfied with the Manufacturer's testing procedures.

The construction of installation of all piles shall be undertaken using techniques and equipment which have a well proven record of success and be implemented by specialised personnel who have extensive experience in carrying out such work.

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1.4. Submittals

1.4.1. Geotechnical Soil Characteristics

Unless specified otherwise the results of the soil investigation and type & the capacity of pile shall be made available to the contractors.

If the CONTRACTOR judges that the available soil data are incomplete or not reliable he shall to submit a complementary investigation program to the approval of the Owner's Representative.

The Owner's Representative will decide whether or not complementary investigation is really required and has to be executed.

1.4.2. Design Documents

1.4.2.1. Studies and documents prepared by the Owner's Representative

Unless otherwise specified, these studies are limited to :

- the calculation of the service loads i.e. the loads (compression, traction, horizontal forces, bending moments) transmitted by the superstructure to the piles at the pile head level;
- the preparation of the piling drawing comprising all or part of the following information:
  - number and location of piles;
  - the cut-off level for each pile;
  - eventually a minimum pile length;
  - minimum reinforcement requirements.

1.4.2.2. Studies and documents to be performed by the CONTRACTOR

Unless specified otherwise, the CONTRACTOR shall perform following design studies :

- selection of the most adequate type of pile;
- calculation of the maximum allowable pile loads or load combinations;
- detailed characteristics of the piles (section, reinforcement);
- expected settlements and horizontal displacements due to the effective pile loads;
- detailed piling sequence and time schedule.

At least 15 days before the commencement of piling job, the design calculations shall be submitted to the Owner Representative for approval and approval shall be taken for the same before the commencement of the job.

1.4.3. Products Data

The type of pile and design of the driving methodology etc shall be finalised after validating the geo technical data available.

Sources and manufacturers SPECIFICATION for:

- precast concrete piles.
- under reamed piles.

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1.4.4. Test Reports

The CONTRACTOR shall submit as soon as possible reports on the tests specified in clauses 1.3 and 6.2 of this SPECIFICATION.

1.4.5. Certificates

The CONTRACTOR shall submit certificates of compliance with the specified CODES, or other recognised and equivalent STANDARDS in respect of materials specified in clause 2.1 of this SPECIFICATION.

This clause does not apply in case of use of an approved ready mix concrete.

Should the Owner's Representative decide not to carry out tests, the CONTRACTOR shall, whenever required, obtain from the Manufacturer and submit to the Owner's Representative certificates showing that tests of materials have been carried out in accordance with the requirements of this SPECIFICATION and results are tabulated in the prescribed format.

1.4.6. Samples

The CONTRACTOR shall, if so instructed by the Owner's Representative, deliver to the Owner's Representative or to a nominated testing agency such samples as would be required for the independent performance of the tests, and confirmation of conformity with the STANDARDS, as referred to in clause 2.0 of this SPECIFICATION.

1.4.7. Drawings and Other Details

The CONTRACTOR shall submit to the Owner's Representative for his approval full details of all his proposed arrangements for casting, handling and placing of precast concrete units, for the installation of steel piles and for the construction of cast in place piles as specified in the following paragraphs.

The CONTRACTOR shall submit to the Owner's Representative for his approval shop drawings of all precast concrete piles including methods of checking and testing in with specified tolerances.

The CONTRACTOR shall submit to the Owner's Representative and obtain his approval of fully detailed drawings showing the proposed layouts of pile casting yards, the methods of assembling and dismantling moulds, provision for vibrating immediately after casting, for curing and protection from the sun.

All materials used in the fabrication of precast piles and all methods adopted in the manufacturing shall be to the satisfaction of the Owner's Representative.

The CONTRACTOR shall submit to the Owner's Representative for approval detailed descriptions of the plant, equipment, materials and procedures that he proposes to use for every type of piling operation that is to be undertaken. The descriptions shall include plant and equipment specifications, pile construction sequence, protective systems, detailed construction or installation procedures, test procedures, etc.

1.5. Delivery Storage And Handling

The CONTRACTOR shall be responsible for all the necessary arrangements that may be required in connection with the transport of long piles.

The delivery, storage and handling of all piles shall be carried out in an approved manner.

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1.6. Site Conditions

1.6.1. Existing Conditions

If at certain locations, pile driving or pile construction will have to be carried out in close proximity to existing structures, the CONTRACTOR shall take all adequate means to avoid damage to existing structures by for instance :

- vibrations,
- decompression of the soil due to boring;
- other phenomena that could occur during execution.

When during execution the CONTRACTOR encounters underground pipes, sewers, cables or any other obstructions he shall immediately seek instruction from the Owner's Representative.

Drawings are not guaranteed either as to accuracy or completeness for the position of underground obstacles. The

CONTRACTOR shall verify the location of any underground obstacles before starting any work.

1.6.2. Environmental Requirements

The contractor shall abide by the rules and regulations of the Noise & Pollution Control Board of the area.

1.7. Alternatives

If the CONTRACTOR is of the opinion that the piling design, undertaken by the Owner's Representative, is inadequate for execution purposes, the same has to be informed to the Owner's Representative by writing and an alternative proposal including drawings and design calculations shall be submitted for approval.

The Owner's Representative is free to consider or not alternative proposals.

2. PRODUCTS

2.1. Materials For Concrete Works

For specification of Cement, Aggregates, Water, Ad-mixtures, Concrete and Reinforcement Steel, refer GTS Z/02/0004.

2.1.1. Steel Pipes for Pile Permanent Casings

Pipes diameters of less than 20 cm shall not be used.

Pipes wall thickness shall not be less than :

8 mm	for diameters between	20 and 25 cm;
9 mm	for diameters between	30 and 35 cm;
11 mm	for diameters between	40 and 45 cm;
13 mm	for diameters greater than or equal to 50 cm.	

A corrosion allowance of 2 mm shall be included in the wall thickness design.

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2.2. Fabrication And Storage Of Precast Concrete Piles

2.2.1. General

All precast concrete piles shall be manufactured by approved suppliers as per the approved design by the Owner Representative.

The piles shall be truly straight. The maximum allowance for deviation of the longitudinal axis from a straight line drawn from the centre of the tip to the centre of the head shall not exceed 10 mm per 10 metre of length of the pile.

The length of each pile shall be determined by the CONTRACTOR according to the required bearing capacity.

The piles shall be designed, cast and cured to develop the strength necessary to withstand the stresses imposed while handling, transporting and driving without suffering any damage.

Square piles up to 400 mm x 400 mm shall have chamfered corners. Piles larger than 400 mm x 400 mm shall be octagonal in cross section (Nominal size measured across the flats).

Where precast piles are to be used in the permanent works in aggressive ground conditions, they shall be protected from sulphate attack by the use of a protective coating : this coating shall be a coal tar epoxy paint system to the approval of the Owner's Representative and consisting of :

- a primer coat;
- a top coating with a high build two-pack coal-tar epoxy capable of providing a dry film thickness of up to 200 microns.

2.2.2. Fabrication

2.2.2.1. Casting Yard

The casting yard for all concrete piles shall be so arranged that the piles can be lifted from their beds and transported to the piling frames with a minimum of handling. The casting yard shall have a well-drained surface to prevent excessive or uneven settlement due to softening during manufacture and curing.

2.2.2.2. Concrete Casting

The piles shall be cast in a continuous operation from end to end of each pile. The concrete shall be thoroughly compacted against the forms and around the reinforcement be means of immersion and / or shutter vibrators. The faces of the pile including those exposed at the top of the pile shall be dense as far as possible. Immediately on completion of the casting, the top surface shall be finished without excessive trowelling. Care should be taken to ensure that vibrations from adjoining work does not affect the previously placed concrete for piles during the settling period.

2.2.2.3. Curing

After casting, freshly cast piles shall be protected from sudden changes of temperature and humidity by shading and covering from hot sun and by watering to ensure that the concrete remains humid during the curing period.

The method and time of curing shall be subjected to the approval of the Owner's Representative.

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2.2.2.4. Reinforcement

The reinforcement shall extend along the whole length of the piles.

A minimum concrete cover of 40 mm shall be maintained.

The main longitudinal reinforcement shall not be less than 0.8 % of the cross pile section, with a minimum of 6 bars diameter 12 mm. Longitudinal bars shall be of one stretch, by means of butt-welded standard lengths. They shall be fit tightly into the pile shoe.

The lateral reinforcement shall be at least 8 mm diameter at a 200 mm pitch and shall be carefully welded to the main reinforcement. It shall be in the form of hoops, links or spirals and shall resist the driving stresses.

The CONTRACTOR may deviate from these requirements in case of prestressed piles types.

2.2.2.5. Marking of piles

Each pile shall be marked indelibly with a reference number, length and the date of casting.

2.2.2.6. Inspection

Each pile shall be inspected as soon as possible after removal from formwork for any defects such as honeycombing, voids or movement of forms or reinforcement.

The Contractor shall be advised to made good of any such defects to the satisfaction of the Owner's Representative. If, in the opinion of the Owner's Representative, a pile has major defects, it will be rejected.

2.2.3. Handling, Stacking and Storing of Precast Concrete Piles

Piles shall not be handled or moved until the concrete has attained the specified 28 days characteristic strength determined by field control test cubes.

Care shall be taken at all stages of transporting, lifting and handling to ensure that the piles are not damaged or cracked. Any piles damaged during such operations will be rejected by the Owner's Representative and shall be replaced at the CONTRACTOR'S own expense.

Piles shall be lifted and handled, using lifting rings designed for this purpose. Cast-in lifting eyes will not be permitted. The rings shall be installed only at the indicated lifting points. Steel wire rope slings or other tackle that might cause damage shall be padded.

If the piles are put down temporarily after being lifted, they shall be placed on trestles or blocks located at the lifting points.

Piles shall be stored on firm ground not liable to unequal settlement under the weight of the stack of piles. The piles shall be placed on timber / steel supports which are truly level and spaced so as to avoid undue bending in the piles.

The supports shall be placed vertically above one another.

Spaces shall be left round the piles to enable them to be lifted without difficulty. The order of stacking shall be such that the older piles can be withdrawn for driving without disturbing new piles.

Separate stacks shall be provided for different lengths of piles.

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Arrangements shall be provided to enable the piles to be sprayed with water if necessary, to meet weather conditions or to provide further curing during storage; in hot weather the piles shall be shaded from direct sunshine.

3. EXECUTION OF PILES

3.1. Preparatory Works

3.1.1. Site Preparation

Before commencing the piling work, and if the presence of existing underground utilities is known or suspected, the CONTRACTOR shall establish the exact location of these by means of carefully excavated trial pits, using hand methods in the immediate vicinity of the pipe, duct or cable, and shall carry out such diversion or protection of these as is shown on the Drawings or as directed by the Owner's Representative.

The areas where piling operations are to be carried out shall be levelled and kept clear of water to provide a dry stable working platform for the plant and equipment to operate on.

3.1.2. Setting out

By means of bench marks the Owner's Representative shall provide two reference lines and one level point. The

setting out of the piles shall be done by the CONTRACTOR starting from these reference lines.

3.2. General Prescriptions For All Types Of Piles

3.2.1. Program

The CONTRACTOR shall submit to the Owner's Representative a weekly piling program. He shall inform the Owner's Representative each day of the piling to be carried out on the following day and give adequate notice of his intention to work outside normal hours and at weekends.

3.2.2. Piling Method

The CONTRACTOR shall supply for approval detailed method statement and procedures for each piling operation in the form of instructions to his Foremen on how to execute the Piling.

3.2.3. Piling Records

The CONTRACTOR shall keep detailed records of each pile.

For this purpose a record book shall be drawn up and updated by the CONTRACTOR; it shall be submitted at regular intervals to the approval of the Owner's Representative.

This record book shall include for each pile details on :

- Location, reference number (corresponding to the number fixed on the implantation drawing), type and size of the pile;
- Length of the tube in case of temporary casing;

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- Date and hour of start and end of each operation :
- Drilling or driving, reinforcement placing, concreting;
- Level from which the pile is bored or driven (working platform level);
- Level of the pile base;
- Top level of the concrete pile before the cut-off operation;
- Useful length;
- Used materials (drilling or driving tools, concreting equipments);
- Curing results of the bottom hole before putting down the reinforcement cage and before concreting (including mainly the slurry characteristics);
- Nature and description of the bored soils;
- Poured concrete volume and theoretical volume (measured concrete curves);
- For driven cast in place piles, used concrete volumes during base concreting and shaft concreting will be distinguished;
- Behaviour, workability, fluidity of concrete, results of the compression tests;
- Water level within the hole before concreting;
- Slurry characteristics before and during drilling;
- For driven piles, the refusals corresponding to the three last sets of blows (10 hammer blows) will be noticed for each pile; for one pile by each 20 piles, a driving diagram will be drawn up according to the prescription of the IS:2911-Part-I,II,III

The CONTRACTOR will submit to the approval of the Owner's Representative a proposal of piling record sheet including all the details mentioned here above.

3.2.4. Tolerances

The maximum permitted deviation of the pile centre from the centre point shown on the setting out drawing shall be 25 mm in any direction.

The maximum permitted deviation of the completed pile from the vertical is 25 mm per meter.

For raked piles the maximum permitted deviation of the finished pile from the specified rake is 40 mm.

3.3. Execution of Driven Cast-In-Situ Piles

3.3.1. General

Driven cast-in-place piles can be of two types, the first having a permanent steel or concrete casing and the second being with only a temporary casing during construction to maintain the stability of the pile hole.

All plant materials and operations employed in the formation of a pile shall be such as to ensure that the completed pile is of the full cross section.

3.3.2. Equipment

The CONTRACTOR provides to the Owner's Representative all data proving the suitability, efficiency and energy of the driving equipment.

The weight of the falling mass must always be adequate to take down the piles at the depth defined by the design.

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3.3.3. Driving

Pile driving will not be allowed to commence before the approval by the Owner's Representative of the CONTRACTOR'S proposals and calculations which shall include the following:

a) calculation for refusal;

b) proposed minimum depths the piles are to be driven through the ground;

c) details of hammers proposed to be used.

The first pile to be installed with a particular rig shall be one located at or close to one of the soundings shown on the piling drawings. For this pile the tube shall at least be driven to the required tip elevation. A blow count shall be made over the entire pile length.

The number of blows required to drive the tube over the last 25 cm to the required tip elevation shall be used as a guidance for the adjacent piles to be installed with the same rig in the area covered by the same sounding.

The final set of each pile shall be recorded either as the penetration in millimetres per 10 blows or as the number of blows required to produce a penetration of 25 mm (see piling records 3.2.3.).

When a final set is being measured, the following requirements shall be met :

a) The exposed part of the tube shall be in good condition without damage or distortion.

b) The dolly and packing, if any, shall be in sound condition.

c) The hammer blow shall be in line with the pile axis and the impact surfaces shall be flat and at tight angles to the pile and hammer axis.

d) The hammer shall be in good condition and operating correctly.

e) The temporary compression of the pile shall be recorded if required.

In case of any variation or change in the driving conditions, such as another type of hammer or a different stroke, a new blow count shall be made at or close to a sounding.

The calculation for refusal shall be performed with the help of the Danish driving formula :

$$Q^c = \frac{e_h E_n}{s + \left(\frac{h_n L}{2AE}\right)^{1/2}}$$

$$Q_a = \frac{Q_c}{5}$$

Where : e_h = Efficiency of the hammer (dimensionless ratio).

s = Average penetration of the pile per hammer blow for the final ten (10) blows (m/blow).

A = Cross sectional area of the pile (m²).

E = YOUNG'S modules of the pile (kN/m²).

E_n = Nominal energy of the pile hammer (kNm/blow).

L = Pile length (m).

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Q_c = Calculated pile capacity (kN).

Q_a = Allowable pile capacity (kN).

The CONTRACTOR shall submit for approval a detailed description of the material and devices being used and also the application of the above formula for the selected material (3 weeks before site installation).

The CONTRACTOR shall inform immediately the Owner's Representative when any unexpected change in driving characteristics occurs and propose methods to solve the problem. A detailed record of the driving resistance over the full length of the nearest available pile shall be taken if required by the Owner's Representative.

The pile driving is carried out following a sequence in order to avoid, as much as possible, an increasing of the driving resistance for the last piles.

Damage to neighbouring piles during driving

In case of damage to the adjacent piles, for example observation of concrete raising in the neighbouring piles, the CONTRACTOR shall review the driving sequence.

Particular dispositions may be needed and decided with the agreement of the Owner's Representative.

3.3.4. Mixing of Concrete

Approved power driven - revolving drum type mixers shall be used equipped with suitable mechanisms for accurately measuring water. The volume of materials per batch shall not exceed the manufacturer's rated capacity for the mixer.

Mixers with worn or badly bent blades shall not be used.

The time allowed for mixing, after all ingredients have been placed in the mixer shall not be less than 2 minutes for drums of one cubic metre capacity or less. For drums in excess of one cubic metre the mixing time shall be increased by 30 seconds for each cubic metre or fraction thereof in excess of one cubic metre.

All concrete must be thoroughly mixed to an even colour and consistency throughout.

The entire contents of the drum shall be discharged before the materials for the succeeding batch are fed into the drum. No re-mixed, re-tempered, excessively wet or partially set concrete shall be permitted in the work.

The drum of the mixer shall be thoroughly cleaned of all adhering concrete at frequent intervals during continuous operation. Mixers which have been out of use for more than 30 minutes shall be cleaned before any fresh concrete is mixed.

3.3.5. Placing of Concrete

Before starting concreting, the CONTRACTOR has to check the implantation of the driven tube and verify that no water or soil is present within the tube. A special procedure must permit to execute this control at any moment.

Concrete shall be placed in the work within 30 minutes after mixing or discharge from a ready-mix truck.

In depositing concrete through a cage of reinforcement care shall be taken to prevent segregation of concre te mortar from the aggregate.

At all stages of the works every precaution shall be taken to prevent wasting and the formation of voids in

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the concrete. These defects can be due to faulty consolidation, insufficient head of concrete during placing, concrete of inadequate workability, flow of groundwater past green concrete or extracting the casing too late or too quickly.

The volume of the concrete shall be checked at frequent intervals and steps taken to maintain a sufficient head of concrete above the bottom of the casing to prevent inflow of soil or water.

The poured concrete volume needed by the concreting of each pile has to be measured and noted in the piling record.

In case of successive pourings of dry concrete with tamping, a minimum thickness of concrete must be maintained within the tube to avoid any insertion of soil or water at the base of the tube. In any case, this thickness must be larger than the half-diameter of the tube.

In case of continuous pouring of concrete, the concrete has to fill the tube in order that the pile is continuous up to the top level when the tube is removed. If the tube is not long enough to contain a sufficient concrete volume, the complement of concrete is added after raising of the tube over the needed length. T he basis of the tube is always 1 m below the concrete level except at the cut-off level.

The concreting curve is usually drawn up by the CONTRACTOR for one pile by each 50 piles. If the concrete consumption is not normal (under-volume or more than 30 % of over-volume), special procedures will be taken by the CONTRACTOR in agreement with the Owner's Representative.

In case of successive pourings with tamping, the concreting curve is drawn up by measuring the quantities of each pouring of concrete (max. 0.5 m^3) versus the top level of concrete into the tube.

In case of continuous pouring over the full length of the tube, the concreting curve is drawn up by measuring the concrete top level every time the tube is raised over 2 m.

During extraction of the casing observation shall be kept on the surface of the concrete to detect any tendency towards lifting of the concrete.

3.3.6. Finishing Pile Heads

The concrete of the pile shall be brought up sufficiently far above the required finished level to allow for slumping on withdrawal of the casing and to ensure that all laitance and weak concrete rises above cut -off level. The concrete shall be cast to a minimum of 0.5 m above the cut-off level, and to a minimum of 0.3m above groundwater level.

3.3.7. Reinforcement

Except otherwise specified, the reinforcement shall extend along the whole length of the piles. It shall be adequately assured in position.

A minimum concrete cover of 40 mm shall be assured.

The main longitudinal reinforcement shall not be less than 0.8 % of the cross pile section with a minimum of 6 bars diameter 12 mm. Longitudinal bars shall be executed in full accordance with IS:1786 -1985.

The spiral reinforcement shall be at least 8 mm diameter at a 200 mm pitch and shall be carefully welded to the main reinforcement.

3.4. Execution of Bored Cast-In-Situ Piles

3.4.1. General

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Bored cast-in-place piles can be of two types, the first having a permanent steel or concrete casing and the second being with only a temporary casing during construction to maintain the stability of the pile hole.

Bored cast-in-place piles are formed by boring or grabbing and subsequently filling the hole with concrete.

Piles, 600 mm or less in diameter are commonly know as small diameter bored piles.

All plant, materials and operations employed in the formation of a pile shall be such as to ensure that the completed piled is of the full cross section.

3.4.2. Boring

3.4.2.1. Boring with permanent casing

The piles are bored into the depth required by the particular SPECIFICATION, by the drawings or by the CONTRACTOR'S calculation notes.

For each pile, the CONTRACTOR draws up the geotechnical profile of the boring with description of the strata and samples taken for each stratum as mentioned in the piling record item of these SPECIFICATIONS.

If required by the Owner's Representative, a representative sample - even disturbed - from each stratum will be kept in tight packing until the end of the works.

The bottom of the casing shall be kept sufficiently far below the boring to prevent the inflow of soil and the formation of cavities in the surrounding ground.

This is particularly important for pile borings carried out in close proximity to the foundations of adjacent buildings when loss of ground from beneath the foundations can occur.

When the casing cannot practicably be advanced below the bottom of the borehole (for example in compact sand and gravel) inflow of soil and groundwater shall be prevented by drilling mud such as bentonite suspension maintained within the boring (see 3.4.2.3).

If any block of hard material or any part of old foundations or piles is encountered by the boring, the surrounding soil will be disintegrated as few as possible during drilling through the block.

The boring of a hole located closer than 3 diameters centre to centre of a pile may not started before placing of the concrete into that pile.

The bottom of the hole is regularly checked during boring to detect any hazard (e.g. unexpected change in soil condition, presence of erratic blocks ...), to produce the geotechnical cross-section and control the stability of the bottom of the hole.

Care shall be taken to avoid over rapid withdrawal of the boring tools causing suction leading to excessive removal of the casing.

3.4.2.2. Boring with temporary casing

The temporary tube used to maintain the stability of the pile excavation will be free from distortion and will be of uniform cross section throughout its length.

The base of the tube is always located below the bottom of the boring. During drilling, the thickness of water and soil within the tube must be large enough to create an overpressure at the base of the drilling-tool.

Boring using a hollow twist drill.

A hollow twist drill is screwed in the soil by means of a hydraulic turntable.

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The central hollow pipe of the twist drill is closed at the bottom in order to avoid water and soil penetration during screwing.

The hollow twist drill is by preference made of one piece, the use of more than 3 twist drill elements is prohibited.

Once the requested depth has been reached, the twist drill will be pulled out while simultaneously concrete is pumped in the central hollow pipe of the twist drill.

The pulling out of the twist drill will be done without rotation.

Concrete pumping is done with a pressure of approximately 2.5 N/mm² and without interruption.

Pouring concrete has to follow scrupulously the putting out of the twist drill in order to avoid empty spaces in the bored pile. The pulling out of the twist drill has to be stopped if the supply of concrete is interrupted.

The concrete pressure has to be maintained as long as the bottom of the twist drill hasn't reached the theoretical cut-off level.

A reinforcement cage is placed in the wet concrete using a vibrator fixed on top of the cage.

3.4.2.3. Boring with drilling mud

When drilling slurry is used for the boring, the removal of the slurry shall be made by the CONTRACTOR permanently and with efficiency in order to avoid the pollution of the working platform. Then cleaning of the site includes the evacuation of all the drilling slurry.

The level of the drilling slurry and accordingly the level of the working platform from which the piles are executed is always located at one meter minimum above the highest static levels of the ground water.

The drilling slurry consist of water, bentonite and eventually clay, cement and other additives. The drilling slurry must be able to maintain the stability of the pile excavation during the boring and until the end of concreting to ensure a perfect concreting.

Bentonite characteristics are given hereunder. The CONTRACTOR has the possibility to use other equivalent slurry mixture as per local practice. In that case, the CONTRACTOR has to demonstrate the equivalent quality of the slurry used.

Bentonite

Bentonite is a clay containing mainly montmorillonite having special swelling and thixotropic properties.

The source and properties of the bentonite to be used for the bored piles shall be provided in the form of certificates from the supplier. The certificates shall be submitted prior to the beginning of the works to the Owner's Representative's approval.

Bentonite suspension

The bentonite suspension shall agree to the criteria shown in the following table at stages "fresh", "ready to re-use" and "before concreting".

TABLE FOR BENTONITE SUSPENSIONS	**STAGES**		
	fresh	**ready for re-use**	**before concreting**

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Density	< 1.10	< 1.25	< 1.20
Marsh value	32 to 50	32 to 60	32 to 50
Fluid loss	< 30 cm^3	< 50 cm^3	-
pH	7 to 11	7 to 12	-
Sand content	< 15 %	< 15 %	< 4 %
Filter cake	< 3 mm	< 6 mm	-

Test

The CONTRACTOR shall submit to the approval of the Owner's Representative the test method he intends to apply on site. The proposed method shall be equivalent to the one described hereunder :

The Marsh value, the fluid loss, the sand content, the filter cake and the 10 minutes gel strength (using a Fann viscometer), will be measured using the tests described in the American Petroleum Institute document "Recommended Practice Standard Procedure for Field Testing Water-Based Drilling Fluids" (reference : American Petroleum Institute Recommended Practice 13B-1, June 1, 1990). The main characteristics of these tests are as follows :

- Marsh value : a marsh funnel with a capacity of 946 cm^3 is used.

The dimensions are :

cone :	length :	305 mm
	diameter :	152 mm
	capacity to bottom of screen :	1500 cm^3
orifice :	length :	50.8 mm
	inside diameter :	4.7 mm
screen : (fixed 19.0 mm below top of funnel)	openings :	1.6 mm

fluid loss and filter cake : a filter press is used. The main dimensions and parameters are :

a mud cell :	inside diameter :	76.2 mm
	height :	64 mm
filtration area :		4580 ± 60 mm^2
pressure :		690 ± 35 kPa
time :		30 minutes

- sand content : this value is the volume percent of particles larger than 74 mm. It is measured by sand-screen set.
- Fann viscometer 10 minutes gel strength : the instrument is of rotational type, which allows controlled

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roto speeds (600 rpm, 300 rpm and 3 rpm). The 10 minutes gel strength is measured using the 3 rpm speed, after a 10 minutes reset.

Remark

Works will not start if control equipment has not been approved by the Owner's Representative.

Polymers

Polymers, sometimes in addition with bentonite, may be used as supporting fluids on the basis of a certain experience, including :

- either previous cases for similar or worse geotechnical conditions,
- or according to full-scale trial trenches on the site.

A reasonable extrapolation of previous cases may be made with the support of laboratory tests and theories.

Stability during excavation

The stability of the hole/trench during excavation is due to the stabilising loads of the supporting fluid acting against the walls of the hole/trench. This action is due to the formation of a cake of bentonite mud by filtration at the contact with the soil.

The main factors affecting the stability, which can be controlled during the execution are:

- the level and the density of the supporting fluid
- the length of the pile/panels
- the time during which the hole/trench is left open, related to the soil and groundwater conditions (loss of shear strength with time).

The stability of the hole/trench shall be determined on the basis of comparable experience in similar geotechnical conditions.

When a loss of supporting fluid occurs, one of the following measures may be adopted :

- addition of filler material in the bentonite suspension,
- filling the trench with lean mix concrete and re-excavating up to grade level,
- grouting the layers concerned before excavating the trench.

Control pipe + borings

If required by the Particular Technical SPECIFICATION, each pile shall be equipped with 3 vertical steel rigid pipes which shall be linked to the reinforcement cage (located inside the cage each 120°) by means of a system avoiding any deformation of these pipes during insertion of the cage down to the boring and during concreting.

These pipes shall allow the core boring controls of the bearing soil -pile base contact and, if required, the grouting process after concreting. The inner diameter of these pipes shall allow the insertion of boring and grouting equipment (at least 100 mm). The length of pipes shall be 100 cm smaller than the whole pile length and shall allow the access to the top of the pipes for boring/grouting operation.

Both ends of the pipes will be hermetically closed by PVC stoppers to avoid any insertion of soils, cement-wash or concrete at the bottom and any obstruction at the top. The steel pipes must be connected by screw-coupling.

21 days after the concreting of the pile, the CONTRACTOR shall drill into 5% of all steel pipes and into all piles pipes where execution and concreting problems where recorded in order to take core samples from 1 m above base level down to min. 1.2 meter below this level and to allow setting up of tub-a-manchette for grouting

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down to 2 pile diameters (min. 1, 2 m) of pile below the base level of the pile. This drilling can be performed by core boring with record of bore parameters.

When the pile base contact will be found to be unsatisfactory by the Owner's Representative, the base grouting will be carried out.

3.4.3. Mixing of Concrete

The requirements of 3.3.4 apply.

3.4.4. Placing of Concrete

3.4.4.1. Concreting of bored piles with permanent casing

The concrete needed by the concreting of a pile has to be supplied regularly. The waiting times between the concrete-trucks have to be reduced to a minimum. No concreting interruption will be tolerated.

Before starting the concreting, the cleaning at the bottom of the hole has to be made. All loose, disturbed or remoulded soil will be removed from the base of the hole.

This operation is to be executed immediately before starting the concreting. It means after the introduction of the steel reinforcement cage and not only at the end of the boring (and within the hour of the starting of concreting).

The waiting time between the end of boring and the start of concreting may not exceed 10 hours for each pile.

All concrete is to be placed by tremie (grouting) pipe; the starting of the concreting by this method has to be particularly well executed. The good quality of concrete at the base of the pile in mainly concerned by this operation.

When the top of concrete is below the level of the working platform, the corresponding hole is immediately filled by gravely sand after the end of concreting.

After concreting of each pile, the concrete volume will be checked in relation with the theoretical bore-hole volume; for this purpose, a concrete-curve is drawn up for each pile, truck by truck. A complete concrete - curve is established from the measurements of concrete consumption every meter on the length of the pile for 1 pile each 50 piles.

If the concrete consumption is not normal (under-volumes or more than 30 % of over-volumes), special procedures will be taken by the CONTRACTOR in agreement with the Owner's Representative.

3.4.4.2. Concreting of bored piles with temporary casing

The bore is cleaned at least 1 hour before starting of concreting except special cares against decantation.

Water level within the hole must be permanently higher than the groundwater level during concreting.

The concrete will be poured by tremie pipe.

3.4.4.3. Concreting under water or drilling mud

When concreting under water or drilling mud, all soft or loose material shall be removed from the bottom of the hole and concrete pumping or an efficient tremie technique shall be used. The following procedures shall apply to the use of tremie concrete in piles.

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a) The concrete shall be cohesive, rich in cement (i.e. not less than 400 kg/m^3) and of slump not less than 150 mm.

b) The sides of the borehole shall be stable. This shall be achieved by maintaining and adequate head of fluid or by the provision of a temporary casing of the necessary length.

c) The tremie shall be watertight throughout its length and have a hopper attached at its head by a watertight connection.

d) The tremie pipe shall be large enough in relation to the size of aggregate. For 20 mm aggregate the tremie pipe shall be of diameter not less than 150 mm, and for larger aggregate tremie pipes of larger diameter are required.

e) The tremie pipe shall be lowered to the bottom of the boreholes allowing ground water to rise inside it. It is essential to prevent the tremie concrete from mixing with water in the tremie pipe and to this end a plug or other device shall be used.

f) The tremie pipe shall always be kept full of concrete and shall penetrate well into the concrete in the borehole with an adequate margin of safety against accidental withdrawal.

g) The pile shall be concreted wholly by tremie and the method of disposition shall not be changed part way up the pile, to prevent the laitance from being entrapped within the pile.

h) If the time taken to form large piles is likely to be excessive the use of set retarding admixtures shall be considered, particularly in the case of high ambient temperatures.

i) All tremie tubes shall be scrupulously cleaned before use.

j) When drilling muds such as bentonite suspension are used, the fluid at the pile base shall be checked for contamination before concreting to ensure that it will be readily displaced by the rising concrete.

3.4.5. Finishing of Pile Heads

The requirements of 3.3.6 apply.

3.4.6. Reinforcement

The reinforcement shall extend along the whole length of the piles. It shall be adequately assured in position.

A minimum concrete cover of 70 mm shall be maintained with help of circular concrete covers to achieve the proper cover between reinforcement and casing.

Except otherwise specified, the main longitudinal reinforcement shall not be less than 0,8 % of the cross pile section with a minimum of 6 bars diameter 12 mm and a maximum distance of 200 mm between the longitudinal bars. Longitudinal bars shall be one stretch, by means of butt-welded standard lengths of bars and executed in full accordance with IS:1786-1985.

The spiral reinforcement shall be at least 10 mm diameter at a 200 mm pitch and shall be carefully welded to the main reinforcement.

The spacers can be either vertical pipes or individual units (pads, rollers,…) made of a material different from steel, with a chemical resistance at least equal to the one of the concrete.

3.4.7. Grouting for bored piles with mud

If required by the Particular Technical SPECIFICATION, grouting shall be carried out through control pipes below pile level with a mixture of cement + bentonite slurry (see British CODE of Practice BS 8004 or AFTES STANDARDS).

The nature and setting time of this grout shall be submitted by the CONTRACTOR to the approval of the Owner's Representative.

The grouting shall be performed by rising steps under high pressure. The pressure must be permanently

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under control by the CONTRACTOR who must limit the pressure to avoid any dislocation of the soils or heaving of piles and of any other structure.

This limit must be submitted by the CONTRACTOR to the approval of the Owner's Representative.

In order to respect this limit, the CONTRACTOR shall provide a pressure -limit device at the output of the grouting installation and deformation captors at the most critical locations above the soils to be grouted.

The grout is mechanically malaxed and sifted in order to be homogeneous and without deposits during the grouting. The CONTRACTOR shall provide an extensive procedure for the grouting of the piles.

The grouting procedure will include:

- type and proportioning of the grout,
- grouting velocity and pressure,
- quantities to be grouted, pressures to be obtained gradually or by steps,
- water tests, sequence of the zones to be grouted,

The procedure shall be submitted by the CONTRACTOR to the approval of the Owner's Representative. The proposed grouts have to be tested by the CONTRACTOR with its equipment on site.

3.5. Execution of Precast Concrete Pile

3.5.1. General

Precast concrete piles can be of a constant cross section or can have an enlarged pile tip. In any case the pile tip shall be adequately reinforced with a pile shoe made in steel plate of appropriate thickness and anchored in the concrete by means of hooks.

3.5.2. Equipment

The CONTRACTOR shall satisfy the Owner's Representative regarding the suitability, efficiency and energy of the driving equipment.

3.5.3. Driving of Precast Concrete Piles

Precast concrete piles shall not be driven until the concrete has achieved the specified characteristic strength. The

length of pile to be driven in any position shall be approved.

At all stages during driving and until incorporation in the superstructure the pile shall be adequately supported and restrained by means of trestles, temporary supports or other guide arrangements to maintain position and alignment and to prevent buckling. These arrangements shall be such that damage to the pile does not occur.

Each pile shall be driven continuously until the specified or approved set and/or depth has been reached, except that the Owner's Representative may permit the suspension of driving if he is satisfied that the rate of penetration prior to the cessation of driving will be substantially re-established on its resumption or if he is satisfied that the suspension of driving is beyond the control of the CONTRACTOR.

The CONTRACTOR shall inform the Owner's Representative without delay if an unexpected change in driving characteristics is noted.

A detailed record of the driving resistance over the full length of the nearest available pile shall be taken if required.

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4. CUTTING PILE HEADS

4.1. Procedure

Head of already cast RCC piles shall be cut after 28 days of casting up to a length and elevation as shown on the drawing by chiselling taking al necessary safety precautions. Care shall be taken that pile reinforcement is not cut or damaged during chiselling operation. All debris and loose or cracked concrete in the pile shall be removed and disposed off within the plant boundary as per the directions of the Owner's Representative and site shall be left clean for casting of pile caps. The surface of reinforcement bars shall be cleaned, if required by wire brushing, so that no old concrete sticks to them.

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5. BUILDING-UP PILE HEADS

5.1. Procedure

Concrete in existing piles shall be chiselled off minimum upto the lap-length of the reinforcements in the pile. In cases where reinforcements are longer than the concreted piles, the top concrete of the existing piles shall be chiselled off upto a length of 800 mm.

Concrete surface and reinforcement of pile shall be cleaned of any dirt, grease, debris etc. and concrete surface shall be made rough by hacking. Reinforcement shall be lapped/welded as per the direction of the Owner's Representative. Neat cement slurry shall be applied on top surface of concrete and using approved formwork concreting shall be done upto the level shown on the drawing or as directed by the Owner's Representative.

6. FIELD QUALITY CONTROL

6.1. Testing of Concrete / Reinforcement Bars

For testing of concrete and reinforcement bars, refer GTS Z/02/0004.

6.2. Testing of Piles

Static loading tests

If required by the Particular Technical SPECIFICATION or by the contractual documents, the CONTRACTOR shall execute static loading tests on 5% of the total quantity of the piles.

The pile(s) to be tested shall be indicated by the Owner's Representative. The procedure to be followed is provided by IS:2911-1985.

Unless other delays provided by the Owner's Representative, the test has to be carried out more than 4 weeks after concreting of the pile.

The loading materials and equipment, the measurement devices and procedures have to be submitted to the Owner's Representative'S approval by the CONTRACTOR. In particular the foundations soil may not be disturbed by using of anchoring.

All tests shall be carried out only under the direction of an experienced and qualified supervisor familiar with the test equipment and test procedure. All personnel operating the test equipment shall have been trained in that field.

The number of increments of load shall be at least four, with a decreasing of load down to zero after reaching of the net vertical load.

If tests prove unsuccessful, the CONTRACTOR shall propose all necessary adaptation to the foundations. These proposals shall be submitted to the Owner's Representative. All costs requested to perform the foundation adaptation shall be at the CONTRACTOR'S cost.

Except where otherwise indicated herein payment will be made for satisfactory tests only and for not those resulting in failure. If any pile fails under test, it shall be replaced at the CONTRACTOR'S cost by pile as indicated by the Owner's Representative.

Presentation of results

The CONTRACTOR shall submit to the Owner's Representative the results of the test in two stages as follows:

a) within 24 hours of the completion of the test, unless otherwise agreed, the maintained load and the period for

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which it was held for each stage of the test and the maximum settlement recorded;

b) within 7 days of the completion of the test unless otherwise agreed by the Owner's Representative, a complete report on the test with descriptions of the testing equipment, the methods used to record load and settlement and results in tabular and graphical form with recorded load against settlement with times.

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PLASTERING AND POINTING

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1. GENERAL

This GTS covers the plastering of all types of concrete and / or masonry surfaces in all kind of work.

1.1. REFERENCE

IS 1661 : Code of Practice for application of cement and cement-lime plaster finishes.

IS 2250 : Code of Practice for preparation and use of masonry mortar.

2. MATERIALS

2.1. Cement

Cement shall be ordinary Portland Cement (Grade 43) conforming to IS 8112.

2.2. Sand

Sand for plaster and pointing shall conform to IS:1542 and grading of sand shall be as per Table I of IS1542. Sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain any appreciable amount of silt, day bails or pellets. Sand shall not contain harmful impurities such as iron pyrites, coal particles, lignite, mica shale etc.

Sand whose grading falls outside the limits of IS:460 due to excess or deficiency of coarse or fine particles shall be processed to comply with the standards.

Fine sand shall be obtained from river beds not affected by tidal water of the sea and shall be clean, sharp and free from excessive deleterious matter. The sand shall not contain more than 8 per cent of mud and silt as determined by field test with a measuring cylinder.

2.3. Gypsum

Gypsum for use in plaster of paris work shall be according to IS 2333. For lath plastering, wherever specified galvanised hexagonal wire netting conforming to IS 3150 shall be used.

2.4. Water

Water for plastering and pointing shall conform to 'GTS for Structural Concrete' – Z/02/004.

2.5. Mixing of Cement Mortar

Unless specified cement sand mortar shall be used. Cement mortars shall be prepared by mixing cement and sand in specified proportion by volume in mechanical mixer Cement sand in specified proportion shall be fed into the mixer and mixed dry thoroughly in the mixer. Water shall then be added gradually and the wet mixing shall be continued for at least 3 minutes. Hand mixing shall be permitted on a clean approved platform in special cases only.

Plastering

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The mix proportion and thickness of plaster for various surfaces shall be specified or indicated in the relevant drawings.

2.6. Cement Mortar with Waterproofing Compound

Waterproof compound shall conform to IS:2645 of approved make. The compound shall be well mixed with dry cement in the proportion of 3% by weight or as recommended by manufacturer. Further procedures for preparation of cement mortar shall be as per above clause (viz. 2.5).

3. WORKMANSHIP

3.1. Preparation of Background Surface

The surface shall be cleaned of all dust, loose mortar droppings, traces of algae, efflorescence and other foreign matter by water or by brushing. Smooth surfaces shall be roughened by wire brushing or hacking for non-hard and hard surfaces respectively. Projections on surfaces shall be trimmed wherever necessary to get even surfaces. In case of brick/stone masonry, raking of joints shall be carried out wherever necessary. The masonry shall be allowed to dry out for sufficient period before carrying out the plaster work. The masonry shall not be soaked but only damped evenly thereafter before applying the plaster.

In case of concrete work, projecting blurs of mortar formed due to the gaps of joints in shuttering shall be removed. Such surface shall be scrubbed clean with wire brushes. The surface shall be pock marked with a pointed tool at spacing of not more than 50 mm centers, the pocks being made not less than 3 mm deep to ensure a proper key for the plaster. The surface shall be washed off and cleaned of all oil, grease etc. and damped evenly before the application of plaster.

3.2. Sequence of Operations

For external plaster, the plastering operations shall be started from the top floor and carried downw ards. For internal plaster, the plastering may be started wherever the building frame, roofing and brick work are ready.

The surfaces to be plastered, shall first be prepared as described in Clause 3.1.

The first underlayer shall then be applied to ceilings. After the ceiling plaster is complete and scaffolding for the same removed, plastering on wall shall be started.

After a suitable time interval as detailed under various types of plaster in subsequent paras, depending upon the type of mortar, the secondary layers if required shall be applied. After the suitable elapse of time as detailed under various type of plaster in subsequent paras, the finishing coat shall be applied first to the ceiling and then to the walls.

Plastering of cornices, decorative features, etc. shall be completed before the finishing coat is applied. Unless otherwise specified corners and edges shall be rounded off to a radius of 25 mm, such rounding off shall be complete along with the finishing coat to prevent any joint marks showing out later.

Chicken mesh must be provided at the jointing of RCC and Brick work with an overlap of minimum 150 mm. Groove also shall be provided at the beam and column location as per the guidance of Owner / Owner's Representative.

3.3. Scaffolding

Scaffolding/staging for plastering/pointing shall be as per 'Technical Specification for Brick Masonry.

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3.4. Damage Rectification

Any cracks, damages, any part of work which sound hollow when tapped or found damaged or defective otherwise shall be cut out in rectangular shape and redone as directed by Owner's Representative.

4. PLAIN CEMENT PLASTER

4.1. Preparation of Mortars

The mortars of specified mix. shall be used as per the specifications of 'Cement Mortar' as described in clause no. 2.5 above.

4.2. Application of Plaster

4.2.1. One Layer Plaster Work

To ensure even, specified thickness, plaster of 150 mm x 150 mm shall be first applied horizontally and vertically at not more than 2 meter interval over the entire surface to serve as gauges. The surface of these gauged areas shall be truly in the plane of the finished plaster surface. The mortar shall be brought to true surface by working with a wooden straight edge reaching across the gauges with small upward and sideways movements at a time. Finally the surface shall be finished off true with a trowel or wooden float to obtain a smooth texture. Excessive trowelling or overworking the float shall be avoided. All corners, arises, angles and junctions shall be truly vertical/horizontal and shall be carefully finished. Rounding or chamfering of corners, arises, junctions etc. shall be carried out with proper templates to the size required.

In suspending the work, the plaster shall be left, cut clean to line, both horizontally and vertically. When recommencing the plastering the edge of the old work shall be scrapped clean and wetted before plastering the adjoining area. Plastering work shall be closed on the border of the wall and nearer than 150 mm to any corners or arises and shall not be closed on the body of the features such as plaster bands, cornices nor at the corners or arises.

4.2.2. Two Layer Plaster Work

4.2.2.1. First or Under Layer

The first or underlayer of the specified thickness shall be applied as described in clause no. 4.2.1 above. Before the first coat hardens, surface of it shall be beaten up by edges of wooden tapers and close dents shall be made on the surface. The subsequent coat shall be applied after this coat has been allowed to set for 3 to 5 days depending upon weather conditions. The surface shall not be allowed to dry during this period.

4.2.2.2. Second or Finishing Layer

The second layer shall be complete to the specified thickness in the same manner as for first layer.

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4.3. Curing

Curing shall be started 24 hours after finishing the plaster. The plaster shall be kept wet for a period of 7 days. During this period the plaster shall be suitably protected from all damages at the Contractor's expense by such means as approved by the Owner's Representative. The date of execution of plastering shall be marked on the plastering to ensure the proper duration of curing.

5. SAND FACE PLASTER

5.1. Preparation of Mortar

The mortar of specified mix shall be used as per the specifications of cement mortar as described in clause no. 2.5 above.

5.2. Application of Plaster

Sand face plaster shall consist of 12 mm thick (1 cement : 4 coarse sand by volume) underlayer and 6 mm thick (1 cement : 2 coarse sand by volume) top layer. Application of plaster shall be as described in 'two coat plaster work' in clause no. 4.2.2 above.

The surface of the sand face plaster shall be finished rough with sponge or as directed by the Owner's Representative.

5.3. Curing

Curing shall be as described in clause 4.3 above.

6. EXPOSED AGGREGATE FINISH

6.1. Preparation of Mortar

The mortar of specified mix shall be used as per the specifications of 'cement mortar' as described in clause no. 1.4 above. White and coloured marble chips shall be of 6 mm to 12 mm size out of Makrana/Ambaji, grade I or Dongri Chittor Brown/Rajnagar/Abu green grade-1 quality as specified. Marble dust shall be obtained from crushing hard marble stone.

6.2. Application of Plaster

Exposed aggregate finish plaster shall consist of 12 mm thick plain cement plaster underlayer (1 cement : 4 coarse sand by volume) finished rough and 20 mm thick top layer. Underlayer shall be applied in accordance with 'One Layer Plaster Work' as described in clause no. 3.2.1 above.

Top layer shall be 20 mm thick admixture of white cement and grey cement (mix. Ratio 1:1 by volume) mixed with white/coloured marble chips/pebbles of 6 mm to 12 mm nominal size as per item description. Mix ratio shall be 1 cement : 1 marble chips/pebbles by volume. Marble dust @ 15% by volume shall be added to the admixture. The pebbles to be used shall be well washed and drained. The admixture shall be thrown wet on to the underlayer while it is still plastic using strong whipping motion at right angles to the face of the wall. One coat of neat cement slurry @ 2.75 kg cement per square metre of area shall be applied on to the underlayer to receive the top layer. The whole plastering shall be laid in panels of maximum 1.2

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M x 1.2 M or as per drawing with 12 mm x 20 mm grooves in between formed by holding removable wooden battons of 12 mm x 25 mm size over the under layer.

Loose mortar etc. on the top surface shall be cleaned/removed by brushing/washing/ spraying with water jet after initial setting of mortar.

6.3. Curing

Curing shall be as described in clause no. 3.3 above.

7. POINTING

Pointing shall be of the type specified such as flush, cut or weather struck, raised and cut etc.

7.1. Preparation of Base Surface

The joints shall be raked to such a depth that the minimum depth of the new mortar measured from either the sunk surface of the finished pointing or from the edge of the brick shall be less than 20 mm.

7.2. Mortar

Mortar shall be in accordance with the specifications of cement mortar as described in clause no. 1.4 above.

7.3. Application of Mortar and Finishing

The mortar shall be pressed into the raked out joints with a pointing trowel according to the type of pointing specified. The mortar shall be spread over the corner edges or surfaces of the masonry. The pointing shall then be finished with the pointed tool. The superfluous mortar shall be cut off from the edges.

7.4. Flush Pointing

The mortar shall be pressed into joints and shall be finished off flush and levelled. The edges shall be neatly trimmed with trowel and straight edges.

7.5. Cut or Weather Struck Pointing

The mortar shall first be pressed into joints. The top of the horizontal joints shall then be neatly pressed back by about 15 mm with the pointing tool so that the joint is sloping from top to bottom. The vertical joint shall also be similarly pointed. The junctions of vertical joints with the horizontal joints shall be at true right angles in case of brick and coursed rubble masonry.

7.6. Raised and Cut Pointing

This type of pointing shall project from the wall facing with its edges cut parallel so as to have a uniforml y raised band about 6 mm and width 10 mm more as directed. The pointing shall be finished to a smooth but hard surface.

7.7. Curing

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Curing shall be as described in clause no. 3.3 above.

8. LATH PLASTER & GRADING UNDER BED

The lath plaster shall be applied over structural steel members.

Before plastering, the surface of metal type shall be brushed over with the cement slurry or given a protective coat of bitumen oil paint unless specified otherwise.

Plastering shall be carried out in two coats. Mortars for the first coat shall be of stiff consistency and applied as evenly as possible to give a uniform good cover to the lathing. It shall be allowed to dry until all strinkage movement has ceased before the second coat applied. Too much pressure shall not be used in applying plaster to lathing to guard against distortion.

Galvanised chicken wire mesh wherever specified shall be provided for lath plaster.

Cement-sand mortar greding under bed shall be provided upto an average thickness of 25mm. The underbed shall be laid to the specified slope.

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PLUMBING AND BUILDING DRAINAGE

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1. SCOPE

1.1. The specification is intended to establish and define the materials and constructional requirements for plumbing and building drainage works.

1.2. All materials, fixtures and workmanship shall be in accordance with the relevant Indian Standards Specifications, Codes of Practices and good engineering practices.

2. STOP COCKS

2.1. Stop cocks of screw-down type shall conform to IS:781. All taps shall be of heavy grade. The taps shall be chromium plated brass or ordinary easy cleaning type as specified.

2.2. The payment shall be made on units basis. The rate quoted shall include supplying and fixing bib or stop cocks with white zinc and yarn etc. complete.

3. H.C.I. NAHNI TRAP {FLOOR TRAP)

3.1. Nahni trap shall be of heavy cast iron as per IS:3989 with 100 mm inlet and 80/100 mm outlet with CP pressed steel grating. It shall be of self-cleaning design. Grating shall be of either hinged or screwed down type.

It shall be fixed in cement mortar 1:2 and as directed by Owner's Representative.

3.2. The payment shall be made per number basis. The rate shall include supplying and fixing Nahni trap, including cement mortar, cutting walls and floors and making good the same, providing and fixing chromium plated pressed steel grating all complete.

4. STONEWARE GULLY TRAP CHAMBER

4.1. The sqaure mouth gully trap shall be of 100 mm dia, conforming to IS:651 of specified and/or approved quality stoneware, complete with cast iron grating, and shall be got approved by the Owner's Representative. The size of CI frame and cover shall be of 300 mm x 300 mm. It shall be properly fixed as directed by the Owner's Representative.

The size of the chamber shall be 300 x 300 x 675 mm (internal) it shall be constructed of brick masonry walls 125 mm thick in 1.4 cement mortar and M-15 concrete foundations. Inside and outside faces of the masonry walls shall be plastered with 1:3 cement mortar. The top of the chamber shall be provided with CI cover and frame.

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4.2. The payment shall be made on per number basis. The rate shall include supplying and fixing of stoneware gully trap, CI grating, construction of masonry chamber, providing and fixing CI frame and cover, earthwork in excavation, foundation concrete and backfilling removal of surplus earth upto a lead of 30 m etc. and labour and material complete

5. BRICK MASONRY{MANHOLES/INSPECTION CHAMBER & VALVE CHAMBER)

5.1. The size of the manholes and valve chambers shall be as specified in the drawings or items. It shall be constructed to brick masonry walls 230 mm thick in CM 1:4 (1 cement, 4 sand) resting on M-15 concrete foundations. The inside and outside face of the masonry wall shall be plastered with 13 mm thick plaster of cement mortar 1:3 (1 cement, 3 sand).

The top of chamber shall be heavy duty CI cover frame.

M.S. rungs made out of 16 mm dia M.S. bars shall be fixed inside the manhole as shown in the drawing after applying two coats of anticorrosive paint.

Valve chambers shall be provided and fixed with a heavy duty CI cover and frame.

The top of chamber shall be provided with reinforced cement concrete M-15 grade as per drawings and direction of Owner's Representative.

The C.I. manhole covers and frames shall conform to IS:1726. The type size and grade shall be as per drawing, schedule of items and the directions of the Owner's Representative.

The frame shall be fixed in position during concreting of top slab, inside faces of frame and cover shall be given two coats of approved anti-corrosive paint.

The specification for brick masonry, plastering, concreting, excavation and backfilling etc. as given under relevant clauses shall be applicable for this work also.

5.2. Payment shall be made as per number basis including excavation, backfilling, removal of earth, construction of the chamber/manhole, making connections of pipes through the walls, cost of M.S. rungs, cover slab, cost of CI cover and frame, etc. as per the directions of the Owner's Representative.

The rate shall include breaking concrete or brick masonry work and making good the same with 1:4 cement mortar if necessary, finishing, painting, etc. as per directions of Owner's Representative.

6. C.I. SOIL/WASTE PIPES

6.1. Cast iron pipe, socket and spigot shall be of standard quality conforming to IS:486 (heavy duty).

The spigot of the pipe shall be placed fully resting inside the socket and hemp caulked home to leave space for lead depth as specified. Lead conforming to IS:782 in molten state shall then be poured into the joint filling the same in one pouring. The lead shall be caulked by proper tools to make it even all round. Depths of lead in the joints from the top of the socket shall be 37 mm for 150 mm dia pipes, 25 mm for 100 mm and 50 mm dia pipes. All pipes shall be fixed 25 mm clear of the wall with MS holder bat clamps or as approved by the Owner's Representative. All holes in walls and floors shall be made good by cement concrete M-15 grade and should be leak proof. All soil and waste pipes shall be tested for leakage by hydraulic test.

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All pipes shall be painted with two coats of paint of approved make and shade over a coat of prime. Earthwork in excavation backfilling and removal of surplus earth shall be considered as a part of the work. No separate payment will be made for the same.

6.2. The payment shall be made per running metre of pipe laid with fitting as required on site. The rate quoted shall include supplying and fixing of pipes and necessary specials including cowl with hemp and lead, jointing and testing, bat clamps, fixtures painting, cutting of walls, floors and making good the same and necessry scaffolding, earthwork in excavation, backfilling and removal of surplus earth etc. complete.

7. CI/SOIL/VENT PIPES

7.1. CI pipes shall be standard quality conforming to IS:1729. The supply shall include all necessary accessories e.g. bends, tees etc. complete.

Jute yarn gasket of suitable diameter shall be used as required to support the spigot of the pipe at the proper grade and make truly concentric joints. Single piece of sufficient length shall be used to pass around the pipe and lap at the top and shall be thoroughly saturated in bitumen. This gasket shall be laid in the socket for lower third of the circumference of the joint and covered with cement mortar. The spigot of the pipe thoroughly cleaned with wet brush, inserted and carefully driven home after which a small amount of cement mortar (1:2) shall be inserted in the annular space around the entire circumference of pipe and solidly rammed into the joint with caulking tool. The joint shall then be completely filled with mortar and bevelled off at angle of 45° with outside of the pipe: Cement used to joint shall conform to IS:269.

All holes in walls and floors shall be made good by cement concrete M-15 grade.

All CI pipes shall be painted with two coats of anticorrosive bituminous paint externally.

7.2. The payments shall be on running metre basis of pipes laid. The rate shal include supplying and fixing pipes jute gaskets dipped into bitumen and cement mortar and necessary specials including jointing with clamps, painting, cutting of walls, floor and making good the same, necessary scaffolding etc. complete.

8. GI PIPES AND FITTINGS

8.1. All G.I. pipes and fittings shall conform to IS:1239 and shall be of medium grade for water supply system.

All screwed tubes and sockets shall have pipe threads in accordance with the requirements specified in IS:554. Unless specified otherwise, pipes shall be supplied screwed with taper threads and sockets parallel thread.

All fittings shall be malleable galvanised iron approved by the Owner's Representative. Fittings in GI line shall include all couplings, elbows tees, bends, unions, nipples, reducers, flanged with nuts bolts and rubber insertions, bushes and all other fittings to make a complete job. Screwed GI pipes shall be jointed with screwed socket joints using screwed fittings. Care shall be taken to remove any burr from the end of the pipes after threading. While lead with a few strands of fine hemp shall be applied while tighting. Compounds containing red lead shall not be used.

All pipes above ground shall be fixed with GI holders bat clamps clear off the wall at 1.2 M centres. If the pipes are fixed in encased or embedded in wall, they shall be secured in position by iron hoops at 1.2 M centres. All visible pipes and clamps within and outside building shall be painted with two coats of white paint or aluminium paint as directed by the Owner's Representative. No extra payment shall be made for clamps, hooks, cutting holes in walls, chasing and making good the same.

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All underground pipes shall have a minimum earth cover of 600 mm or as directed by the Owner's Representative. No extra payment shall be made for excavation in trenches, refilling the same and removal of surplus earth. Before any pipes are painted or covered up they shall be tested to a hydro-static pressure of 6 kg/sq.cm.

8.2. Payment shall be on running metre basis of actual pipeline laid. In addtion to the Sectional testing of water supply piping, the Contracotr shall test entire installation on completion of the job to the satisfaction of the Owner's Representative. No extra payment shall be made for testing. The Contractor shall make his own arrangement for supply of water for testing at his own cost. The rate for this item shall include supply and laying of GI pipes with necessary fittings, cutting of pipes to required lengths, threadings; making holes in walls and floors and making good the same, jointing, painting, excavation and refilling including the testing and directions by the Owner's Representative.

9. GUN METAL VALVE

9.1. All full way and globe valves shall be of heavy gunmetal and tested at 300 psi and shall be approved by the Owner's Representative. Valves shall conform to IS:778. Size of valve chamber shall be as per item description, construction of valve chamber shall be carried out as detailed in this specification. Valve chamber shall be provided and fixed with heavy duty CI surface box conforming to IS:3950. The surface box shall be hinged pin open type and shall be fixed in the chamber slab. It shall have a hole for opening.

9.2. The payment shall be made per number basis including valve chamber and surface box. The rate shall include construction of valve chamber supplying and fixing valves and surface box in position as per drawings and direction of the Owner's Representative.

10. HALF FOUND CHANNEL

10.1. Half round channel shall be plain or with stop end and shall have internal dia of 100 mm approved by the Owner's Representative. The jointing work shall be done with white cement slurry. The drains shall be provided with proper slopes as indicated in drawings or as specified by the Owner's Representative. Channel shall be covered with matching tiles leaving provision for cleaning the same.

10.2. The payment shall be made per metre basis and shall include all labour, material etc. complete including laying, jointing etc.

11. PRECAST R.C.C. PIPE

11.1. Materials

For pipe materials, the following specifications shall apply:

Specification for Precast Concrete Pipes (with and without reinforcement)	IS:458
Code of practice for laying of concrete pipes	IS:783

For cement sand, mortar, water etc. the specifications laid down for concrete works shall apply.

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All pipes must be new and perfectly sound, free from cracks, cylindrical, straight, and of standard nominal diameter and length with even texture. Each pipe shall have one collar with it.

The Contractor shall submit manufacturer's test certificate whenever demanded by Owner's Representative. Spun yarn for pipe joints shall be of best quality. It shall be free from dust etc.

11.2. Transportation and Stacking

The transportation of materials to the work site and stacking shall be done in a manner to cause minimum inconvenience to the traffic and other construction works. The pipe shall be protected during handling against impact, shocks and free fall to avoid cracks and damage.

The Contractor shall be fully responsible for the safety and security of materials transported and stacked in the field.

11.3. Lowering and Laying of Pipes

11.3.1. General

The laying and jointing of pipes shall conform to IS:783. The trench shall be checked for proper level, gradient and alignment before lowering the pipes.

11.3.2. Lowering

The pipes shall be lowered cautiously to prevent disturbance of the bed and sides of the trench. The heavy pipes shall be lowered by means of proper shear legs, chain pulley blocks or as directed by Owner's Representative. Great care should be taken to prevent sand etc. from entering the pipes.

11.3.3. Laying

Laying of pipes shall proceed up grade of slopes. The error of grade shall not be rectified by packing up earth underneath the pipes. If required, concrete shall be used for packing. The ends of the pipes shall be kept closed to keep dirt, mud and foreign materials, out. Adequate provision shall be made to prevent floating of pipe in the event of flooding of trenches.

The body of the pipe for its entire length shall rest on an even bed in the trench and places shall be excavated to receive the collar for the purpose of jointing.

11.4. Jointing of Pipes

Joint in the pipe line shall be of the socket and spigot type and conforming to relevant Indian Standards.

As per IS:458-1988 joint in pressure pipes shall be flexible rubber ring joint only. Contractor shall provide pipes of socket and spigot type meeting the above requirement. Concrete pipe where permitted by site incharge with collar shall be water tight.

A few skeins of spun yarn soaked in neat cement wash shall be inserted in the groove at the end of the pipe and the two adjoining pipes butted against each other. Collar shall be slipped over the joint covering equally both the pipes. Spunyarn soacked in neat cement wash shall be passed round the pipes and inserted in the joint by means of caulking tools from both ends of the collar. More skeins of yarn shall be added and well rammed home. The object of the yarn is to centre the two ends of the pipes within the collar.

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Cement mortar 1:2 (1 cement, 2 sand) shall be slightly moistened and must on no account be soft or sloppy and shall be carefully inserted by hard into the joint. The mortar shall then be punched and caulked into the joint and more cement mortar added until the space of the joint has been filled completely with tightly caulked mortar. The joint shall be finished off neatly outside the collar on both side at an angle of 45°.

Any surplus mortar projecting inside the joint is to be removed and to guard against any such projections. Sack or gunny bags shall be drawn past each joint after completion.

11.5. Curing

The cement mortar joints shall be cured at least for seven days.

11.6. Testing

All joints in the pipes shall be tested to a head of 1.5 metres of water above the top of the highest pipe.

11.7. Payment for supplying, lowering, laying, jointing and testing shall be made on running meter basis. The length of pipes laid include collars and the rate shall include all supplies and works mentioned in proceeding paras, including excavation backfilling, concrete, removal surplus earth etc. complete.

12. M.S. RUNGS / C.I. STEPS

12.1. The rungs for pits/manholes and septic tanks shall be of MS conforming to Indian Standard and to the shape and size as showin in drawings.

CI steps for manholes if needed shall be as per IS:5455.

M.S. rungs shall be coated with 2 coats of approved bituminous paint.

12.2. Payment for rungs steps shall be made as per number and the rate shall include supply, fixing, finixhing the walls, painting etc. complete.

13. SOAK PITS

13.1. All earthwork in excavation, brick work etc. shal conform to relevant IS Standard.

The brick bats should preferably be slightly overburnt or thoroughly well burnt, deep red in colour with some proportion of deep blue of black veins. Spongy or vitrified material as a result of excessive over burning is useless and shall be rejected. Brick bats bigger than specified size shall be reduced to required size (40 to 50 mm) before filling in soak pit and no extra payment shall be made for this. It shall be stacked at site as directed by Owner's Representative. Soak pit and septic tank shall be connected with required piping.

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13.2. Payment of soak pit shall be made per number basis. Rate quoted shall include brick masonry work, providing and filling brick bats, earthwork in excavation backfilling making i nlet connection with pipe and connecting same to septic tank etc. complete as shown in drawing.

14. SEPTIC TANK

14.1. Septic tank consisting of sewage receiving chamber inspection door, vent pipe, inlet and outlet connections, manhole cover, C.I. steps etc. shall be used.

Design, testing and commissioning shall conform to IS:2470, Part-I.

Access opening shall be provided for dislodging and inspection.

The ventilating pipe shall be provided with pipe of at least 50 mm dia extended 2 meters above the nearest working platform level.

14.2. Payment of septic tank shall be made per number basis and rate shall include all accessories like, inlet, outlet, vent pipe, manhole cover and CI steps, earthwork in excavation and backfilling removal of surplus earth etc. complete.

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ROADS

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CHAPTER I : CONCRETE PAVEMENT

1. SCOPE

This specification covers the requirements of Material. Laying and finishing concrete pavement.

2. MATERIALS

2.1. Water

Water used for cement concrete, mortar, plaster, grout, curing etc. shall be clear and free from injurious amounts of oils, acids, alkalis, organic matters or other harmful substances. Only natural water suitable for drinking shall be used. It shall conform to IS:456.

2.2. Aggregate for Concrete

The aggregates for concrete shall comply in all respects with IS:383 and IS:456. This should be furnished in at least two separate sizes with separation at 20mm IS sieve when combined material graded from 5 to 38 mm is specified and at 25mm IS sieve when combined material graded from 20 to 50 mm is specified. This shall be obtained from a source approved by Owner's Representative and shall be chemically inert, strong, hard, durable and of limited porosity. This shall be of the gauge specified in the schedule of rates and approximately cubical in shape. It shall be free from soft or decayed pieces, dirt, clay, leaves or any organic matter. The aggregate shall not have any injurious effect when mixed with cement nor shall it corrode the reinforcement, nor otherwise impair the strength and durability of the concrete. The size of coarse aggregate mentioned in this specification denotes maximum size of aggregate and the same shall be grad e downward as per IS: 383.

2.3. Sand for Concrete and Mortar

Fine aggregate shall preferably be natural sands. In case of crushed sand the very fine natural sand amount passing IS: NO. 383. Sand shall consist of clean, hard, strong, sharp, durable uncoated particles free from any mix of clay, dust, vegetable matter, mica, iron pyrites, shells, soft or flakey and elongated particles, alkali organic matter, salts, loam and other impurities which may be considered by the Owner's Representative as harmful. Sulphate content should not exceed 1%. Total content of all deleterious matter should not exceed 5%. This source of sand shall be approved by the Owner's Representative. Sand obtained from river bed subject to tidal effect will not be allowed in works. All sand shall be washed before being brought to site.

2.4. Storage of Aggregates

The subcontractor shall at all time maintain at the site of work such quantities of aggregates as are considered by the Owner's Representative to be sufficient to ensure continuity of work.

Each type and grade of aggregates shall be stored separately. This ground on which the aggregates are stored shall be firm and have sufficient slope to ensure adequate drainage of rain water.

Any aggregate delivered to site wet shall be placed in storage for atleast 24 hours to ensure adequate drainage before it is used for concreting.

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Sand heaps shall be covered with bricks or such other materials to prevent blowing off and to assist in good house keeping.

2.5. Cement

2.5.1. The cement used shall be ordinary Portland cement, conforming to IS:269, unless otherwise specified.

2.5.2. The cement issued to the contractor shall be stored in a suitable weather tight building and in such a manner as to permit easy access for proper inspection. All cement stored at site by the contractor shall be arranged in batches and used in the same order as received from owner. Contractor shall maintain a cement register in which all entries shall be completed day-to-day showing quantities received, date of receipt and daily cement consumption.

2.5.3. Rejection of Cement

The Owner's Representative may reject cement which has deteriorated after issue to the contractor owing to inadequate protection against moisture or other causes or in any other case where the cement is not to his satisfaction.

2.5.4. Admixture

No admixture shall be normally permitted for concrete or mortar. Water proofing compound to be used in concrete, plaster, damp proof course etc. where specified, shall be of approved make. It shall be mixed as per manufacturers specifications and as approved and directed by the Owner's Representative.

2.5.5. Joint sealing in pavements and around equipments structural columns shall be approved compound conforming to IS: 1834 TYPE 'b' (Shalitex or approved equivalent).

3. GRADES AND PROPORTIONING

3.1. The grades indicated in drawings and schedules shall conform to IS: 456, the strengths being indicated below.

Min. Crushing Strength of 15 cm. Cube in Kg/sq.cm at 28 days.

Grade	**Prel. Test**	**Works cube test**
M- 10	135	100
M-15	200	150
M-20	260	200
M-25	320	250
M-30	380	300

3.2. The water cement ratio, aggregates and grading for each mix shall be predetermined from the results of cube tests of trial mixes. The mix proportions determined thus shall be followed at site and shall in no way relieve the contractor of his responsibility as regards the prescribed strength of mix. The mix proportions,

however, shall be revised if the results of the cube tests during the construction show consistently lower or higher

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strength than the prescribed one. No claim to alter the rates of concrete work will be entertained due to such changes in mix designs, as the contractor will be responsible to produce the concrete of required grade. The slump of concrete mix for pavements compacted by vibrations should not be more than 25 mm and that for manual compaction not more than 50 mm.

3.3. All concrete shall be controlled concrete conforming to IS: 456. For mud-mat and filling purpose ordinary concrete of 1:4:8 mix proportion may be used or as indicated in drawings.

4. EQUIPMENT

All equipment like weighting devices, measuring boxes, mixers, sub-grade templates, hand tempers, vibrating screens, internal vibrators, longitudinal floats, bridges, belts, push brooms, straight edges, edging tools etc. shall be on the worksite in first class working condition and shall have been inspected by the Owner's Representative before paving operations are permitted to start. Throughout the construction period the contractor shall maintain adequate equipment in first class working conditions to ensure the proper execution of the work.

5. PREPARATION OF SUB GRADE

5.1. The sub grade or sub base for laying of the concrete slabs shall comply with the following requirements.

5.1.1. That no soft spots are present in the sub grade or sub base.

5.1.2. That the uniformly compacted subgrade or subbase extends atleast 300mm on either side of the width to be concreted.

5.1.3. That the subgrade is properly drained.

5.1.4. That the minimum modulus of subgrade reaction obtained with a plate bearing test shall be 5.54 Kg/cm2.

5.2. Sub grade shall be prepared to the lines and grades shown on the drawings.

5.3. No concrete shall be placed around manholes or other structure until they have been brought to required grade and alignment.

5.4. The subgrade shall be in moist condition at time of concrete placement.

6. FORMS

6.1. All side forms shall be of mild steel unless use of wooden sections are specially permitted. The steel forms shall be MS channel sections and their depth shall be equal to thickness of the pavement. The sections shall have a length of atleast 3.0m except on curves, where shorter sections may be used. These forms should be provided with ample bracing and supports to prevent the springing of the forms under the concrete pressure or thrust of machinery operating nearby.

6.2. The forms should be in sufficient number and they should not be removed until concrete is hardened sufficiently.

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6.3. In case wooden forms are permitted, these shall have minimum base width of 100mm for 200mm slabs and 150mm for more than 200mm thickness.

7. REINFORCEMENT

7.1. All reinforcement work shall confirm to IS: 456. Reinforcing steel shall be free from dirt scale or other foreign matter and rust. The number, size, form and position of all the reinforcement shall unless otherwise directed or authorised by Owner's Representative be strictly as per drawings. The placing of reinforcement shall be such that when properly placed into the work, extreme longitudinal bars will be located not less than 50mm nor more than 100mm from the edges of the slab except for dummy joints, the length of reinforcement will keep clear of transverse joints by not less than 50mm nor more than 100mm as measured from the centre of the joint to the ends of longitudinal bars.

7.2. While overlapping the bars in either direction the overlap shall be atleast equal to spacing between bars in the respective direction.

7.3. To prevent displacement before or during concreting, the bars shall be secured to one another with 16 SWG black soft annealed binding wire. Wooden planks provided for labour to move shall be supported independent of reinforcement and the cage shall never be permitted to sag or get displaced during concreting. Concrete blocks shall be used to ensure correct cover of concrete over bars as shown in drawings.

7.4. Dowels if used as load transferring device shall be checked for exact position before concreting. Dowels shall be parallel to the surface and perpendicular to the joint and shall not place any restraint on the movement of the joint.

8. MIXING

8.1. Mixing should be carried out in mechanical mixers. Drum of the mixer shall rotate at a peripheral speed of 60RPM (Rotation per minute). Hand mixing can, however, be permitted by Owner's Representative in special cases. Water cement ratio shall be rigidly controlled during mixing. Mixers shall be fitted with automatic devices to discharge measured quantity of water directly into the mixing pan. The water shall be introduced into the drum within first 15 seconds of mixing, but not until all the cement and aggregate constituting the batch are thoroughly mixed. Mixing shall continue until the concrete is uniform in colour and for not less than 2 minutes after all the materials and water are in the drum. The entire content of the drum shall be discharged before any materials are placed therein for the succeeding batch.

8.2. Correction for Bulking – In volume batching suitable allowance shall be made for the bulking of fine aggregates due to presence of water. For this purpose the bulking shall be determined as directed by Owner's Representative.

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9. PLACING

9.1. The place where concrete is to be poured should be clean and free from all loose dirt, standing water etc.

9.2. Walking on reinforcement layers is not permissible. Walkways of wooden planks or similar material can be placed with removable supports and should be independent of the reinforcement. The reinforcement position should not be disturbed nor should at sag during carriage and placement of concrete.

9.3. Placing and vibration should not take totally more than 20 minutes from time of mixing. Method of placing should be got approved by Owner's Representative. Segregation during carriage and placement should be avoided. If during carriage concrete segregates, it should be remixed before placement.

9.4. Concrete should not be dropped from a height of over 1.5m.

9.5. To ensure bond and water tightness between old concrete surface and fresh concrete to be placed, the surface should be cleaned and roughened by "initial green cut" by wire brushing or chipping. The initial green may be done by wire brush after 6 hours of placing concrete in order to facilitate the work. Chipping can be done only after 48 hours. A layer of cement slurry with 1:1 mix (1 cement:1 sand) should be poured to obtain a uniform coating on old concrete. Immediately thereafter, the fresh concrete should be poured.

9.6. Concrete shall be mixed in quantities required for immediate use and shall be deposited on the sub-grade in a single operation to the required depth and width of the pavement. Spreading shall be as uniform as possible to avoid re-handling of concrete. Where however, a certain amount of redistribution is necessary it shall be done with shovels and not with rakes. Concrete shall be vibrated with internal vibrators. Concrete shall be placed continuously until completion of the part of the work between construction joints or as directed by Owner's Representative continuously until completion of the part of the work between construction joints or as directed by Owner's Representative.

9.7. Placing in inclement weather

All precautions shall be taken for concreting in extreme weather in accordance with the relevant clauses of IS:456. Due protection shall be provided to prevent cement being blown away while proport ioning and mixing during windy weather. No concreting shall be carried out in continuous heavy rains. Necessary arrangements to cover the freshly poured concrete shall be provided, to protect it from the direct rays of the sun and from drying winds.

9.8. All concreting placement should be co-ordinated with placement of conduits, inserts, embedded parts etc. executed either by same agency or separately.

9.9. Concrete in standing water shall be executed strictly as per IS:456 . this shall be paid as a separate item where applicable.

9.10. The concrete shall be laid in panels not exceeding 4M x4M as shown in layout drawing or as directed by Owner's Representative.

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10. COMPACTION & FINISHING

10.1. Compaction

The surface of the pavement shall be compacted either by means of power driven finish machine or a vibrating hand screed. For areas where width of the slab is very small as the corner of street junction etc. hand consolidation and finishing shall be done as follows:

10.1.1. Concrete as soon as placed, shall be struck off uniformly and screeted to the crown and cross-section shown on the plans and to such level above the base that when compacted and finished, the pavement shall conform to the grade and cross section indicated by the plans. The entire surface shall then be tamped until a close knit dense surface is obtained.

10.1.2. The tamper shall rest on the side forms and shall be drawn ahead with a swing motion in combination with a series of lifts and drops alternating with lateral shifts, the aim of this operation being compaction and screeding to the approximate level required. Subsequent tamping should advance 75mm at a time in the direction in which the work is proceeding and in final stages the tamping should be closer about 12mm at a time until a level and dense surface is obtained.

10.1.3. If so directed by Owner's Representative, hand operated vibrating tamper consisting of normal type of hand tamper attached to a pneumatic or electric vibrating unit shall be used for compaction.

10.1.4. Segregated particles of coarse aggregate which collect in front of the tamper shall be thrown outside the forms or thoroughly mixed by hand with a mass; of concrete already on the base.

10.1.5. Compaction by tamping shall be carried on till the mortar in the mix just works upto the surface. The surfa ce shall be examined after compaction correction, if needed, shall be made by adding or removing concrete followed by further compaction and finishing.

10.2. Floating

As soon as practicable, after concrete has been struck off and compacted, it shall be further smoothened and compacted by means of a longitudinal float 1200 mm long and 75mm wide operated from a foot bridge.

10.3. Straight Edging

After floating is completed and excess water removed but while concrete is still plastic the slab surface shall be tested for trueness with a straight edge and rectified, if necessary.

10.4. Belting

Just before the concrete becomes non-plastic, the surface shall be belted with a two ply canvas belt not less than 200mm wide and atleast 1.0M longer than the width of the slab. Hand belts shall have suitable handles to permit controlled uniform manipulation. The belt shall be operated with short strokes transverse to the carriage way centreline and a rapid advance parallel to the center line.

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10.5. Brooming

After belting and as soon as surplus water has risen to the surface the pavement shall be given a broom finish to produce corrugations of uniform appearance of not more than 1/16 inch in depth.

10.6. Edging

Before the concrete has its initial set the edges shall be carefull y finished with an edger of the radius required and pavement edge shall be left smooth and true to line.

11. CURING

11.1. Initial Curing

Immediately, after the completion of the finishing operations, the surface of pavement shall be entirely covered with wetted burlap, cotton or jute mats.

11.2. Final Curing

Upon the removal of the mats, the slab shall be thoroughly wetted and covered by the following method:

Curing with wet earth- A system of transverse and longitudinal dykes of clay about 50mm high shall be laid over the slab. These dykes shall be blanketed with sandy soils free from stones to prevent drying up. The rest of the slab shall be covered with sufficient sandy soil so as to produce a blanket of earth not less than 37mm depth after wetting. This earth shall be kept thoroughly wet till the concrete has attained the required strength but not less than 14 days.

12. JOINTS

12.1. Wherever called for on the drawings expansion joints, dummy joints and longitudinal joints shall be provided as per details indicated in the drawing and as directed by Owner's Representative.

12.2. Sealing of Joints

12.2.1. After the curing, the temporary seal or other intruded materials of all expansion and contraction joints shall be removed completely and the slots filled with approved joint sealing compound.

12.2.2. The edges of the joints shall thoroughly cleaned and primed with a thin bituminous paint which shall be allowed to dry before the sealing compound is applied.

12.2.3. The primer shall be applied with a brush. The composition of primer shall be as follows:

Name of Material	**Percent by weight**	
1. 200 – Penetration Bitumen	66) Blended	Blended
2. Light creosote oil	14) Hot	Cold
3. Solvent Naphtha	20)	

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The bitumen shall be melted and fluxed with oil. When cold, solvent Naphtha shall be added. BITUMINOUS emulsion shall not be used as primers. Care shall be taken to ensure that the sealing compound is not heated above 200^0C and the temperature does not exceed 180^0C for long periods.

12.2.4. Sealing compound shall be poured into the joint opening in such a manner that the material will not be spilled on the exposed surface of the concrete. When required to prevent pick up under traffic, the exposed surface of the sealing compound shall be dusted with hydrated lime.

13. OPENING TO TRAFFIC

13.1. Traffic shall not be allowed for a period of 28 days after laying of concrete.

13.2. Before opening the roads to traffic all joints shall be filled and trimmed or topped out as required.

CHAPTER II : FLEXIBLE PAVEMENT (UPTO WBM LAYER)

1. SCOPE

This specification covers the material construction details for earthwork in filling for embankments, filling with sand/murrum, WBM sub-base, WBM base course and shoulders for roads and flexible pavements.

2. REFERENCE CODES AND STANDARDS

2.1. B.I.S. Specifications.

IS : 2720- methods of Test of Soil.

2.2. Indian Road Congress Standards.

IRC:19-Standards Specification and Code of Practice for Water Bound Macadam.

3. EARTH WORK FILLING

3.1. Materials

Only material considered suitable by the Owner's Representative shall be employed for the construction and that considered unsuitable shall be disposed off as directed by Owner's Representative at his own cost and no claim for compensation will be entertained. The Contractor shall give the samples of earth, he proposes to use for filling along with the following characteristics of the sample to Owner's Representative prior to collection and use, for approval.

i. Mechanical analysis or gain size analysis as per IS:2720 Part IV.

ii. Liquid limit as per IS: 2720 Part V

iii. Plastic limit as per IS: 2720 Part V.

iv. Moisture density relationship as per IS: 2720 Part VIII.

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The material (soil) used for filling shall be free from boulders, lumps, tree roots, rubbish or any organic deleterious matter.

Material (soil) having plasticity index less than 20 shall be used for filling purposes. Soil having laboratory maximum dry density of less than 1.5 gm/cc shall not be used.

Care shall be taken to see that unsuitable waste material is disposed off in such a manner that there is no likelihood of its getting mixed with the materials proposed to be used for filling.

The work shall be so planned and executed such that the best available material (soil) is reserved for the top portion of embankment.

3.2. Filling for Embankments and Shoulders

3.2.1. The area where filling is to be placed must be cleared of all loose material and virgin soil must be exposed. Such exposed surface must be consolidated properly to obtain 90% of maximum laboratory dry density of the soil. All soft patches must be worked out to remove the soft soil and selected approved earth must be filled back and compacted.

3.2.2. Payment for the removal of loose top soil as described in clause 3.2.1 above shall be included in the item for earthwork in filling. No separate payment for consolidation of exposed ground surface will be made. The rate quoted for the earthfill shall be inclusive of the cost of clearing and stripping, consolidation, including watering, testing etc. of the exposed ground.

3.2.3. Approved fill material shall be spread in uniform layers not exceeding 20 cms in loose depth for embankment filling. Shoulder construction shall be so organised as to keep pace with the construction of different layers of the pavement, which may require earth fill thickness less than 20 cm. All clods, lumps etc. shall be broken before compaction.

3.2.4. In general the soil shall be spread uniformly over the entire width of embankment or shoulder as the case may be. For large embankments, the spreading of soil shall be as directed by Engineer-in Charge.

3.2.5. Successive layers of filling shall not be placed until the layer under construction has been thoroughl y compacted to satisfy the requirements laid down in this specification.

3.2.6. Prior to rolling, the moisture content of material shall be brought to within plus or minus 2% of the optimum moisture content as described in IS: 2720- Part-VIII. The moisture content shall preferably be on the wet side for potentially expensive soils.

3.2.7. After adjusting the moisture content as described in Clause 3.2.6, the layers shall be thoroughly compacted by means of rollers till 90% of maximum laboratory dry density is obtained as per IS:2720 Part VIII.

3.2.8. Each layer shall be tested in field for density and accepted by Owner's Representative subjected to achie ving the required density before laying the next layer. A minimum of one test per 500 M2 area for each layer shall be conducted.00

3.2.9. All type of rollers that should be employed for compaction shall be as per direction of Owner's Representative.

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3.2.10. If the layer fails to meet the required density, it shall be reworked or the material shall be replaced and method of construction altered as directed by Owner's Representative to obtain the required density.

3.2.11. The filling shall be finished in conformity with alignment, levels, cross sections and dimensions as shown in the drawings.

3.2.12. Extra material shall be removed and disposed off as directed by Owner's Representative.

3.3. Tolerance

Embankment and shoulders for roads, units etc. shall be carried to within a tolerance of cm. From final lines but shall be to required grades and slopes.

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4. FILLING WITH SAND/ MURRUM

4.1. Sand for filling shall preferably be locally available sand clean and free from any chemical or other impurities. Murrum for filling shall be clean and well graded. Sand/ Murrum shall not contain any vegetation, organic, clayey or other material and shall be obtained from a source approved by Owner's Representative.

4.2. Murrum/ Sand shall be spread in layers not exceeding 15 cm in loose thickness over the areas. Each layer shall be uniform in density, quality of material and' moisture content before compaction. The moisture content shall be within two percent of the optimum moisture content as per IS: 2720 Part VIII.

4.2.1. In case of pure sand, flooding with water is permissible.

4.3. Compaction of each layer shall be by mechanical means as per directions of Owner's Representative. Only in accessible reaches shall be worked manually. Each layer shall be uniformly compacted to obtain 90% of maximum laboratory dry density of the material. If the material fails to achieve the required density, the layer shall be reworked with necessary alteration in compaction, so that the required compaction is obtained. A minimum of one test per M2 area for each layer shall be conducted.

4.4. Subsequent layers shall be placed only after the layer already laid has been compacted to the required density and approved by Owner's Representative.

4.5. The finish surface must be dressed to required grade and slope. Excess material must be removed from compaction site, as directed by Owner's Representative.

5. WATER BOUND MACADAM SUB BASE/ BASE COURSE

The sub-base course shall consist of one or more layers, each of 100 mm compacted thickness.

The base course shall consist of one or more layers, each of 75 mm compacted thickness.

5.1. Stone Aggregate for WBM

5.1.1. The coarse aggregates shall be hard, crushed or broken stone metal from quarries approved by Owner's Representative, it shall be hard durable and free from flat elongated, soft and disintegrated particles. It shall not have excess of dirt and other objectionable matter. The quality, size and grading of the coarse aggregate shall be conforming to IRC 19 : Std Spec and code of practice for WBM.

a) The grading of the coarse aggregates for the sub-base course shall be as below:

Size Range	**Sieve Designation (IS : 460)**	**% by weight passing the sieve**
90mm to 45 mm	125 mm	100
Grade-I	90 mm	90-100

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63 mm	25-60
45 mm	0-15
22.4 mm	0-5

b) The grading of the coarse aggregate for the base course shall be as below:

Size Range	Sieve Designation (IS : 460)	% by weight passing the sieve
63 mm to 45 mm	90 mm	100
Grade-2	63 mm	90-100
	53mm	25-75
	45mm	0-15
	22.4 mm	0-5

5.1.2. a) Physical requirement of coarse aggregates for sub-base course shall be below:

i) Los Angles Abrasion Value 60% (Maximum) or
ii) Aggregate Impact Value 50% (Maximum)

b) Physical requirement of coarse aggregates for base course shall be as below:

i) Los Angles Abrasion Value 50% (Maximum) or
Aggregate Impact value 40% (Maximum)

ii) Flakiness index value 15% (Maximum)

Samples of test shall be representative of the material to be used and collected as per IS : 2430.

5.1.3. The aggregates shall be stacked at the road side on firm, well drained ground in regular stacks, as directed by Owner's Representative. The various grade shall be stacked separately and contamination by earth and other extraneous matter shall be prevented effectively.

5.2. Binding Material Murrum

5.2.1. The binding material shall be clean, dry murrum free from leaves, organic matter and any deleterious material.

5.2.2. It shall be obtained from quarries approved by Owner's Representative.

5.3. Spreading Coarse Aggregates

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5.3.1. The sub grade or sub-base to receive WBM coarse shall be prepared to the required grade and camber. Before starting with WBM construction, side shoulders shall be constructed in advance to a thickness corresponding to the compacted layer of the WBM coarse for lateral confinement of aggregate. After shoulders are ready, there inside edge shall be trimmed vertical to receive the aggregate. The practice of constructing WBM in a trench section excavated on the embankment/ formation must be avoided.

5.3.2. The coarse aggregate shall be spread uniformly and evenly on the prepared base in required quantities from the stacks. The aggregate shall be spread to proper profiles by using templates across the road about 6m apart.

5.3.3. The surface of the aggregate spread shall be carefully, trued up and all high or low spots remedied by removing or adding aggregate as may be required. The surface shall be checked from time to time, during the spreading and rolling of the coarse aggregate to ensure a finished surface without variation greater than 12 mm, when a 3 metre long straight edge is laid parallel to centre line of the road.

5.3.4. The WBM layer shall be tested by depth blocks. No segregation on large or fine particle shall be allowed and the coarse aggregate as spread shall be of uniform gradation with no pocket of fine materials.

5.3.5. The coarse aggregate shall not be spread in lengths more than 3 days average work in advance of the rolling, spreading murrum and bonding of the preceding section.

5.4. Rolling Road Metal

5.4.1. Immediately following the spreading of the coarse aggregates, if shall be compacted to full width by rolling with either three wheeled power roller of 8 to 10 tonne weight or equivalent vibratory roller true to the line and camber as shown in the drawing. The course shall not be rolled when the sub -grade is soft or yielding or the rolling causes a wave like motion in the base course or sub-grade. When rolling develops irregularities that exceed 12mm when tested with a 3 metre straight edge, the irregular surface shall be loosened and then aggregate added to or removed from it as required and the area rolled until it gives uniform surface conforming to the desired cross-section and grade. The surface shall also be checked transversely by template and any irregularities corrected as above. The use of murrum to make up depression shall not be permitted.

5.4.2. The rolling shall begin from edges with roller running forward and backward until the edges have been firmly compacted. The rolling shall then progress gradually from edges to the centre parallel to the centre line of the road lapping uniformly each preceding rear wheel track by one half width and shall continue until the entire area of the course has been rolled by the rear wheel. On the super elevated portions of road, the rolling shall commence from the lower edge and progress gradually towards the upper edge of the road.

5.4.3. Rolling shall be discontinued when aggregate are thoroughly keyed and creating of stone wheel of roller is no longer visible partially compacted with sufficient void space in them to permit application of screenings. Slight sprinkling of water may be done if required.

5.5. Screenings

5.5.1. Material

5.5.2. Screenings to fill the voids in the coarse aggregates shall, as far as possible be the same material as the coarse aggregates. Where it is decided by the Owner's Representative to use other materials, the same shall

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be predominantly non plastic materials such as Kankar nodules, gravel (other than river -borne rounded aggregate) or murrum, provided that the liquid limit and plasticity indeed of such material is below .20 and 6 respectively, and the fraction passing 75 micron sieve does not exceed 10 per cent.

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5.5.3. Grading requirements of screenings

Size Range	**Sieve Designation (IS : 460)**	**% by weight passing the sieve**
13.2 mm	13.2 mm	100
11.2 mm	95-100	5.6 mm
15-35	180 micron	0-10

This grading, however, shall not be mandatory, in case either murrum or gravel is used as screenings.

5.6. Application of Screenings

5.6.1. After the coarse aggregate has been rolled as described in Clause 5.3, screenings shall be applied uniformly and gradually over the surface to completely fill the interstices. Dry rolling shall be continued while the screenings are being spread so that the jarring effect of the roll will cause them to settle into the voids of the coarse aggregates.

5.6.2. The screenings shall not be dumped in piles on coarse aggregate but shall be spread uniformly in successive thin layers either by the spreading motion of hand shovels or by mechanic spreaders.

5.6.3. The screenings shall be applied at a uniform and slow rate (in three or more applications so as to ensure filling of all voids. Rolling and brooming shall continue with the spreading of the screenings. Either mechanical brooms or hand brooms or both may be used. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface making the filling of voids difficult or preventing the direct bearings of the roller on the coarse aggregates. The spreading, rolling and brooming of screenings shall be performed on sections which can be completed within one day's operation and shall continue until no more screenings can be forced into the voids of the coarse aggregates. Damp and wet screening shall not be used under any circumstances.

5.6.4. The quantity of screenings used shall be such as to fill all voids in the water bound macadam courses.

5.7. Sprinkling and Grouting

5.7.1. After spreading the screenings, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into voids and to distribute them evenly. The sprinkling, sweeping and rolling shall be continued and additional screenings applied where necessary until the coarse aggregates are well compacted and grout of screenings and water form a wave ahead of wheels of the roller. Care shall be taken to see that the base of sub-grade does not get damaged due to the addition of the excessive quantity of water during the construction.

5.8. Binding Material

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5.8.1. Binding material, to prevent revelling of WBM, shall consist of fine grained material possessing P.I.Value upto 6

5.8.2. Application of binding material shall not be necessary where murrum or gravel is used as screenings.

5.8.3. Binding material shall be obtained from quarries/ sources approved by the Owner's Representative.

5.9. Application of Binding Material

5.9.1. After the application of screenings as described above, the binding material shall be applied at a uniform and slow rate (in two or more successive thin layers) so as to ensure filling of all voids.

After each application of binding material, the surface shall be copiously sprinkled with water and the resulting slurry swept in with hand brooms/ mechanical brooms or both so as to fill the voids properly. This shall be followed by rolling with a 6-10 tonne roller during which water shall be applied to the wheels to wash down the binding material that may get stuck to them. The spreading , rolling and brooming of binding material shall be performed on sections which can be completed within one day's operation and shall continue until no more binding material can be forced into the voids of the coarse aggregates and until the slurry of binding material and water forms a wave ahead of the wheels of moving roller. Damp and wet binding material shall not be used under any circumstances.

5.9.2. The quantity of binding material used shall be such as to fill all voids in the water bound macadam.

5.10. Subsequent Layers of WBM

Before laying the subsequent layers of WBM, the surface shall be scarified and reshaped to the required camber and profile, and all ruts, depressions, pot holes etc. made good. The second layer shall be laid after the surface preparation is approved by Owner's Representative. The specification and mode of measurement for subsequent layers of WBM will be similar to that described before.

6. CONSTRUCTION OF SHOULDERS OR BERMS

6.1. After the WBM course is laid and compacted, the existing surface at side berms or shoulders of the roadway must be scarified. Fresh quantity of approved earth must be spread in layers for building up of berms upto the required level and scope.

The earth must be consolidated by at least three passes of an 8-10 tonne road roller. The edges must be well consolidated by suitable means to prevent edge slips and the work properly trimmed and dressed.

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CHAPTER III : BITUMEN PREMIX CARPET

1. SCOPE

This specification establishes the material and construction requirements for the flexible pavement with Bitumen-Premix Carpet.

2. BITUMEN PREMIX CARPET

2.1. Material

2.1.1. Coarse aggregate

The aggregate shall consist of crushed stone of clean, hard, tough, durable rock of uniform quality and shall be clean, free from excess of dust, flat or elongated pieces, soft or disintegrated stone, clay or other deleterious matter. The size of aggregate shall be as mentioned in the schedule of quantities.

2.1.2. Sand

The sand shall consist of clean hard, durable, uncoated, coarse dry particles and shall be free from injurious amounts of dust, soft or flaky particles, organic matter or other deleterious substances.

2.1.3. Binder

The binder shall be bitumen or penetration 80/100 conforming to IS:73. The bitumen shall be collected on road side drums. Any drum leaking or damaged shall not be accepted.

3. QUANTITIES OF MATERIAL (PREMIX CARPET)

3.1. For Premix Carpet 20 mm thick

	Material	**For Premix Carpet Per 100 m^2**	**For Seal Coat Per 100 m^2**
	1	**2**	**3**
1)	Coarse Aggregate 12 mm and down size	2.75 m^3	--
2)	Bitumen 80/100	150 Kg	68.3 Kg
3)	Coarse sand as sealing aggregate	--	0.6 m^3

3.2. For Premix Carpet 25 mm thick

	Material	**For Premix Carpet Per 100 m^2**	**For Seal Coat Per 100 m^2**

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	1	2	3
1)	Coarse Aggregate 12 mm and down size	3.5 m^3	--
2)	Bitumen 80/100	185 Kg	68.3 Kg
3)	Coarse sand as sealing compound	--	0.6 m^3

3.3. For Premix Carpet 50 mm thick

	Material	**For Premix Carpet Per 100 m^2**	**For Seal Coat Per 100 m^2**
	1	**2**	**3**
i)	Coarse Aggregate 25 mm and down size (For 35 mm thick Carpet 1 Layer)	5.5 m^3	--
ii)	Coarse Aggregate 12 mm and down size (For 15 mm thick Carpet Layer)	2.0 m^3	--
iii)	Bitumen 80/100	150 Kg	68.3 Kg
	a) For 35 mm thick Carpet (1 Layer)	269 Kg.	68.3 kg.
	b) For 15 mm thick Carpet (II Layer)	110 kg.	--

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iv)	Coarse sand as sealing aggregate	--	0.6 m^3

3.4. For Premix Carpet 75 mm thick

	Material	**For Premix Carpet Per 100 m^2**	**For Seal Coat Per 100 m^2**
	1	**2**	**3**
i)	Coarse Aggregate 25 mm and down size (For 50 mm thick Carpet 1 Layer)	8.5 m^3	--
ii)	Coarse Aggregate 25 mm and down size (For 15 mm thick Carpet II Layer)	3.5 m^3	--
iii)	Bitumen 80/100		
	a) For 50 mm thick I Layer	375 Kg.	68.3 kg.
	b) For 25 mm thick II Layer	185 kg.	--
iv)	Coarse sand as sealing aggregate	--	0.6 m^3

4. LAYING

4.1. Preparation of Road Surface

The existing surface shall be thoroughly cleaned of dust, loose materials, caked mud and other foreign matter with the help of wire brush, chisel, picks etc. before laying the tack course. The cleaning shall be carried out in such a manner as to expose the stone metal to a depth of 1 to 2 mm without dislodging the interlocking of the metal. All dust and other material thus removed shall be carried away and dumped at suitable places as directed by the Owner's Representative.

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4.2. If pot holes or ruts are found on the existing road surface, these irregularities must be filled in with premi x chippings and well rammed about a week before the carpet is laid.

4.3. Tack Coat

4.3.1. The bitumen shall be heated in asphalt boilers to 177° – 188° C and shall be spread uniformly at the rate of 1 kg / m^2 by means of sprayers. The applied binder shall be evenly brushed.

4.3.2. The tack coat shall be applied just ahead, keeping pace with laying of premix carpet.

4.4. Preparation of Premix

4.4.1. Mechanical mixers shall be generally used for preparation of premix Improvised hand mixing drums may be used if permitted by the Owner's Representative.

4.4.2. Stone chippings of specified size shall be thoroughly mixed dry in the mixer at the rate indicated above. Binder heated at temperature suitable for the grade of bitumen is added to the mixer drum at the specified rate per 100 m^3 of surface and thoroughly mixed till the stone chips are completely coated with the binder.

4.4.3. The premix shall be emptied on to wheel barrows or stretchers and carried to work site.

4.5. Spreading of Premix

Immediately after applying the tack coat, the premix shall be spread with rakes to the required thickness land distributed evenly by means of a drag spreader. The camber shall be checked by means of camber board and the unevenness shall be rectified.

4.6. Rolling

4.6.1. When the premix has been laid for a length of 15-20 meters, rolling shall be commenced with tandem rollers (8 to 10 tonnes). Rolling should commence from edges and proceed towards centre longitudinally.

4.6.2. The wheels of roller shall be continuously moistened to prevent the premix, adhering to the wheels and being picked up.

4.6.3. After the preliminary rolling and honey combing, high spot or depressions shall be rectified by adding or removing the premix as per requirements and the surface shall be rolled again to compaction. Camber shall be checked at every stage and any defects found shall be rectified. Excessive rolling shall be avoided.

4.7. Seal Coat (For low rainfall areas – under 150 cm/yr)

4.7.1. A premix seal coat, mix preferably in a mechanical mixer after heating the sand should be applied immediately after laying the carpet and rolled. Materials required for this seal coat are as per clause 3.

4.7.2. Seal Coat (for high rainfall areas – over 150 cm/yr)

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The material requirement for seal coat in high rainfall areas in as under:-

Binder 80/100 = 98 kg / 100 m^2 of road surface

Coarse aggregates 6.3 mm

Passing IS 10 mm Square mesh

Retained on IS sieve 2.36 mm = 0.9 m^3/100 m^2 of road surface.

A liquid seal coat, preferably with chippings as above (through coarse sand can also be used) should be applied after laying the carpet. The binder, heated to permitted temperature, should be applied to the cleaned surface, blinded with chippings and rolled.

Traffic may be allowed on the road preferably 24 hours after providing the seal coat.

5. PAYMENT

Payment shall be made on sq.m. basis of finished surface including al labour and materials as per above specifications.

6. REMOVAL OF SURPLUS EARTH

6.1. Surplus earth and soil from excavation shall be removed from construction area to the area demarcated by the Owner's Representative.

6.2. Payment shall be made only for lead beyond initial 50M from construction areas Rate shall include loading, transportation, dumping, stacking the surplus earth and soil in the area demarcated. Payment shall be made on cubic meter basis of the difference of measurements of the volumes of the excavated pits and the measurements of the backfilling.

7. JOB SPECIFICATION FOR BRICK PITCHING

7.1. Excavation

Trench shall be excavated / dressed true to line, section and grade as per drawings prior to starting the pitching work.

7.2. Material

7.2.1. Bricks shall be locally available best bricks.

7.2.2. Cement, sand and water used shall be as per IS:269,2116.

7.3. The concrete mix used for bedding shall be as per drawings and schedule of rates.

7.4. The work of pitching shall be done after the bottom concrete has been laid and sides properly trimmed to the required grade and thoroughly compacted.

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7.5. Brick pitching shall be done in 1:4 cement mortar using best quality locally available bricks.

7.6. Bricks shall be laid in herring bone pattern with their length at 45° to the length of the ditch as sown in drawings.

7.7. Mortar joints shall never exceed 6 mm in thickness and all bricks shall be laid with vertical joints quite full of mortar.

7.8. Bricks shall be soaked for a period of at least 12 hours immediately before use and no broken and damaged bricks shall be used in any part of the work except such as will be required to close any line of bricks.

7.9. The face of pitching shall be made even and smooth.

7.10. The brick work shall be raked and flush pointed with cement mortar 1:3 as specified.

7.11. Payment

Payment for brick pitching shall be made on the basis of area paved. It shall include all operations described above except the excavation item.

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ROOF TREATMENT

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1. WATER PROOFING TREATMENT WITH APP (ATACTIC POLYPROPYLENE)

Providing and Laying in situ Seven Course Water proofing treatment with APP (Atactic Polyepropylene) modified polymeric membrane as per drawings/documents by approved manufacturer's like Pidilite/Fosroc/CICO/Shalimar Tar Products.

1.1 Material

Bitumen primer as specified by the manufacturer

Blown type bitumen of grade 85/25 conforming to IS 702.

APP modified Polymeric membrane 3.0mm mm thick of 3.6 kg/sq.m. weight with centre core as 150 -160 Gms/sqm thick High Molecular High Density non woven polyester mat.

Best quality brick tiles of class 100.

Integrated water proofing compound as per IS: 2645-1975.

2. PREPARATION OF SURFACE

The RCC and other surfaces should be cleared of all loose material and all sharp projections and it shall be cleaned, dried and free from dust or loose paint.

2.1 Primer coat

It shall consist of bitumen primer and shall be applied by brush over the prepared bed as adhesive coat @ 0.40 kg per sq.m. as per manufacturer's specification.

2.2 Treatment

Seven course water treatment shall consists of 2nd, 4th & 6th courses of bonding material which shall consists of 85/25 grade of bitumen confirming to IS-702 and shall be applied @ 1.20 kg/sq.m. 3rd and 5th layers of roofing membrane APP modified Polymeric shall be placed over 2nd and fourth layer. Top most layer ie 7th course shall be finished with brick tiles of class designation 100 grouted with cement mortar 1:3 mixed with 2% integral water proofing compound by weight of cement over a 12 mm layer of cement mortar 1:3.

Drain outlets shall be given a four or six course treatment as specified by the Engineer in charge for the roof.

Over coat of bitumen primer at 250 Gms/sq.m. the APP shall be unrolled over the coated surface (with overlaps of 10 cm) and bonded completely to the substrate. The overlaps and complete bottom are then thermofused by flame. Special care shall be taken at similarities such as drains, expansion joints, etc. Subsequent strips shall also be laid in the same manner. Each strip shall overlap the preceding one by at least 10 cm at the longitudinal edges as well as at the ends.

The third layer of bonding material in the seven course treatment shall be carried out in a similar manner after the flashing has been completed.

2.3 High Parapet Walls, Etc.

Membranes shall be laid as flashings wherever junctions of vertical and horizontal surfaces occur. Longitudinal laps shall be 10 cm. The lower layer of membranes in a seven course treatment shall overlap the roof water proofing by not less than 20 cm while the upper layer shall overlap the roofing membranes by 10 cm. The minimum overlap of the membranes in seven course specification over the roofing membranes shall be 10 cm.

The upper edge of the flashing membranes shall be well tucked into the flashing grooves in the parapet, etc. to a depth of not less than 6.5 cm. Corresponding applications of bonding material shall also be made. The flashing treatment shall be firmly held in place in the grooves with wood edges at intervals and the grooves shall filled up with cement mortar 1:4 (1 cement: 4 coarse sand) or cement concrete 1:2:4 (1 cement: 2 coarse sand : 4 graded stone aggregate 6 mm nominal size) surface finished smooth with the rest of the wall. The cement work

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shall be cured for 7 days. When dry, the exposed plaster joints of grooves shall be painted with bitumen and two coats of bituminous solution shall be applied on the vertical and sloping surface of flashing.

2.4 Low Parapet Walls

Where parapet walls are of height 45 cm or less, APP membranes flashing shall be provided in the same manner as for flashings in the case of high parapet wall except that the upper edge shall be carried upto the full height of the wall and taken right across the top of the parapet and down on the external vertical faces to a minimum distance of 5 cm.

2.5 Low Dividing Walls

Where low dividing walls or inverted beams are met with, the same shall be covered with layer treatment as for the main roof, the latter bearing carried down both sides of the wall and overlapping the roofing treatment as in the case of flashing of high parapet walls.

Drain outlets where formed in the low dividing walls, shall be given water proofing treatment of the same number of courses as specified for the flat roof surface. The bottom and sides shall be so treated that all overlaps are in the direction of flow of drainage.

2.6 Pipes

Where vertical pipe outlets are met with 7.5 x 7.5 cm fillets of cement concrete shall be provided and flashing seven course treatment, same as for the roofing treatment shall be laid.

The upper edge of the flashing shall be laid sloping down forward and butted against the pipe and annular depression so formed shall be filled with hot bitumen. A circular metal collar in the shape of an inverted truncated cone shall be fixed on the pipe to throw off the rain water clear of the flashing.

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ROOFING

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1. GENERAL

Reference shall be made to the following Indian Standards for information etc. not covered in the specification. In case of any conflict/contradiction, provisions of specification shall override.

IS 277 Galvanised steel sheet (plain & corrugated)

IS 730 Hook bolts for corrugated sheet roofing.

IS 459 Specification for unreinforced corrugated and semi corrugated asbestos cement sheets.

IS 3007 Code of practice for laying asbestos cement sheets (corrugated sheets)

IS 3007 Code of practice for laying asbestos cement sheets (semi corrugated sheets)

IS 1230 Cast iron rainwater pipes and fittings.

IS 1626 Specifications for asbestos cement building pipes and pipe fittings, gutter and gutter fittings and roofing fittings.

IS 1728 Specification for sheet metal rain water pipes upto 100 mm nom. Size gutters, fittings and accessories.

The roof slope shall be as specified and in general not pitched flatter then 1:5. The normal pitch if not specified shall be 1:2. Materials shall be supplied by approved manufacturer. The items supplied shall be free from cracks, chipped edges or corners or other damages. Storage and safety precautions shall be taken to avoid damage to the accessories.

2. MATERIALS

2.1. Corrugated GI Sheet (CGI) Roofing/Cladding

2.1.1. Corrugated GI Sheet

GI sheets shall be of specified thickness and of class-3 galvanised as per IS 277 and shall be approved brand.

2.1.2. GI Ridges and Hips

These shall be of specified thickness and of class-3 galvanised and shall be bent to the required shape and dimensions as per drawings without damaging the sheet in the process of bending.

2.1.3. GI Valleys and Flashings

These shall be of specified thickness and of class 3 plain galvanised and shall be bent to the required shape and size as per drawings, without damaging the sheet in the process of bending.

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2.1.4. GI Gutters

These shall be of specified thickness and of class-3 plain galvanised and shall be constructed to the required shape and size as per drawings.

2.1.5. Wind Ties

Wind ties of MS flats shall be of specified size, subjected to minimum size of 40 mm x 6 mm.

2.2. Corrugated Asbestos Cement (AC) Sheet Roofing/Cladding

2.2.1. Asbestos Cement Sheets

These shall be of specified thickness and as per IS:459 and shall be of approved brand.

2.2.2. Ridges and Hips

These shall be of the same thickness of CGI sheets, as specified. The type of ridges shall be suitable to the type of sheets used and location.

2.2.3. Other Accessories

Accessories such as flashing pieces, eaves filler pieces, northlight and ventilator curves, barge boards etc. shall be of approved brand and shall be suitable to the location of items as specified.

3. WORKMANSHIP

3.1. Corrugated GI Sheet Roofing

3.1.1. Spacing of Purlins

One purlin each shall be provided at the ridge and the eaves. Spacing of the purlins shall be as specified. Purlin shall coincide with the centre line of the end lap. Ridge purlin shall be placed such that ridges can be placed properly. Portion overhanging the wall support should not be more than one fourth the purlin spacing.

3.1.2. Finish for Purlins

The top surfaces of the purlins shall be painted before fixing the sheets and the embedded portion shall be finished with two coats of coal tar.

3.1.3. Laying of Sheets

Sheets shall be laid on the purlins to a true plane with the lines of corrugation truly parallel or normal to the sides of area to be covered, unless otherwise specified. They shall be bent up along their side edges close to the wall and the junction shall be protected by flashing on projecting drip course as specified.

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3.1.4. Laps

End laps shall be 150 mm for 1:2 slope and 200 mm for flatter ones. Side lap shall be of two ridges of corrugations on each side.

3.1.5. Cutting of sheet

Sheets shall be cut according to the dimensions and as specified as per drawings. Sheets shall be cut with a straight edge and chisel to give a straight finish.

3.1.6. Fixing of Sheets

The sheets shall be fixed to the roof members with J or L polymer coated bolts, polymer cap, seal washer and thrust washer. The bolts shall be long enough to project at least 12 mm above the top of their nuts. The grip of J or L hook bolts on the side of purlins shall not be less than 25 mm. There shall be at least three hook bolts placed at the ridges of corrugations in each sheet in every purlin and their spacing shall not exceed 300 mm. Sheets shall be joined together at side laps by polymer coated bolts and nuts as specified, each bolt shall be with a polymer cap (grease filled) seal washer and polymer coated thrust washer. Bolts shall be placed zig zag on overlapping corrugations. The spacing of the beam bolts shall not exceed 600 mm in each of the staggered rows.

3.1.7. Holes

Holes for all bolts shall be drilled in the ridges of the corrugations from the underside before placing in position. The holes in the sheet shall be at least 50 mm from the edge. The holes in the washers shall be of diameter of the hook bolts or the seam bolts. The nuts shall be tightened from above to give a leak proof roof.

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3.1.8. Ridges and Hips

The overlap for ridges and hips on either side of CGI sheet and end legs shall be at least 225 mm. Ridges & hips shall be fixed to the purlins with polymer coated hook bolts, thrust washer and polymer cap. At least one of the fixing bolts shall pass through the end laps of ridges and hips on either side. If it is not possible extra hook bolts shall be provided. Each endlap of ridges and hips shall be joined together by at least galvanised iron seam bolts and GI washers.

Ridges and hips shall fit squarely on the sheets.

3.1.9. Valleys and Flashings

The edge, wherever the roof sheeting or valley gutter is turned up against a wall shall be made weather proof with flashing. Flashing shall be bent to shape and fixed as specified. Lap over the sheet shall be minimum 150 mm. End laps between flashing sheets shall not be less than 225 mm.

Flashing shall be inserted into brick work or masonry joints to a depth of 50 mm and shall be filled with cement mortar(1:3). When flashing has to be laid at a slope, it shall be stepped at each course of masonry. The steps shall be cut back at an angle of at least 30°.

Valleys shall be bent to shape and shall have at least 225 mm end lap and projection on either side under CGI sheet. Valleys shall be fixed to the roof members below with polymer coated GI bolts, polymer cap, seal washer and polymer coated thrust washer. At least one fixing bolt shall pass through end laps of the valley piece.

3.1.10. Gutters

The longitudinal edges shall be turned back by 12 mm and beaten to form a rounded edge. The ends of the sheet at junctions of pieces shall be hooked into each other and beaten flush to avoid leakage.

Gutters shall be laid to minimum 1:120 slope. Gutters shall be true to line and slope and shall be supported by brackets as specified.

3.1.11. Wind Ties

Wind ties shall be of 40 mm x 6 mm flat iron section and other size as specified. These shall be fixed at the two eaves end of the sheet. Fixing shall be done with the same loose bolts which secure sheets to the purlins. Slot holes shall be cut in the wind ties to allow for temperature variations.

3.2. Asbestos Cement Corrugated Sheet Roofing

3.2.1. Spacing of Purlins

The minimum spacing of purlins shall be 1.6M in case of 7 mm thick AC sheets and 1.4M in case of 6 mm thick AC sheets. Ridges and purlins shall be fixed 75 mm to 115 mm from the apex of the roof.

3.2.2. Laying and Fixing of Sheets

Sheets shall be laid on the roof members as per the codes. The top bearing surfaces of all roof members shall be in one plane. The finished roof shall have uniform slope and the line of corrugations shall be

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straight and true. The sheets shall be laid smooth side upwards. Corrugated sheets shall be laid starting at the eaves from one side as directed.

3.2.3. Overhang

The free overhang of the sheets at the eaves shall be maximum 300 mm for 6 mm thick sheets and 400 mm for 7 mm thick sheets.

3.2.4. Mitre

The length of the mitre shall be 150 mm and width shall be equal to the width at the side lap.

3.2.5. Laps

End laps shall be at least 150 mm in cases of pitch flatter than 1:2 large and appropriate laps shall be given as directed. Side laps shall be laid with a side lap of half a corrugation. The roof shall be pitched at least at a slope of 18". Usually it shall be 1:2.

3.2.6. Fixing Accessories

Sheets shall be secured to the roof members by means of 8 mm dia polymer coated GI bolt. ('J' type hook bolt in case of purlins and 'L' type bolts in case of R.S. joists and precast concrete) and nuts bearing on seal washer and polymer coated thrust washers. The roof hook bolt and nut bearing on the washers shall be used for stitching of sheets, fixtures, etc. The grips of the J and L bolt on the side of purlins/joists shall not be less than 25 mm. Both type of washers mentioned above shall be placed over the sheets before the nuts are screwed down. On purlin there shall be one hook bolt on the crown adjacent to the side lap on either side. GI washer shall be of 25 mm dia and 1.60 mm thick while bitumen washer shall be 35 mm dia and 1.5 mm thick.

Nuts shall be screwed lightly first. After laying about a dozen sheets nuts shall be tightened enough. Length of J bolt shall be 75 mm more than the length of purlin for side sheet fixing and 90 mm more where two sheets overlap in ridges or other accessories are to be fixed. Number and length of bolts and number of washers shall be as follows:

a) At horizontal laps of sheets, at eaves when filler pieces are used, at ridge when sheets and ridge pieces are secured by the same bolt = Thrice the number of sheets in one horizontal course. Length = Depth of purlin plus 90 mm.

b) At eaves when filler pieces are not used, at ridge when corrugated sheets and ridge pieces are secured by the same bolt Number: Twice the number of sheets in one horizontal course, Length = Depth of purlin plus 75 mm.

c) At intermediate purlins where horizontal laps do not occur Number: Twice the number of sheets in one horizontal course, length = Depth of purlin plus 75 mm.

3.2.7. Holes

The holes for fixing shall be drilled in the centre of the end lap of sheets to suit one purlin. Holes for hook bolts etc. shall be drilled. The diameter of the holes shall be 2 mm more than the dia of the fixing bolt. Holes shall be made at least 40 mm away from any edge of sheet or accessory.

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3.2.8. Wind Ties

It shall be same as in case of CGI sheeting.

4. PRECOATED GALVANISED STEEL SHEET ROOFING/CLADDING

4.1. Material

The base metal of the roofing shall be Cold Rolled Steel Sheet conforming to IS-513. It shall be galvanised by Hot-dip process as per IS-277. The bottom unexposed surface shall then be coated with alkyd backer of minimum 7 microns. Top exposed surface shall have epoxy primer of minimum 5 microns followed by polyester top coat of minimum 20 microns of specified colour.

4.2. Properties

The precoated galvanised steel sheets shall meet the following performance standards

Pencil Hardness	:	H-2H
Formability	:	2-3 t
Impact Resistance	:	40"/lb
Salt spray test	:	750 hours
QUV-Wealterometer Test	:	1000 hours
Humidity Test	:	1000 hours
Temperature Resistance	:	150°C
Fire performance	:	Class I

4.3. Profile

The profiles shall have a depth of not less than 30 mm and pitch of 198 mm. Overall sheet thickness shall be 0.60 mm minimum weight shall be 5.24 kg/Sq.M.

4.4. Accessories

Al roofing accessories like ridge, gutters, north light curves etc. shall be fabricated out of the approved precoated sheet as per drawing. Metallic Fasteners and Fixing accessories shall be corrosion proof. Non metallic fasteners shall be of neoprene. Sealants shall be neutral cure type and cold setting variety.

5. MEASUREMENTS AND RATES

Measurements and rates as mentioned here is applicable for item rate tender only.

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5.1. Measurement

a) Measurements shall be taken in square metres for the finished work in superficial area in the general plane of the roof. Laps along ends and side edges shall not be measured. The overlaps of sheets over valley pieces and under the ridge, hip and flashing piece shall be included in the measurement. Measurement for ridges, hips, valleys and gutters shall be taken for the finished work in length along their centre line. No laps for these shall be measured. All measurements shall be made correct up to two places of decimal. No deductions shall be made for openings in roof for chimneys, skylights etc. for area upto 0.40 sq. m. No extra shall be allowed for extra labour in cutting or wastage. For openings exceeding 0.40 Sq. M deductions shall be made for full opening. Cuttings across corrugations shall be measured flat.

b) Roofs with curved sheets shall be measured and paid for separately.

c) No additions shall be made for laps cut through.

d) Cutting required to be done in position shall be measured separately.

e) Openings or recesses involving cutting not exceeding 1 M girth shall be classified as hole, notches and shall be enumerated according to the following:

i) Those not exceeding 0.01 sq. m.

ii) Those exceeding 0.01 sq. m. but not exceeding 0.04 sq. m.

iii) Those exceeding 0.04 sq. m.

5.2. Rates

The roofing rate shall include the cost of all labour and materials involved in all the operations. The rate shall also include the cost of provision, erection and removal of scaffolding, benching, ladders, templates and tools required for the proper execution and erection. The cost of fixing purlins shall not be included in the rate. The rate for flashing shall include the cost of mortar for fixing apart from the other labour and material required. The rate for gutters shall include cost of all labour and material, all specials such as angles, junctions, drop ends or funnel shaped connecting pieces, stop ends etc. flat iron brackets and bolts and nuts required for fixing latter to the roof members.

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ROUTE SURVEY

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CHAPTER I • GENERAL ROUTE SURVEY

1. OBJECTIVE

1.1. Route Survey

The objective of route survey work is to obtain topographic features, soil stratification, geo-technical and soil resistivity data, carry out cadastral survey, collect information and data about the existing facilities located along and in the vicinity of the pipeline route, collect revenue maps,determinine population density index, locating centreline of pipeline alignment on the ground etc.

2. SCOPE OF WORK

The scope of work of Contractor specified in this document shall include, but not limited to the following.

2.1. Detailed Route Survey

2.1.1. Carrying out detailed route survey work along the entire route of the proposed pipeline in accordance with specification. The proposed route will generally follow the recommended route except for changes made at places due to site conditions. The detailed route survey will also include identification of most optimum location/position for the Tee–offs which are foreseen along the pipeline route.

2.1.2. Carryout Topographical survey of the route

Survey should extend up to a maximum of 50 m width of pipeline in cross country and 15 m where route is parallel to a wall or fenced property.

2.1.3. To parepare cross section drawings at each crossing of pipeline with other features like pipes/cables/roads/railway track and other obstructions etc and at every 200 m along the pipeline showing details of 50 m on either side of pipeline.

2.1.4. Observe clockwise horizontal angles in direction of survey to indicate change in direction.

2.1.5. Azimuth observation to the sun are to be made at regular interval to obtain true bearing of the line.

2.1.6. Establish Bench Marks (BM's) along the route and fix apex points.

2.1.7. Levelling is to be carried out using automatic levels between the BM.'s.

2.1.8. Carrying out soil investigation along the proposed pipeline route including water body crossing in accordance with specification.

2.1.9. Carrying out Hydrographic survey (if any) of water bodies.

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2.1.10. Supply and installation of the survey markers as per requirements of the specification and instructions of the CONSULTANT.

2.1.11. Locating all buried/ above ground pipelines, their diameter, type of material transported through them, their design pressure, cables and other utilites within a distance of 50 metres on either side of the pipeline alignment with the help of pipelines/ cable locators or other suitable instruments. Underground scans will be taken with appropriate scanning technique to positively identify position of possible pipelines at pinch point . These scans are also to be used to locate other problem front areas. At specific areas trial excavations will be needed to confirm location/details of pipelines, cables etc.

2.1.12. Carrying out population density survey and location class along the pipeline route as per enclosed specifications. A zone of 400 M width is to be considered along the pipeline route with proposed pipeline in the centre of the zone.

2.1.13. Carrying out cadastral survey covering areas 50 metres on either side of center-line of the proposed pipeline. All revenues and other maps as well as forms required for carrying out this survey shall be arranged by the Contractor at his own cost and responsibility. The contractor shall mark the pipeline route on maps with the following details.

- Land schedules giving the survey numbers, area and details of owners as per the latest official revenue records for last 10 years.
- Major features/land marks including:
- All built-up areas such as
- Religious place, school, hospital etc.
- District/village and panchayat roads.
- Water bodies
- Forest land
- Overhead and underground utility crossings
- Marshy land/ waste land
- Existing pipelines, their diameter, their design pressure etc.
- Name/ type of Industries.
- Present and future railway lines.

These information shall be adequate in all respects for ROU acquisition.

Width of ROU proposed to be acquired will be for 50 m.

2.1.14. Pipeline Alignment must be selected in a manner that the entire width of ROU corridor proposed to be acquired lies in firm ground.

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2.1.15. Carrying out corrosion survey including measurement of soil resistivity, chemical analysis of soil/water and collection of Cathodic Protection related data including powerlines along ROU of the proposed pipeline as per Specifications .

2.1.16. Collection of all information and proposed development plans etc. of the area through which the pipeline passes from the concerned departments of Government of India/State Governments, private/public institutions/ companies, etc. within 500 metres on either side of the proposed pipelines alignment.

- 25 years historical data for Hydrographic, Flood, Soil erosion, Crop patterns Rainfall data, seismic data etc.Detailed information about high and low tide etc
- Information regarding future plans (0-10 years), irrigation project, infrastructure project, Railway project, Forestation, Defence, Industrial growth, Private/Public constructions, unless otherwise specified.

2.1.17. The scope of work shall also include any other item/work required to complete the work in all respects as per specifications, drawings and instructions of CONSULTANT whether specifically mentioned herein or not, but is required to fulfil the intended purpose of this tender document.

2.1.18. Carry out Soil Investigation upto refusal using SPT at End Point Stations and intermediate stations and at location of Tee-Offs.

3. CONTRACTOR'S RESPONSIBILITIES

3.1. Contractor shall provide all qualifed skilled/ unskilled personnel to carry out the entire job, all surveying and other equipment, tools, tackles and other necessary materials and facilites required to complete the job to the entire satisfaction of the CONSULTANT in accordance with the requirements of the tender document.

3.2. CONTRACTOR shall also be responsible for arranging, acquiring all data, access, permissions and other activities/ services required for and/ or incidental to performing the work tendered.

3.3. Location of Survey of India Bench marks and determination of their values including tieing-in of proposed pipelines profile to the same shall also be Contractor's responsibility.

3.4. Contractor shall be responsible for settling all compensation and disputes arising out of any damages caused by him or his workmen during the execution of work.

3.5. The detailed survey to ensure:

- Connectivity with adjoining surveys.
- Geocoding be done and closing of surveys at both the ends.
- Data and inputs to be organised in a prescribed manner and output so as to be easily transformed to GIS & LIS platform

3.6. Resurvey can be ordered in case of doubt; descripancy; change in route; problem in cadastral and better option. Different alternative routes may have to be survey if required.

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3.7. Contractor should check for the presence of underground services prior to commencing of any drilling or trial excavations and will validate and confirm that no underground services are at risk to be damaged or disturbed in any way.

3.8. At least one supervisor is required at work site when work is ongoing for Route Survey and Soil Investigation.

4. CONTRACTOR'S SCOPE OF SUPPLY

4.1. The mobilization / supply in sequence and at appropriate time of all equipment, data, skills, accessories, materials, softwares, hardwares and consumables etc. required for completion of all work covered under this contract shall be entirely the responsibility of the Contractor.

4.2. The pillars used for TBMS (Tremporary Bench Marks) at TP's/IP's, crossing etc. shall be pre-cast R.C.C, with reinforcement of 4 nos. 6 mm dia bars with 4 equally spaced rings of 6 mm dia. All pre-cast R.C.C. pillars should also be engraved with letters "HLPL" on the shorter vertical face. Casting/ supply of these pillars is in scope of supply of contractor.

5. LIST OF ENCLOSURES

5.1. SPECIFICATIONS

Specification required for Detailed Pipeline Route Survey is enclosed at Chapter-1-7.

6. DOCUMENT/ DATA SUBMISSION

6.1. Documents to be submitted for detailed route survey shall be as per requirement of applicable specifications and other documents enclosed with tender documents.

6.2. Contents and presentation of survey data/ records shall be reviewed / approved by CONSULTANT in the initial stage on sample drawings/documents to be prepared by the Surveyor. The CONTRACTOR shall incorporate all comments/ suggestions given by CONSULTANT and prepare all documents accordingly.

6.3. Two sets of paper copy of completed drawings/ data/ documents shall be submitted by the Contractor for review in the form of draft report. Comments, if any, shall be incorporated by the CONTRACTOR. This report can be demanded in parts and in different phases at the discretion of CONSULTANT.

6.4. All drawings, reports, formats, etc. forming the part of submission shall be prepared on approved computer package. All drawings, including, but not limited to alignment sheets, crossing drawings, soil profiles etc. shall be prepared using AutoCAD R 2000 / GIS based suitable package as per decision of CONSULTANT. All reports, formats, write-ups, charts shall be prepared on computer using software package compatible with MS Office.

6.5. The data and drawings submitted shall be in approved GIS package.

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6.6. Final drawings/data/documents, after incorporation of comments by Surveyor, shall be submitted to CONSULTANT in the following number of copies.

a) Drawings - six copies, one transperancy and one copy on CD & floppy diskettes.

b) Soil Resistivity Report - six copies and one copy on CD & floppy diskettes.

c) Geo- technical investigation - six copies and one Report copy on CD & floppy diskettes.

d) Other Reports and Records - six copies and one copy on CD & floppy diskettes.

CHAPTER II : DETAILED ROUTE SURVEY

1. SCOPE

This chapter covers the minimum requirements of topographical survey along the pipeline route including locating the centre-line of pipeline alignment on the ground, constructing survey monuments, field measurements, profiles and preparation of drawings and documents.

2. REQUIREMENTS

2.1. All survey works shall be performed under the supervision of a experienced persons deputed by the CONTRACTOR.

2.2. All measurements shall be in metric units.

2.3. The reading and noting shall be neat, legible and scorings and over-writing shall be duly initialled by the Contractor.

2.4. All surveys shall be carried out using approved methodology and equipment e.g. GPS, DGPS, Total Stations, Auto levels,High Precision Theodolite, EDM.

2.5. Survey should take into account not only existing obstructions /infrastructures / facilities but should also consider other facilities in the master plan of the area that may come up in future. This needs to be accomplished by collection of development plans (Approvaed Master Plans for the area along the foreseen route).

2.6. The contractor should also identify most optimum way in which a fresh water pipeline (Max 6" diameter) can be laid alongside HP pipeline in the same corridor.

2.7. Contractor should check for the presence of underground services prior to commencing of any drilling or trial excavation and will validate and confirm that no underground services are at risk to be damaged or disturbed in any way.

3. PRELIMINARY AND LOCATION SURVEYS

The Contractor is expected to make himself aware of the general conditions of the terrain before starting detailed

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survey

3.1. Alignment and location surveys

A preliminary survey for locating the centre-line of pipeline alignment on the ground shall be carried out as follows:

3.1.1. Contractor shall make a preliminary survey along the route of the Proposed Pipe line to establish flag control point. Based on the preliminary survey drawings, a geocoded mapping be developed as preliminary

plan, particularly the start and end point and other major TP's/IP's. Contractor shall study and suggest better alignment based on site visit and shall make suitable alteration in the proposed route after consultaton with CONSULTANT.

3.1.2. Where it becomes apparent that a better route could be followed, the Contractor shall consult the CONSULTANT for authorisation to make a change. In selecting the pipeline route, the contractor shall take into account the requirement for safe construction, operation and maintenance of pipeline.

3.1.3. Alternate routes (partly)at different places has to be surveyed considering the requirement for safe construction, operation and maintenance etc. Routing should take into account any planned facilities / utilities not only at the time of survey but also facilities which may come up in future. This needs to be accomplished by collection of approved Master Plans of the area along the route.

3.1.4. Turning Points (TPs) shall be located by Contractor considering the following:

- Detailed survey would be carried out using Differential Geographical Positoning system and/or Geographical Positioning system and Total Stations. Use of high precision Theodolite and/ or Total Station shall be made in suitable conjunction with GPS to establish the markers.
- To avoid obstruction along the line, by ranging on ground and shifting the Turning Points, wherever needed.
- Check for terrain gradient by using hand Clinometer/ Total Stations.
- Ensure proper angle of crossing by keeping as nearly right angle (to road/rail/rivers etc.) as possible. Unless mentioned otherwise all minor/ major crossings shall be surveyd by total stations.
- To check the route for ease of construction and avoid objects like, trees, dwellings, poles (power, telephone and telegraph), walls, tubewells or such other structures falling in the strip of land, 25M on either side of pipeline alignment unless directed otherwise.

3.1.5. While finalising the pipeline route, the contractor should also identify most optimum way in which a fresh water pipeline (Max 6" diameter) can be laid alongside HP pipeline in the same corridor.

3.1.6. Alignment to be studied on SOI maps as well as on village maps.

3.2. Staking of pipeline route

3.2.1. The pipeline defining trench centre line shall be staked by placing suitably painted marker stakes at Turning Points (TPs) and at Intermediate Points (IPs) between consecutive TPs. All Turning Points (TPs) and intermediate points are referred as Intersection Points.

The pipeline centre line shall be staked on the ground as follows:

First, the Turning Points (TPs) shall be staked on the ground. After locating and marking the TPs, the intermediate

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points shall be staked while measuring stack distance. The staking shall normally be done at intervals of 500 M along the centre line of the pipeline.

3.2.2. The Intersection Points shall be serially numbered from the starting point. The serial number of each Intersection Point shall be boldly inscribed on the marker stake. In addition, the Turning Point (TP) marker stake shall identify the Turning Point reference number from the starting point.

3.2.3. For Intermediate Points (IPs) letter "P" shall precede the serial number of the instersection point marker. For Turning Points, the "TP" shall precede the Turning Point reference number.

Example : P52; TP16

3.2.4. The marker stakes at Turning Points (TPs) shall be referred with three reference stakes around the TP. The reference stakes shall carry the Turning Point reference number and their respective distance from the TP marker stake.

Example : TP32 – 3.5L; TP6 – 4.8R, TP18-3.6W etc.

3.2.5. Change in direction of line shall be marked on the TP marker stakes. In addition, direction markers near TPs and other locations shall be placed wherever necessary.

3.3. Stakes and Markers

3.3.1. All marker stakes shall be pre-cast reinforced concrete blocks having dimension 150x200x1000 mm deep, and shall be buried to a depth of 500 mm.

The exposed surface of the blocks shall have a smooth finish and shall be painted with 'Post Office' red paint. All letters and figures shall be paint marked on the surface of the blocks in white.

3.3.2. On the top surface of the reinforced concrete blocks, a cross inside a circle shall be engraved at the centre or a nail shall be put centrally inside an engraved circle, to indicate the exact position of the Intersection Point. The circle shall be of approximately 50mm diameter.

3.3.3. Contractor can, however, propose CONSULTANT other types stakes/markers which are better suited to site conditions.

3.3.4. Where it is apprehanded that the marker may get lost, damaged, flooded or Vandalised some adjoining markers and landmark locations may also be included.

4. BENCH MARKS

4.1. Permanent Bench Marks (BM) approx. at every 1 KM or permanent structures on or off the Right-of-Use (ROU) shall be established and described.

4.2. Additional permanent bench marks shall be established near the major pipeline crossing sites. All these bench marks shall be geocoded and an index be submitted soon after the completion of detailed survey.

4.3. Location of Bench Marks shall be established in the field by using reinforced concrete blocks similar to pipeline marker stakes described earlier. Exact position of BM shall be marked by a cross inside a circle or a nail put centrally inside an engraved circle on the top surface of the concrete block. The reduced level of

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the BM shall be paint marked on the concrete block. Letters "BM" shall precede the reduced level of bench mark recorded to the second place of decimal.

4.4. Accuracy of the reduced levels of the Bench Marks shall be verified wherever possible by checking levels with the nearest permanent Bench Mark established by Survey of India, which shall be connected through geocoding system.

5. CROSSINGS

5.1. General

As far as possible, crossing shall be made at right angles. The Contractor shall record the angles of crossing for all fences, property lines, utilities, roads, railways, canals, streams, etc. that are crossed. In addition, the true bearings of the centreline of the road, railway, canal, as well as that of the pipe centre -line shall be recorded. Turning Points (TPs) provided near crossings shall be located, atleast 50m from the crossing's boundaries, in stable and firm ground.

5.2. Railway Crossings

The angles for all railway crossings shall be as close to 90 degrees as possible, but in no case less than 85 degrees to the centre line of the railway, unless approved otherwise.

5.3. Primary Road Crossings

Primary roads are the National & State Highways, all-weather roads (paved/unpaved) and roads providing access to major installations. The angle of crossings shall be as close to 90 degree as possible, but in no case less than 80 degrees to the centre line of the road, unless approved otherwise.

5.4. Secondary Road Crossings

The angles of crossing for secondary roads shall be as close to 90 degrees as possible, but in no case less than 45 degress to the centre-line of the roads. All seasonal roads, unpaved village roads, cart/tracks, etc. come under this category.

5.5. Stream/Drain/ Drainage Ditch crossings

These crossings shall be established as close as possible to the locations shown on the route map. Crossings shall be located in a comparatively straight reach of the Drain where the banks are stable and there is sufficient area for construction. Angle of crossing shall be as close to 90 degrees as possible, unless approved otherwise. Crossings shall be proposed on firm ground, banks and where there is no presence of authorised/ unauthorised borrow area for gravel/sand etc.

5.6. River/ Canals Crossings

The angle of crossing shall be as close to 90 degrees as possible but in no case less than 60 degrees to the centerline of the canal/River unless approved otherwise. Crossings shall be located where there is no evidence of slumping or erosion of banks or bed.

5.7. Utility Crossings

Utilities crossings shall be located at their centerlines with stakes containing station numbers in the survey. The angle of crossings shall be measured and locations established relative to their aboveground facilities. The names and sizes of all utility lines shall be included in the survey notes. In the cases of overhead power

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and telephone lines, the distance to the poles and towers on each side of the survey line shall be measured, and the numbers of poles or towers noted. Line voltage shall also be recorded. Where possible, the survey shall be established so that there is a minimum distance of 50 metres from the survey line to the nearest High Tension pole or tower except at crossings.

Underground utilities shall be located as far as possible and staked for a minimum distance of 25 metres on either side of the Survey Line.

6. ACCURACIES IN MEASUREMENT

6.1. Contractor shall incorporate corrections to the linear ground measurement due to differential corrections, standard errors, variations from standard temperature and free from selective availability causing inaccuracies in position and velocity imposed by regulatory authorities and needed corrections be applied.

6.2. For Linear detail survey, sub-meter accuracy (less than 1m in 1km) is required while using GPS/DGPS technique.

The error for angular closure for the work shall not exceed one minute per station and for linear measurements it shall be read to the nearest 0.005 M in case of crossings, surveys for which use of Total Stations/ high precision Theodolite is mandatory.

6.3. The error on closure for measurements on vertical distance to establish benchmarks shall not be more than 24 $(K)^{½}$ millimeters (where 'K' is the linear distance in KM). The observations for measurement of vertical distances on benchmarks shall be read to pipeline route and at crossings to the nearest 5 mm. The error of mis-closure in vertical distance shall be distributed linearly.

6.4. Azimuth checks shall be made by observations of the sun or Polaris at intervals of 1 -2 Km. These observations of bearings together with deflection angles shall be recorded in survey notes.

Azimuth mis-closure based on bearings with observed angles at Turning Points shall be equally distributed over the number of stations observed in between. Accuracy of azimuth observations shall be acceptable if the three deductions agree within one minute.

7. CHAINAGE

Generally the chain age system shall not be adopted for surveying except in special circumstances and locations e.g. thickly habited / paved area, thickly wooded area and prohibited area where use of GDS/DGPS/ Total Stations may not be permitted. In such cases: -

7.1. Slack distance measurement will be made using 50M steel tapes or 30M chains. However, in case of abrupt slope change the tape/chain is straightened parallel to the probable grading.

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7.2. Distance between Intersection Points staked along the pipeline route should be measured and recorded. In addition, distance between level points shall also be measured and recorded.

7.3. Chaining will be continuous in the direction of survey

7.4. The true bearing of all straights shall be observed and recorded.

7.5. Data on nature of terrain, viz. sandy, rocky, vegetation, etc. and type of ground will also be recorded along with chainage of change points.

7.6. Check on distance measurements will be stadia method and also GPS based measurements at the time of leveling.

7.7. Standard chain survey format will be used for record keeping.

8. MEASUREMENT OF HORIZONTAL ANGLES

Horizontal angles are measured to indicate the change in direction of alignment and specify the horizonrtal bend at the Turning Points.

8.1. Theodolite reading direct to 10 seconds or better, shall preferably be used. Angles shall be measured clockwise from back station to fore-station. Mean of two readings-one on face left and other on face right shall be taken as the horizontal angle.

8.2. The line at both ends shall be tied to the grid control system being used for end facilites. True bearing at the beginning, end and every 1-2 KM shall be observed to keep a check on errors in angular measurements.

9. PROFILES

9.1. The continuous profile of the proposed pipeline route shall be established from the reduced levels taken.

a) at the starting point,

b) at all Turning Points (TPs)

c) at all Intermediate Points staked on the ground

d) at all points on the pipeline route where there is a change in slope.

9.2. When the terrain is flat, reduced levels shall be additionally recorded along the pipeline route at 25m interval.

9.3. When the terrain is undulating observation of reduced level shall be made at a sufficient number of points so as to give an accurate plotting of the ground profile along the route.

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9.4. For road and railway crossings, the reduced levels shall be recorded at all points along the pipeline alignment wherever there is a change in slope with the entire width of the Right-of-Use of the road/railway. CONTRACTOR shall prepare a detailed drawing for the crossing in scale 1:100 (in both horizontal and vertical directions) which shall be truly representative of the crossing profile.

9.5. For river/stream/nala/canal crossings, levels shall be taken at intervals of 5M to 30M beyond the highest banks of both sides. Levels shall be taken at closer intervals, if there is a change in slope. CONTRACTOR shall prepare a detailed drawing for the crossing in scale 1:100 (in both Horizontal and Vertical directions) which shall be truly representative of the crossing profile.

9.6. For major water crossing sites, cross section as above shall be observed at both banks.

9.7. Method of RISE and FALL shall be used to compute reduced levels of various poins. Check on computation shall be made by using the following formula:

Back site – Fore site = Rise- Fall = First R.L. – Last R.L.

9.8. Maximum misclosure shall not exceed 24 $K^{½}$ MM where 'K' is the distance in KMs. Maximum length of the sight shall not exceed 100 M.

9.9. All levels shall be with respect of Mean Sea Level (MSL).

9.10. Levels need to be taken on both sides of all crossings.

10. BUILT-UP AREAS

10.1. Monuments and Properties

The pipeline alignment shall run clear of the existing monuments, properties and structures etc.

For congested areas, closer distance may be adopted, however, location shall be approved by CONSULTANT.

10.2. Parallel Alignment

The pipeline alignment wherever runs parallel to an existing or planned under/over ground facility will be treated as parallel alignment. For underground facilites, surveyor shall identify and locate them with suitable special ground laths. The following clearances shall be observed in case of parallel alignment defined above.

1) Between existing/planned electrical power cables/lines and the proposed line – 50.0 metres

2) Between existing/planned communication cables/lines and the proposed line – 25.0 metres.

3) Between existing / planned pipelines and the proposed pipeline- 1m.

10.3. Parallel encroachment

Unless otherwise stated, when the pipeline alignment runs generally parallel to a road or railway it shall be kept sufficiently clear of the Right of Way limits of the facility.

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11. AZIMUTH OBSERVATIONS

Azimuth control shall be maintained by observation of azimuth at every 1 to 2 kilometres by closing the traverse on existing control points. Azimuth may be obtained by making observations to sun or star depending upon the location of the area and direction control. In case of azimuth from sun, the computed values must be with one minute. In case of stars the computed values should agree within 10 to 15 sec.

Horizontal misclearances between two azimuth stations shall be equally distributed away TP's in between.

12. SURVEY NOTES, OBSERVATIONS AND COMPUTATIONS

12.1. The procedures followed both for field and office calculations shall be such that the results obtained shall be readily understood and retraceable.

12.2. All up-to-date notes and observations related to the basis for determination of boundary lines and corners shall be maintained by surveyor.

12.3. Survey records must contain schematic diagrams of all horizontal controls pertinent to the project showing all existing and established control points, bench marks, any triangulation station and boundary lines.

12.4. Geo-graphical and UTM co-ordinates of all Turning Points and starting/end points of the pipeline shall be computed and furnished to the CONSULTANT.

13. MAPS AND DRAWINGS

13.1. All maps and drawings shall be made on standard format furnished by the CONSULTANT. Contractor shall peform mapping and drawing work so as to contain all relevant data consistent with the survey notes and observations. The drawings shall also contain details of roads, streets, highways, structures, all types of crossings, terrain, surface vegetation and all other details which will be required for the purpose of enginnering design.

13.2. Following types of detailed survey drawings will be made:

a) -	Right of Use Planimetry in UTM grid	:	1:5000 along the line 1:1000 across the line
b) -	Ground Profile	:	1:5000 Horizantal 1:500 Vertical
c) -	Crossing Details	:	1:100 Horizontal 1: 100 Vertical
d) -	Detailed Route Map	:	1:50000
e) -	Cross-Section Details	:	1:100 Horizontal

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1:100 Vertical

* (Key route map to be indicated in all drawings)

14. PRESENTATION OF FIELD SURVEY DATA

Survey drawings shall contain the following data as a minium requirement.

14.1. Pipeline Route Map

Pipeline route map shall be prepared on approved GIS package. Pipeline route map shall show all features including, but not limited to roads and railroads, canals, streams, lakes, rivers, villages, towns that are located within a distance of 1 Km from the pipeline centre-line on either side of it. For the entire region, contours shall be plotted on the route map at 1 M contour interval. Additional information like cultivated areas, barren land, areas prone to flooding, rocky areas and forests including access path/roads to Right-of-Use shall also be shown on the route maps.

Pipeline route map should also indicate facilities/ obstructions/ infrastructures etc. that are planned for future. This needs to be accomplished by collection development plans (Approvaed Masterplans for the Area along the route).

14.2. Pipeline Route map should also show location and details of 3rd party pipelines, cables (overhead and buried) utilities etc within the foreseen pipeline corridor and ROW. At specific problem areas trial excavations will be needed to confirm location/details of pipelines, cables etc.

14.3. Right-of-Use Planimetry shall show all objects within 50 metres on either side of the Pipeline in Plan.

14.4. In case of all rail, road, river, stream, canal, existing pipelines and utility crossings, the angle of crossing shall be mentioned.

14.5. In case of rail, road, river, stream and canal crossing wider than 10M, the distances at the start and at the end of the crossing from the nearest IP shall also be mentioned. For crossing less than 10M, the distance of the centre line of crossing from the nearest IP shall be given.

14.6. For all river, stream and nala crossings, the level of water at the time of survey and the approximate surface velocity of the flowing stream shall be observed and recorded and reported in the survey drawings. Also, the general nature of the surface soil (soft/hard, normal soild or rock/boulders) at the banks of the river/stream/nala shall be observed and mentioned in the drawings.

15. ADDITIONAL DATA REQUIREMENT

Detail description of route all alongwith the route chainage wise is required.

The following data is also to be submitted in tabular form with respect to the chainage along the route.

Crossing	Railways	Distance of center of rail from center of pipeline
Roads	Type	Distance of center of road from center of pipeline
Pipelines:		location
		Type of product transported

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	Burried/ above ground backfill depth
	Protection
	History of leaks
Rivers, canals	location
	depth
Electrical lines	location
Telephone lines	location
Vegetation	type
	Location
	History of wood fire in dry season
	Ground types at and above backfil depth
	Topography

16. DOCUMENTS/DATA SUBMISSION

All drawings shall be prepared on approved AutoCAD/GIS based package including but not limited to the Pipeline Route map, alignment sheets and Crossing details. All other document shall also be prepared on computer package approved by CONSULTANT. The documents shall generally be prepared on MS Office.

In addition, hard copies of documents shall also be submitted.

CHAPTER III : SOIL INVESTIGATION ALONG ROUTE

1. GENERAL

The purpose of soil investigation is to obtain visual engineering classificationof soil along the pipeline route.

2. SCOPE

The scope of soil investigation includes boring, collection of disturbed samples from boreholes and visual engineering classifcation of soil along the pipeline route, and submission of detailed report. Visual classification of soil shall be in accordance with IS-1498, "IS Classification and Identification of Soils for General Engineering Purposes." Data for high / low tide is to be prep ared. Tide timings and water table details during high/low tide is also to be prepared.

3. BORING

3.1. Boreholes shall be made at intervals of 500M (maximum distance) along the pipeline route, Boreholes are also to be made at all intermediate points where there is apparently a change in the type of soil and at any other place as directed by CONSULTANT. The objective will be to determine different types of terrain and the transition points between different types of terrain.

3.2. For canal, stream and river crossings, boreholes shall be made one on either bank and one on the bed.

3.3. Minimum diameter of boreholes shall be 150 MM. Auger boring shall be resorted to above the water table, whereas below water table the boreholes shall be advanced by shell and auger.

3.4. Along the pipeline , the boring shall be either terminated at a depth of 3 M below NGL or on top of bed rock if rock is encountered at a dept of less than 3 M.

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3.5. The boring shall be upto 6.0 m on either side at all crossing locations.

3.6. Contractor should check for presence of underground services prior to commencement of drilling.

4. SAMPLING

Disturbed representative samples shall be collected from boreholes to classify the subsoils visually at site.

5. DETAILED REPORT

5.1. The report shall include proper visual engineering classification of soils encountered along the pipeline route in borelog form. Depth of Ground Water Table (GWT) below NGL shall also be mentioned ,if encountered.

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

5.3. Regions along the pipelines route where special excavation techniques like blasting, etc. needs to be adopted for excavation of pipeline trenches shall be clearly indicated in the report.

5.4. Data for high/low tide is to be noted. Tide timings and water table details during High/Low tide is also to be collected.

CHAPTER IV : POPULATION DENSITY INDEX & CLASS LOCATION SURVEY

1. GENERAL

When survey is performed for gas pipelines, the class locations based on population density index as per code ANSI B31.8 “Gas Transmission and Distribution Piping Systems” shall be recorded along with chainages at change points of each class location.

2. SCOPE

Population density index along the pipeline route shall be determined as follows:

A zone, 400 M (one quarter mile) wide (200 m either side) shall be considered along the pipeline route with the pipeline in the centre-line of this zone. Then the entire route of the pipeline shall be divided into lengths of 1600 M (one mile) such that the individual lengths will include the maximum number of dwellings intended for human occupancy. The number of such dwellings which are intended of human occupancy within each 1600 M (one mile) zone shall be counted and reported along with other survey data.

3. CLASSIFICATION GUIDELINES

Areas shall be classified based on guidelines as given below:

3.1. A. Class 1 Location (Including its subparts)

Class 1 location is any 1600 M (one mile) section that has 10 or fewer dwellings intended for human occupancy.

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B. Class 2 Location

Class 2 location is any 1600 M (one mile) section that has More than10 but less than 46 dwellings intended for human occupancy.

C. Class 3 Location

Class 3 location is any 1600 M (one mile) section that has 46 or more dwellings intended for human occupancy except when a Class 4 Location prevails.

D. Class 4 Location

Class 4 location include areas where multi-storey buildings are prevalent, and where traffic is heavy or dense and where there may be numerous other utilities underground.

3.2. In addition to the criteria contained in Clause 3.1 above, while classifying areas, additional consideration must be given to possibilities of increase in concentration of population along the pipeline route such as may be caused by the presence of schools, hospitals, recreational areas of an organized character, places of assembly, places of worship, etc. If one or more of these facilities are present, the area shall be classified as a Class 3 Location.

3.3. Notwithstanding the provisions of Clause 3.1 and 3.2 above, while determining class location of an area due consideration shall be given to the possibility of future development of the area during the design life of the pipeline. If it appears likely that future development may cause a change in the location class, this shall be taken into consideration while determining its class location.

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CHAPTER V : CADASTRAL SURVEY

1. SCOPE

This document covers various requirements for Cadastral survey to be carried out along pipeline route.

2. OBJECTIVE

The objective of the Cadastral survey is to identify the Ownership and land use details, collect data/ all other details sufficient for acquisition of ROU.

3. REQUIREMENTS

The contractor shall carry out detailed plane table cadastral survey along the pipeline route covering areas 50 metres on either side of centre line of the pipeline. All revenue and other maps as well as the forms required for carrying out this Survey shall be arranged by the Contractor at his own cost and responsibility. However, authorisations, if any required, shall be provided by CONSULTANT. Contractor's scope of work shall be as follows:

3.1. Prepare the following maps in six copies:

- Maps to scale 1:5000 as per format to be provided by CONSULTANT, showing the pipeline route and the villages block No. survey numbers encountered enroute.
- Maps to scale 1:1000 as per format to be provided by CONSULTANT showing the pipeline route and areas 50 metres on either side of the centre line of the pipeline complete with the following details:
  - Property Identification / Survey number , parts 'Hissas" on survey numbers as well as details of owners(Name, Address , Village etc.) as per the latest official revenue records along with an appropriate listing of the land owners.
  - Major features/land marks inlcuding
  - All built-up areas.
  - Creeks, river, canals and nallahs
  - Forest land
  - Industrial land
  - Quarry/mining and other prohibited areas
- Map of individual survey number is to be prepared indicating name of Owner , area, type of crops etc.
- Route alignment is to be provided on village map for ROW and ROU activities.

3.2. Ownership of all crossings, road, pipelines, canals etc. is to be collected.

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3.3. Details of illegal structures like shops, hutments, canteen etc. are to be indicated along with their name , type of business etc.

3.4. Search report for Ownership of land along the route for last 10 years is to be collected from revenue records.

3.5. Type and cost of crop along route in the local market is to be collected.

3.6. Arrange and furnish extracts in duplicate of all land areas to be shown in map area as per para 3.1 above. These extracts are required to be duly certified by the "Talatis" concerned. Expenses in obtaining these extracts shall be borne by the Contractor.

3.7. In respect of the map at 3.1 above, Contractor's work of marking part "Hissas" as per the latest official revenue records shall be checked/verified by the Competent Authority. The Contractor shall ensure that the land records are submitted to Competent Authority for checking and verification as work proceeds.

3.8. Prepare a schedule, as per format to be approved by CONSULTANT showing information on part "Hissas" and details of owner (to be extracted from map at para 3.1 above for obtaining pipeline Right of Use (ROU). This ROU shall generally be a 50 metre wide strip.

3.9. The cadastral maps to be prepared in computer package approved by CONSULTANT with suitable compatibility with GIS / LIS based package.

CHAPTER VI : CORROSION SURVEY

1. SCOPE

The chapter covers the corrosion survey including measurement of soil resistivity, chemical analysis of soil/ water and other cathodic protection related data collection along right of way of the pipeline.

2. CODES AND STANDARDS

Equipment and measurement techniques shall unless otherwise specified, conform to the requirement of following latest applicable standards:

BIS Specifications

BS specifications and codes of practice

NACE publications

The work shall be carried out in compliance with all applicable local laws and regulations.

3. GENERAL

This specification defines the basic guidelines for carrying out the corrosion survey. Contractor shall be responsible for providing necessary data interpretation based on corrosion survey measurements which is intended to form a basis for design of cathodic protection system for the pipeline to be buried along ROW.

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4. SOIL RESISTIVITY SURVEY

4.1. Unless otherwise specified, the soil resistivity measurements shall be carried out at intervals of maximum 500 mtr along the ROW. Where soil resistivity is less than 100 ohm mtr and two successive readings differ by more than 2:1 then additional soil resistivity readings in between two locations shall be taken. Measurements of soil resistivity can be at intermediate points also where there is apparent change in type of soil and at other places as directed by CONSULTANT.

4.2. To carryout the soil resistivity measurement Wenner's 4-pin method or approved equal shall be used. The depth of resistivity measurement shall be around the burial depth of the pipeline or 1.5 mtr Approximately. At locations where multi layer soil with large variation in resistivity/ corrosiveness is expected, measurements at additional depth of up to 2.5 mtr (Approx.) or more shall be taken. In general the resistivity of soil, which shall be surrounding the pipe, shall be measured. Hence the depth of measurement/ electrode spacing may vary depending on topography and strata at the area. In general, electrode spacing shall be approximately equal to 1.5 times the depth of the pipeline.

4.3. At places where Right of Way has not yet been cleared measurements shall be made right over the center line of pipeline route surveyed accounting for the cuttings/ fittings also.

4.4. Observations shall be made enclosing the soils adjoining the trench wherever pipeline trenching has already been done.

4.5. The observations shall be made enclosing the soil immediately surrounding the pipeline route where right of way has been cleared but trenching has not been done.

4.6. All measurements shall be taken at right angles to the right of way, unless otherwise asked by CONSULTANT or his representative at site.

4.7. At places in right of way where other pipelines already exist, care shall be taken to precisely locate such pipelines and take such precautions that observations are not adversely affected by presence of such pipelines.

4.8. Care shall also be taken that the observations are not influenced by presence of other earth currents in the area especially in the vicinity of HT lines and plants using earth return in their source of power etc.

4.9. Wherever possible/ advised by CONSULTANT, depth of water table shall be determined by resistivity observations.

4.10. All measurements shall be made and recorded in metric units. While recording the data, reference to the nearest intersecting point shall be made. To provide visual representation of variations in the resistivities along right of way, values shall be plotted on semilog graph sheets. The resistivity graph shall also indicate the resistivities at additional depths measured at various locations and depth of water table.

5. TESTS OF SOIL SAMPLES

Soil/ water samples shall be collected along the Right of way for analysis. Samples shall be collected on an average at one location per every 500 M (maximum distance) along Right of way. Exact locations shall be decided at site depending on the type of soil, soil resistivity and in consultation with CONSULTANT. The soil samples shall be collected at 1 mtr and 2-mtr depths at each location.

The collected soil/ water samples shall be analysed to determine prese nce and percentage of corrosive compounds including moisture content, oxygen activity and pH value.

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6. ADDITIONAL DATA COLLECTION

The following data shall be collected with a view to generate design for evaluation of cathodic protection interaction possibilities due to presence of other services in Right of Way and its vicinity.

6.1. The following data shall be collected with a view to generate design for evaluation of cathodic protection interaction possibilities due to presence of other services in Right of Way and its vicinity.

6.2. Coating details, Diameter, wall thickness, pressure, soil cover etc. of the foreign pipeline.

6.3. Voltage rating, phase and sheathing details of parallel running or crossing cables with ROW.

6.4. Details of existing cathodic protection systems protecting the services including rating and location of grounds bed test station locations and connection schemes etc. Where pipeline is likely to pass close to any existing ground bed, necessary anode-bed potential gradient survey shall be carried out.

6.5. Interference remedial measures existing on nearby pipelines/ services/ shall be collected from the owner of the foreign pipeline/ services.

6.6. Graphical representation of existing structure/ pipe to soil potential record. T/R unit / CP power source voltage/ current readings.

6.7. Possibilities of integration/ isolation of the pipeline CP System with foreign pipeline/ structure CP System, which may involve negotiations with owner's of foreign services.

6.8. Information on existing and proposed DC/AC power sources and system in the vicinity of the entire Right of way.

6.9. Details of Crossing and parallel running of electrified and non-electrified railway tracks along with details of operating voltage and type (AC/DC).

6.10. Details of Crossing or parallel running of any H.T. AC/DC overhead line with in approximately 25 mtr from ROW along with details of voltage rating, fault level etc.

6.11. Any other relevant information that may be needed in designing and implementing of proper cathodic protection scheme for the proposed pipeline.

6.12. Type of CP provided by other pipeline is also to be collected.

6.13. Description of soil all along the route.

7. REPORT

On completion of all the field and laboratory work an interim report incorporating results generated from surveys, additional data collected, results of tests carried out, etc. shall be submitted for comments/ approval. The final report incorporating comments/ missing data shall be furnished for records. The report along with various drawings, graphs etc. prepared in connection with the work shall be submitted along with six prints by the contractor.

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8. INFORMATION REQUIRED WITH BID

Bidder shall provide following information along with the bid without which the bids are liable for rejection.

8.1. Instruments that will be used for carrying out soil resistivity survey.

8.2. Measures that will be taken to avoid foreign pipeline / HT lines etc. affecting the soil resistivity observations.

8.3. Measurement location identification procedure.

8.4. Procedure for collection of soil samples.

8.5. Description of soil test procedure.

8.6. Specification of soil testing instruments.

8.7. Formats for presentation of results.

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CHAPTER VII : SOIL INVESTIGATION AT STATIONS

1. INTRODUCTION

Soil investigation is to be carried out at end point station , at intermediate block valves station and at locations of Tee-Offs using SPT. Number of tests to be performed are 4 for main end point station and 1 for intermediate block valve station and at locations of Tee-Offs. Thereafter laboratory tests are to be done on selected soil samples.

2. IN- SITU GEOTECHNICAL WORK EXECUTION TECHNIQUE

2.1. Equipment and measurement techniques shall unless otherwise specified, conform to the requirement of following latest applicable standards:

The program of the works must comply with the site availability.

2.2. Setting up of the in- situ tests

2.2.1. The CONSULTANT shall provide location of the in-situ tests on maps. The Contractor must set up the tests on the site, after locating the position of the boreholes accurately, which will be checked by the CONSULTANT.

2.2.2. If the location, azimuth or inclination of any drill holes or in situ tests do not conform to the given indication, such holes shall be executed anew at the contractor's expenses.

2.2.3. After completion of the work, the Contractor shall provide a map with the location of in situ tests " as built".

2.2.4. Contractor should check for presence of underground services prior to commencing drilling or excavation.

2.2.5. Contractor should check for the presence of underground services prior to commencing of drilling or trial excavations and will validate and confirm that no underground services are at risk of being damaged or disturbed in any way.

2.3. Execution of the bore-holes with SPT

2.3.1. General marks

a) Boreholes of 110 mm to 200 mm internal diameter shall be sunk to the required depth with Shell and auger equipment through sand, silt and clay, but excluding rocks, pebbles or grabbers.

b) The methods and machinery must, in all cases, tend to mark the levels and confirm the nature of the crossed layers.

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c) If one of the crossed layers causes landslide or soil instability, the drilling hole is to be protected by any efficient means, provided the subjacent soil is not contaminated . Bentonite slurry can be used in case of cohensionless soils.

d) The drilling machine is to be steered by a chief drilling operator with the help of at least one experienced workman.

e) The method of drilling is the responsibility of the Contractor. This method must permit to collect samples for identification and description of the crossed layers and to perform SPT. The Contractor shall propose his method before starting the works.

f) The drilling is to be vertical.

g) In the boreholes SPT will be performed. Mode of operation is explained before.

h) During the drilling operation, all incidents are to be recorded, and in particular the losses of water, with estimates of flow and volume, possible caverns, rising of water level, alteration in type and colors of mud, etc.

i) The boreholes shall be cased throughout the depth of boring.

j) Boreholes shall be cleaned properly before conducting any in-situ test or taking out undisturbed samples.

k) After the tests are conducted, the boreholes shall be filled with sand.

2.3.2. Description of the bore log

a) Levels survey

During the drilling, the levels of separation of the different layers and the upper and lower levels of the possible caverns are to be recorded in relation to the level of topsoil.

The location of the water table is to be determined. The dates and hours corresponding, to the end of the perforation and to the recording of levels as well as the losses of water observed during the drilling are to be noted.

b) Soil identification

As drilling progresses, the extracted soil shall be carefully preserved to enable its identification.

However the following information must be noted immediately:

- Sampling level,
- Temporary name given to the soil by the driller,
- Colour and odour,
- Soil consistency,
- Recuperation.

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2.3.3. Documents to be supplied by the Contractor

At each time, the contractor shall fill in a report giving details on the work executed, describing difficulties and methods used, the description of machinery, the precise depth of each operation, etc.

The CONSULTANT must have access to these documents at all times.

In addition, two weeks after the completion of boring which is covered by the contract, the Contractor hands over a provisional report in two copies including a drilling log, and in particular:

- The reference number of the bore-hole
- The location marked on a map to a convenient scale together with the X, Y and Z co-ordinates of the bore-hole
- The point level from which depths are measured
- The diameter of the bore-holes
- The recuperation
- All observations and incidence noted by the operator concerning the boring operation
- The equipment in use and the process for drawing samples
- The levels of water at the start and at the end of each shift
- The date at which the boring starts and ends, together with a graph showing progress and effective preparation speeds
- The depths at each operation
- The reports on special tests or sampling with the numbers of the samples extracted and their position
- The sectional drawing of the bore-hole with references and symbolic representations of the nature of the crossed soils

A global report shall collect all the results and data from the various daily reports, from the drilling logs, etc.

Five copies of this global report shall be handed over to the CONSULTANT two weeks after completion of the in-situ works.

The Contractor shall also hand over to the CONSULTANT a reproducible original of all the maps, drilling maps, etc., which are part of his daily report and of the global report.

2.3.4. Standard Penetration tests in the boreholes

a) Mode of operation

Standard Penetration Tests shall be carried out during the boring in accordance with IS 2131 (latest). The depth of each test shall be correctly determined. In the event that the penetration resistance "N", determined in a test, is less than 5, the Engineer may require to clean out the borehole and to carry out another test immediately afterwards. Small-disturbed samples removed from the Standard Penetration

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Test split spoon sampler shall be taken in accordance with IS 2132 (latest). The Standard equipment with split spoon sampler in soil or solid cone in hard soil with 65 kgs hammer shall be used.

Unless otherwise instructed by the CONSULTANT a Standard Penetration Test shall be carried out every 0.5m in the upper soft layers and at 1.0 m interval in the bottom layers.

b) Documents to be supplied by the Contractor

The information on the Standard Penetration Test to be submitted by the Contractor consists in of the following:

- Penetration resistance (Nblows/300 mm) or the Penetration (mm) for 50 blows. The procedure of testing and determination of N value shall be as per IS:2131 (latest).
- Depths (m) between which penetration resistance is measured.
- Depth of casing and size at time of test.
- Before start of test depth SPT tools sunk under own weight from base of borehole.
- Number of blows for each 75 mm of Penetration including seating blows.
- Type of equipment

Weight of hammer.

Height of drop.

- Method of release.
- Use of drilling mud or casing.

Disturbed samples resulting from SPT shall be taken for classification purposes. They shall be placed immediately in an airtight, non-corrodible and durable container, which the sample will fill with a minimum of air space. The undisturbed samples shall be taken at intervals of 2 m or at change of stratum whichever occurs earlier. The samples shall be minimum 100 mm dia and 450 mm long.

2.4. Document and Report

At the end of the investigation and on completion of all the tests, the contractor shall submit a report consisting of the following documents and recommendations.

2.4.1. Plan showing the location of the boreholes with co-ordinates as executed.

2.4.2. All field records namely the bore-log, details of samples taken, records of all in-situ and laboratory test profiles, classification of soil stratum, and any other significant details which might be found out during investigation.

2.4.3. All computations leading to the logical conclusion of bearing capacities of soil, safe capacity of piles etc. shall be included in report. If references are drawn from standard test books, such references shall be clearly indicated.

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2.4.4. The report shall contain recommendation about: -

a) The safe net bearing capacity of soil for isolated / strip footings and proposed depth of footings, starting from bottom level.

b) The safe net bearing capacity of soil for mat/ raft foundations at basement level.

c) Estimated lengths, and capacities of piles of various diameters, if recommended.

d) For design of retaining walls, recommendations shall be made as to the layer of excavated Design parameters like coefficient of earth pressure at rest shall be recommended.

e) Safe bearing capacity of soil for temporary structures and structures of secondary importance shall be included.

f) Water table in each bore hole.

g) Max. Water table to be adopted for design of foundations.

3. LABORATORY TEST ON SELECTED SOIL SAMPLES

The following tests shall be performed on the selected soil samples (according to IS 2720) and water samples collected.

- Atterberg Limits: - Liquid limit + plastic limit shall be required for U.D. samples
- Natural Moisture: - shall be required for U.D. samples.
- Particle size analysis: Sieve & hydrometer analysis on at least one sample from each stratum shall be required.
- Wet & Dry Density: for U.D. samples.
- SP Gravity: For one sample from each stratum.
- Unconfined compression Test: To be conducted at site on about 25% of U.D. Samples.
- Triaxial Tests: Un-drained quick tests shall be done on UD samples available at Laboratory.
- Consolidation Tests: on U.D. samples taken at least one from each stratum shall be conducted for a range of pressure from 2.7 t/sq.m to 8.6 t/sq.m
- Chemical Tests: Sulphate- & chloride contents of water samples.
- Sulphate, carbonate, chloride and organic matter, content of soil samples.

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CHAPTER VIII : HEALTH, SAFETY & ENVIRONMENT MANAGEMENT

1. SCOPE

This specification establishes the Health, Safety and Environment Management (HSEM) requirement to be complied with by the Contractor during execution of work.

Requirement stipulated in this specification shall supplement the requirements of HSEM Management given in relevant Act (s)/legislations. Where different documents stipulate different requirements, the most stringent shall be adopted.

2. REFERENCE

This document should be read in conjunction with the following:

- Relevant IS Codes
- Reporting Format

3. REQUIREMENT OF HEALTH, SAFETY AND ENVIRONMENT MANAGEMENT {HSEM} SYSTEM TO BE COMPLIED BY BIDDERS

3.1. Management Responsibility

3.1.1. The Contractor should have a documented HSEM policy to cover commitment of their organization to ensure Health, Safety and Environment Management aspects in their line of operations.

3.1.2. The HSEM system of the Contractor shall cover the HSEM requirement including but not limited to what is specified above.

3.1.3. Contractor shall be fully responsible for planning and implementing HSEM requirements. Contractor as a minimum requirement shall designate/deploy the following to co-ordinate the above:

No. of workers deployed

Up to 5 - At least one safety supervisor

5 –10 - At least two safety supervisors

Contractor shall indemnify and hold harmless CONSULTANT and their representatives from any and all liabilities arising out of non-fulfillment of HSEM requirements.

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3.1.4. The Contractor shall ensure that the Health, Safety and Environment (HSEM) requirements are clearly understood and faithfully implemented at all levels, at site.

3.1.5. The Contractor shall promote and develop consciousness for Health, Safety and Environment Management among all personnel working for the Contractor Regular awareness programmes and fabrication shop/work site meetings shall be arranged on HSEM activities to cover hazards involved in various operations.

3.1.6. Arrange suitable first aid measures such as First Aid Box, Trained Personnel to give first Aid to the satisfaction of CONSULTANT.

3.1.7. The Contractor shall evolve a comprehensive planned and documented system for implementation and monitoring of the HSEM requirements. This shall be submitted to CONSULTANT for approval. The monitoring for implementation shall be done by regular inspections and compliance to the observations thereof. Any review/approval by CONSULTANT shall not absolve contractor for his responsibility/liability in relation to all HSEM requirements.

3.1.8. Non-Conformance on HSEM by Contractor (including his Sub-contractors) as brought out during review/audit by CONSULTANT shall be resolved forthwith by Contractor. Compliance report shall be provided to CONSULTANT.

3.1.9. The Contractor shall ensure participation of his Resident Engineer/ Site-In-Charge in the Safety Committee/HSEM Committees meetings arranged by CONSULTANT. The compliance of any observations shall be arranged urgently. He shall assist CONSULTANT to achieve the targets set by them on HSEM during the project implementation.

3.1.10. The Contractor shall adhere consistently to all provisions of HSEM requirements. In case of non-compliance or continuous failure in implementation of any HSEM provisions; CONSULTANT may impose stoppage to work without any Cost and Time implication to CONSULTANT and/or impose a suitable penalty for non-compliance with a notice of suitable period, up to a cumulative limit of 1.0% (one per cent) of Contractor Value. The penalty shall be in addition to all other penalties specified else where in the contract. The decision of imposing stoppage of work, its existent and monetary penalty shall rest with CONSULTANT and shall be binding on the Contractor.

3.2. House Keeping

3.2.1. Contractor shall ensure that a high degree of house keeping is maintained and shall ensure interalia the following.

A. All surplus earth and debris are removed/disposed off from the working areas to identified location(s).

B. All wooden scrap, drums and other combustible packing materials shall be removed from work place to identified location(s).

C. Water logging on roads shall not be allowed.

D. No parking for trucks/trolleys, etc. shall be allowed on roads, which may obstruct the traffic movement.

E. Utmost care shall be taken to ensure over all cleanliness and proper upkeep of the working areas.

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3.3. Health, Safety And Environment Management

3.3.1. The contractor shall provide safe means of access to any working place including provisions of suitable and sufficient scaffolding at various stages during all operations of the work for the safety of his workmen, and, members of CONSULTANT. Contractor shall ensure deployment of appropriate equipment and appliances for adequate safety and health of the workmen and protection of surrounding areas.

3.3.2. The Contractor shall ensure that all their staff and workers including their sub -contractor(s) shall wear Safety Helmet and Safety shoes. Contractors shall also ensure use of safety belts, protective goggles, gloves, etc. by the personnel as per job requirements. All these gadgets shall conform to relevant IS specifications or equivalent.

3.3.3. The contractor shall assign to his workmen, tasks commensurate with their qualification, experience and state of health of driving of vehicles, handling and erection of materials and equipment. All lifting equipment shall be tested certified for its capacity before use. Adequate and suitable lighting at every work place and approach there to, shall be provided by the Contractor before starting the actual operations at night.

3.3.4. Hazardous and/or toxic materials such as solvent coating, or thinners shall be stored in appropriate containers.

3.3.5. All hazardous materials shall be labeled with name of the materials, the hazards associated with its use and necessary precautions to be taken.

3.3.6. Contractors shall ensure that during the performance of the work, all hazards to the health of personnel have been identified assessed and eliminated.

3.3.7. Chemical spills shall be contained and cleaned up immediately to prevent further contamination.

3.3.8. All personnel exposed to physical agents such as ionizing or non-ionizing radiation, ultraviolet rays and similar other physical agents shall be provided with adequate shielding or protection commensurate with the type of exposure involved.

3.3.9. Where contact or exposure of hazardous materials could exceed limits or could otherwise have harmful effects, appropriate personal protective equipment such as gloves, goggles, aprons, chemical resistant clothing and respirator shall be used.

3.3.10. Suitable facilities for toilet, drinking water, proper lighting shall be provided at site and labour camps, commensurate with applicable Laws/Legislation.

3.3.11. Contractor shall ensure storage and utilization methodology of materials that are not detrimental to the environment. Where required Contractor shall ensure that only the environment friendly materials are selected.

3.3.12. All persons deployed at site shall be knowledgeable of and comply with the environmental laws, rules and regulations relating to the hazardous materials substances and wastes. Contractor shall not dump, release or otherwise discharge or dispose off any such materials without the express authorization of CONSULTANT.

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4. DETAILS OF HSEM SYSTEM BY CONTRACTOR

4.1. On Award of Contract

The Contractor shall prior to start of work submit his Health, Safety and Environment Management Manual or procedure and HSEM Plans for approval by CONSULTANT. The Contractor shall participate in the pre-start meeting with CONSULTANT to finalize HSEM Plans including the following:

- Job procedure to be allowed by Contractor for activities covering handling of equipment, scaffolding, electric installation, describing the risks involved, actions to be taken and methodology for monitoring each activity.
- CONSULTANT review/audit requirement.
- Organization structure along with responsibility and authority, records/reports etc. on HSEM activities.

4.2. During Job Execution

4.2.1. Implement approved Health, Safety and Environment Management procedure including but not limited to as brought out under Para 3.0. Contractor shall also ensure to:

- Arrange workmen compensation insurance, registration under ESI Act, third party liability insurance etc. as applicable.
- Submit timely the completed checklist on HSEM activities. HSEM report, accident reports, investigation reports etc. as per CONSULTANT requirements. Compliance of instruction on HSEM shall be done by Contractor and informed urgently to CONSULTANT.
- Ensure that Resident Engineer/Site-In-Charge of the Contractor shall attend all the Safety Committee/HSEM meetings arranged by CONSULTANT. Only in case of his absence from site that a second senior most person shall be nominated by him in advance and communicated to CONSULTANT.
- Display at site office and work locations, caution boards, and list of hospitals, emergency services available.
- Carryout audits/inspection at sub contractor works as per approved HSEM document and submit the reports for CONSULTANT review.
- Assist in HSEM audits by CONSULTANT and submit compliance report.
- Generate and submit HSEM records/report as per HSEM Plan.
- Appraise CONSULTANT on HSEM activities at site.

CHAPTER IX : APPENDIX-I

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1. **RELEVALENT IS CODES**

IS: 2925-1984	Industrial Safety Helmets
IS: 4770-1968	Rubber gloves for electrical purposes
IS: 6994-1973 (Part-I)	Industrial Safety Gloves (Leather and Cotton Gloves)
IS: 1989-1986 (Part-I & III)	Leather safety boots and shoes
IS: 3738-1975	Rubber knee shoes
IS: 5557-1969	Industrial and Safety rubber knee Boots
IS: 6519-1971	Code of practice for selections, care and repair of Safety footwear
IS: 11226-1985	Leather Safety footwear having direct molding sole
IS: 5983-1978	Eye protectors
IS: 9167-1979	Ear protectors
IS: 3521-1983	Industrial Safety belts and harness

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CHAPTER X : APPENDIX-II

1. HEALTH, SAFETY & ENVIRONMENT MANAGEMENT {HSEM} PLAN

PROJECT : _____ CONTRACTOR :_____

DATE : _____ CONSULTANT :

ACTIVITY DESCRIPTION	PROCEDURE/W.I. / GUIDELINES	CODE OF CONFORMANCE	PERFORMING FUNCTIONS			AUDIT FUNCTION
			PERFORMER	CHECKER	APPROVER	CUSTOMER REVIEW/AUDIT REQUIREMENTS

PREPARED BY REVIEWED BY APPROVED BY

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2. WEEKLY HSEM CHECKLIST CUM COMPLIANCE REPORT

PROJECT : _____ **CONTRACTOR :**_____

DATE : _____ **CONSULTANT :**_____

INSPECTION BY: _____

Note: Write 'NA' wherever the item is not applicable

ITEMS	**YES**	**NO**	**REMARKS**	**ACTION**
HOUSEKEEPING				
General neatness of working areas				
Others				
Personnel protective equipment				
Face protection				
safety belts				
others				
Excavations/openings				
Openings properly covered or barricaded				
Excavations shored				
Excavations barricaded				
Overnight lighting provided				
Others				

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3. WEEKLY HSEM CHECKLIST CUM-COMPLIANCE REPORT

ITEMS	YES	NO	REMARKS	ACTION
VEHICLE AND TRAFFIC				
Rules and regulations observed				
Inspection and maintenance				
Licensed drivers				
Others				
TEMPORARY FACILITIES				
Emergency instructions posted				
Fire extinguishers provided				
Fire-aid equipment available				
Secured against storm damage				
Others				
HANDLING AND STORAGE OF MATERIALS				
Properly stored or stacked				
Passageways clear				
Others				
WORKING AT HEIGHT				
Erection plan				
Safety nets				
ENVIRONMENT				
Chemical and Other Effluents properly disposed				
Lubricant Waste/Engine oils properly disposed				
ITEMS	**YES**	**NO**	**REMARKS**	**ACTION**
Disposal surplus earth, stripping materials, Oily rags and combustible materials done properly				
Green belt protection				

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HEALTH CHECKS				
Hygienic conditions at labour camps O.K?				
Availability of First Aid facilities				
Proper sanitation at site, office and labour camps				
Arrangement of medical facilities				
Measures for dealing with illness				
Availability of Potable drinking water for workmen and staff.				

Signatures of CONSULTANT

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4. ACCIDENT CUM FIRE REPORT

(To be submitted by contractor after every accident within hours of accident)

Report_____

Date : _____

Name of the Site

Contractor_____

NAME OF THE INJURED_____

FATHER'S NAME_____

SUB-CONTRACTOR M/S_____

DATE AND TIME OF ACCIDENT_____

LOCATION

BRIEF DESCRIPTION OF ACCIDENT

CAUSE OF ACCIDENT

NATURE OF INJURY/DAMAGE

MEDICAL AID PROVIDED/ACTIONS TAKEN

INTIMATION TO LOCAL AUTHORITIES

DATE: **SIGNATURE OF CONTRACTOR**
WITH SEAL

TO CONSULTANT 1 COPY

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5. SUPPLEMENTARY ACCIDENT & INVESTIGATION REPORT

Project :_____ Supplementary to Report No.:_____

(Copy enclosed)

Site : _____Date : _____

Contractor :_____

NAME OF THE INJURED_____

FATHER'S NAME_____

SUB-CONTRACTOR M/S_____

DATE AND TIME OF ACCIDENT_____

LOCATION

BRIEF DESCRIPTION & CAUSE OF ACCIDENT

NATURE OF INJURY/DAMAGE

COMMENTS FROM MEDICAL PRACTITIONER WHO ATTENDED THE VICTIM/INJURED

SUGGESTED IMPROVEMENT IN THE WORKING CONDITION, IF ANY

LOSS OF MANHOURS AND IMPACT ON SITE WORKS

ANY OTHER COMMENT BY SAFETY OFFICER

DATE: **SIGNATURE OF CONTRACTOR WITH SEAL**

TO: **CONSULTANT** **1 COPY**

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6. WEEKLY HEALTH, SAFETY, AND ENVIRONMENT {HSEM} REPORT

Actual work start Date : _____ For the Month of: _____

Project : _____ Report NO : _____

Name of the Contractor : _____Status as on : _____

Name of the Work_____Name of the safety officer_____

ITEMS	**THIS WEEK**	**CUMULATIVE**
Total Strength (Staff + Workmen)		
Number of HSEM meetings organized at site		
Number of HSEM awareness programmes conducted at site.		
Whether workmen compensation policy taken	Y/N	--
Whether workmen compensation policy is valid	Y/N	--
Whether workmen registered under ESI Act	Y/N	--
Number of Fatal Accidents		
Number of Loss Time Accidents (Other than Fatal)		
Other accidents (Non Loss Time)		
Total No of Accidents		
Total man-hours worked		
Man-hours loss due to fire and accidents.		
Compensation; cases raised with Insurance		
Compensation cases resolved and paid to workmen		
Remarks		

Date : Safety Officer/Resident Engineer
(Signature and Name)

□ □ □

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SANITARY FITTINGS AND FIXTURES

1	04.09.09	Logo Changed	MJ	AK	SB
0	12.11.07	Logo Changed	BK	KD	AM

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Rev.	Date	Subject of revision	Author	Checked	Approved
B	07.02.05	Logo Changed	SKS	RJ	RM
A	01.10.02	First Issue	RJ	VVA	VVA

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1. GENERAL

Reference shall be made to the following Indian Standards for any further information etc. not covered in the specification. In case of any conflict/contradiction, provisions of this specification shall override.

IS:2556 Specification for Vitreous Sanitary Appliances (Vitreous-China, Part 1-15).

IS:774 Specification for Flushing Cistern for Water Closets and Urinals.

IS:781 Specification for Cast copper alloy screw down bib taps and stop valves for water services.

IS:2064 Code of Practice for Selection, Installation and Maintenance of Sanitary Appliances.

2. SANITARY FITTINGS

All glazed earthen ware shall be of approved make, colour and of one piece construction. All metallic fixtures like taps, stop cocks, soap holders etc. shall be CP brass and approved make. All wall fittings shall be fixed with nylon sleeve and CP brass screws and washers.

3. INDIAN TYPE WATER CLOSET

Squatting Pan shall be 580 mm long Orissa Pan conforming to IS:2556. The closet shall be fixed in the floor with 150 mm thick sand cushion and shall be connected with 100 mm dia CI 'S' or 'P' trap. The closet shall also be fitted with 10 litres valve less symphonic type glazed earthen ware flushing cistern, conforming to IS:774, 15 mm dia. PVC inlet with brass union, PVC ball valves, handle, telescopic 32 mm dia GI flushing pipe with union, 15 mm dia GI overflow pipe and fixed with mosquito proof cover.

The cistern shall be fixed on MS brackets at a minimum height of 1150 mm from top of pan. All exposed metallic surface shall be painted with two coats of synthetic enamel paint of approved quality over a coat of primer (primer is not required for GI pipe).

Rate quoted for item rate tenders shall include providing and fixing water-closet and flushing cistern with al accessories, breaking wall and floors and making good the same, all inlet and outlet connections of cistern and water closet, finishing of solder joints, painting and testing of all connections etc. complete.

4. WASH DOWN TYPE WATER CLOSET

Wash down water closet shall be of Pattern-1 conforming to IS:2556, Part-II. Water Closet shall be of one piece construction. This shall be fixed with plastic seat and cover as per IS:2548 of approved make, fixed with CP brass hinges and rubber buffers and an integral 100 mm dia 'S' or 'P' trap with antisyphonage vent horn.

A low level earthenware cistern conforming to IS:774 of about 10 litres capacity, with 15 mm dia PVC inlet pipe and brass union with wiped solder joint, internal overflow arrangement, 40 mm dia CP brass flushing pipe. CI or MS supporting brackets shall be fixed with the water closet. The closet shall be fixed firmly in the floor with matching cement mortar. All exposed metallic surfaces shall be painted with two coats of synthetic enamel paint of approved quality over a coat of primer. The clearance between top of pan and bottom of cistern shall not exceed 300 mm.

Rate quoted for item rate tenders shall include providing and fixing of all fittings, breaking floors and wall, making good the same, making inlet and outlet connection to the cistern and the closet, testing of joints, painting the exposed metallic surface with two coats of white enamel paint over a coat of primer etc. complete.

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5. URINALS

Half stall type urinal shall be conforming to IS:2556, Part VI. Urinals shall be of single piece construction with integral flushing box rim. These shall be mounted on walls. The flushing inlet pipe shall be of CP brass 15 mm dia and waste pipe 32 mm dia GI, 750 long shall be embedded in wall. Necessary unions and CP bottle trap shall be provided in the waste line.

Rawl plugs with CP brass screws shall be used for fixing the urinal. Fixing shall ensure that no liquid is left over in the pan after flushing. Unless otherwise indicated height above finished floor shall be 600 mm.

Urinals shall be connected to glazed earthenware automatic flushing cisterns either individually, or in groups. Where individually connected to flushing cistern, the cistern capacity shall be 5 litres. For two urinals, one cistern of 10 litres capacity and for three urinals, one cistern of 15 litres, capacity shall be provided.

Cistern inlet shall be 15 mm dia PVC pipe with brass union. Outlet pipe from cistern shall be 25 mm CP brass main, with 15 mm CP distributor pipe of sufficient lengths to reach each bowl. Where individual cisterns are provided the outlet shall be of 15 mm CP brass.

Rate quoted for item rate tenders shall include cost of urinals inlet and outlet pipes, flushing cistern, breaking and making good the walls and flooring, making inlet and outlet connections, painting exposed brackets and GI pipes etc.

6. WASH BASINS

This shall be flat back wash basin with one tap hole conforming IS:2556, Part-IV. Wash basins shall be of one piece construction including a combined overflow having an area of not less than 5 Sq. cm. shall be provided in the front or back of the bowl and it shall be so designed as to facilitate cleaning of the overflow. This shall be fitted on CI or MS brackets. Brackets shall conform to IS:775. The brackets shall be given two coats of synthetic enamel paint or aluminium paint, over a coat of primer.

The wall side shall be fixed well flushed with the plaster or wall and the joint if any, shall be properly stopped with an elastomeric sealant. One CP brass pillar cock, PVC connecting pipe with brass union, a CP brass bottle trap with union, CP brass chain and rubber PVC stopper, 32 mm dia GI waste pipe shall also be supplied and fitted with the wash basin and embedded in the wall. The top of rim of the wash basin shall be fixed at 800 mm above finished floor level, unless otherwise specified.

Rate for item rate tenders shall include provision and fixing of wash basin with all accessories, providing stop cocks and pillar cocks, breaking and making good walls, fixing and making inlet and outlet connections for stop cock, pillar cock and waste pipe, providing and fixing MS brackets painted as mentioned above etc. complete.

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SEWER AND DRAINAGE SYSTEM

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1. GENERAL

This general technical SPECIFICATION is based on Indian CODES.

1.1. SCOPE

This SPECIFICATION covers the requirements to be followed by the CONTRACTOR in assembling, erecting, imparting and testing of underground sewage and drainage systems.

The following definitions shall apply :

Subject to the requirements of the context, the terms (hereafter listed in alphabetical order) used in this document are given the following meaning :

AGREEMENT	Designates the agreement concluded between the OWNER and the CONTRACTOR, under which the latter undertakes to the former the GOODS and/or SERVICES according to the stipulations which are agreed and specified in the form of an order.
OWNER	Designates the purchaser of the GOODS and/or SERVICES which are the subject of the AGREEMENT.
CODE	Designates a set of systems and Indian rules or international standardization documents for design, materials, tests, etc.
CONTRACTOR	Designates the individual or legal entity with whom the order has been concluded by the OWNER. The term "CONTRACTOR" may be used indifferently for a supplier, a manufacturer, an erection CONTRACTOR, etc.
DAYS - WEEKS - MONTHS	Specify the number of calendar days, weeks or months and not of working days, weeks or months.
OWNER'S REPRESENTATIVE	Designates the individual or legal entity to which the OWNER has entrusted various tasks in relation with the carrying out of his PROJECT.
GOODS and/or SERVICES	Designate, depending on the case, all or part of the drawings or documents, substances, materials, materiel, equipment, structures, plant, tools, machinery,... to be studied, designed, manufactured, supplied, erected, built, assembled, adapted, arranged or put into service by the CONTRACTOR under the AGREEMENT, including all the studies, tasks, works and services specified by the order. The terms GOODS or SERVICES may be indifferently used one for the other as required by the context.
PROJECT	Designates the aggregate of GOODS and/or SERVICES to be provided by one or more CONTRACTORS.
STANDARD	Designates a set of models or references, corresponding to common practice and generally used by the OWNER'S REPRESENTATIVE. This can be : typical standard drawings or documents.
SPECIFICATION	Designates a document describing in some details general or particular requirements for specific type of works.

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1.2. REFERENCES

The STANDARDS and CODES referred to in this section are :

Subject	Foreign CODES
Concrete testing; water absorption	[IS:456-2000.]
Non-reinforced concrete pipes; without internal pressure	[IS:458-1988]
Circular reinforced concrete pipes; without internal pressure	[IS:458-1988.]
Pipes and connections made of reinforced fibre cement for sanitary sewage systems	[IS:458-1988.]
Pipes made of vitrified clay	[IS:651-1992.]
Pipes made of PVC	[IS:4985-2000]
Modified Proctor test	[IS:2720-Part-28]
Code for Labour Protection	[Indian Labour Laws.]

The General Technical SPECIFICATIONS related to this section are :

- Structural Concrete
- Main earthworks & site preparation
- Excavation, Backfilling, Compaction

2. SETTING OUT

The OWNER'S REPRESENTATIVE will provide the required benchmarks at the plant battery limits.

The CONTRACTOR shall be responsible for all detailed survey in accordance with the construction drawings.

3. REMOVAL OF TOP SOIL

All surface soil likely to contain organic matter shall be removed from the site of the works and shall be either set aside carefully in separate spoil heaps when needed for re-use, or removed from the job site.

Top soil heaps shall be kept tidy and free of sub-soil and rubbish. The location of spoil heaps shall be approved by the OWNER'S REPRESENTATIVE.

4. EXCAVATIONS AND PREPARATION OF TRENCHES

All excavations shall be carried out to the lines and levels shown on the drawings. Suitable approved material from excavations shall, where required for filling, either be deposited immediately at the spoil heaps in such

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a manner as to preserve its natural moisture content as closely as possible. All other excavated materials shall be removed from the site.

Trench width shall be the minimum width required to permit the laying of the pipe, making and inspecting joints, and consolidating backfill.

When during excavation the CONTRACTOR encounters existing underground pipes, sewers, cables or any other obstructions he shall immediately inform the OWNER'S REPRESENTATIVE for further instructions.

The drawings do not guarantee the accuracy nor the completeness for the position of the underground obstacles. The CONTRACTOR shall verify their locations before starting any work affected by the obstacles.

The trench shall be excavated so that the pipe can be laid to the required alignment and depth and it shall be excavated only so far in advance of pipe laying as permitted by the OWNER'S REPRESENTATIVE.

Trenches normally shall be left open more than 50 meters in advance or 50 meters to the rear of pipe laying. However, in the case of manholes spaced more than 50 meters apart, the trench may be left open over the entire distance between, plus 25 meters beyond, each manhole to facilitate testing and continuation of work.

If unsuitable or poor material is encountered at the bottom of the trench, the unsuitable material shall be removed and replaced with well compacted stabilised material or, the trench shall be excavated to a deeper elevation and backfilled with large granular material.

The native or improved trench bottom shall be graded to a smooth surface prior to adding clean granular fill (bank-run sand) and lowering the pipe into the trench.

Excavations shall be kept free of water at all times. When pumping or dewatering is necessary, it shall be done in such a manner as to avoid disturbance to the ground or existing structures in and around the excavations. All sumps shall be formed clear of the excavation for the permanent work.

Solid rock or large boulders shall preferably be broken up by mechanical breakers or wedges. Where this is not practical, blasting methods shall be employed on receipt of approval in writing.

A specialist in the use of explosives shall be employed, and all necessary safety precautions and statutory requirements shall be observed, with regard to the use and storage of explosives.

Rock excavation shall be taken down 150 mm below the level of the bottom of the pipes, and replaced with a compacted sand bed.

Where necessary, for the safety of workmen, or to prevent damage or disturbance to any new or existing work or structures, excavations shall be provided with adequate sheeting, timbering, and shoring, to secure the sides and prevent any slippage, subsidence, or movement, in the excavation or surrounding ground. The positions and depths of all pipes, mains, cables, or other services in the vicinity of the works, shall be ascertained as accurately as possible.

Safeguards, consisting of temporary barriers, walkways, lights and safety signs shall be erected and maintained for the duration of the project to protect the personnel.

The CONTRACTOR shall inform the OWNER'S REPRESENTATIVE where an excavation is ready for inspection. No pipes or manholes shall be installed before the excavation has been inspected.

5. BEDDING

Compacted granular bedding with tamped backfill : the pipe shall be bedded in compacted P.C.C 1:4:8 placed on a flat trench bottom. The granular bedding shall have a minimum thickness of 150 mm. The thickness of bedding shall allow for the incorporation of sockets. In no way sockets shall support on the trench bottom.

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The remainder of the side fills and a minimum depth of 300 mm over the top of the pipe shall be filled with carefully compacted material.

In case the construction drawings indicate that the pipe lines have to be laid on concrete, joint holes shall be left for the sockets or collars of the pipes. When the concrete has set, the pipes shall be laid in sand-cement mortar. In no case, the sockets or collars shall rest on the concrete without proper support being given to the barrel.

6. PIPE HANDLING AND INSTALLATION

Protection shall be taken during handling of pipe against shocks and free fall.

Before the pipe is lowered into the trench, it should be inspected for damage and any unsatisfactory lengths rejected for use. The inside of each pipe length should be swabbed to remove loose dirt and other foreign matter.

Trenches shall be maintained dry during pipe installation and construction.

Socket and spigot pipe shall be installed upgrade with the spigot ends pointing in the direction of flow.

Pipe invert shall be adjusted by the addition or subtraction of bedding fill and not by wedging or blocking.

Socket and spigot, tongue and groove and other compression type joints shall be made with tools, lubricants and assembly procedures in accordance with the pipe manufacturer's recommendations with special care to guarantee that direct or other foreign material shall not enter the joints.

Cracked, chipped or broken pipes and damaged gaskets shall not be used for installation and they shall be removed from the site.

All pipes shall be laid conform to the line of direction and slope as shown on the drawings.

Completed sections of the pipe shall be partially backfilled to an elevation equal to the pipe centreline, and if pipe laying is suspended for a time, the ends shall be enclosed to prevent the entrance of foreign material.

The nonabrasive belts or other equipment designed to prevent damage to coating shall be used for the handling of coated pipe. The use of any tools or equipment which might be injurious to the coating shall not be permitted.

When stored, the pipe shall be placed on bags or similar in sufficient numbers to prevent damage to the coating at the points of support.

Walking on coated pipes shall not be permitted.

The manufacturer's specification shall be followed in case of plastic pipe installation.

Carbon steel butt weld joints shall be constructed according to the OWNER'S REPRESENTATIVE as required.

Flanged connections shall be constructed according to applicable specifications and shall satisfy the following specific requirements :

- Weld-neck flanges shall be aligned and positioned on and welded to the pipe so that the bolt holes straddle the horizontal and vertical axes and the refacing of the flange due to protrusion of the welding bead is not required.
- Valves shall be assembled with flat face companion flanges and full face gaskets.
- Tensioning of bolts shall be as follows : bolts diagonally opposed shall be tensioned in sequence with each diagonally opposed set 90° apart until all have been tightened evenly to partial tension; full tension shall

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be obtained by executing several passes of this procedure.

7. CATCH PITS AND MANHOLES

The location and construction of catch pits and manholes shall be in accordance with the construction drawings and the SPECIFICATION - Structural Concrete.

The manholes could be either prefabricated or built in site.

7.1. MANHOLES MADE OF REINFORCED CONCRETE

Reinforced concrete manholes built in site shall be in accordance with the SPECIFICATION - Structural Concrete.

7.2. MANHOLES IN BRICKWORK

The manholes shall be executed in brickwork; they shall be built at regular distances and in any case when the sewer and drainage system changes in direction and also at the location where the pipes meet together. The CONTRACTOR shall use full bricks for supporting brickwork or heavy concrete blocks. The brickwork and the rendering, inside and outside, shall be carried out with cement mortar 1:4 (1 cement : 4 coarse sand). At the outside a protective coaltar treatment is required. For manholes inside a building the covers shall be of the cast iron type.

8. MATERIALS

8.1. VITRIFIED CLAY PIPES AND CONCRETE PIPES

- Vitrified clay pipes according to :

[IS:651-1992]

- concrete pipes according to :

[IS:458-1988]

- In order to build the pipes together, the CONTRACTOR will use low C_3A cement mortar.
- Joints will be made of synthetically elastomers.

8.2. PIPES MADE OF PVC AND PVC-C

- PVC pipes according to :

[IS:4985-2000]

- PVC pipe connections will be made watertight using a watertight joint.

For draining of effluent water of temperature other than the ones indicated in the above mentioned CODE, one or eventual more manufacturers should be consulted.

When stored for a long period of time, the pipes and connection pieces shall be protected from the sun. The storage area shall be such that the pipes will not be subjected to thermal, chemical or mechanical damage. The surface on which the pipes are stored, shall be smooth and dense so as to give a full support to the pipes over their full length and to protect them from hard and sharp irregularities in the surface. The pipes shall also be free of materials which could provoke contamination.

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For temperatures below - 10° C, pipes in polyethylene shall not be handled. During the loading, the unloading, the storage and the placing of the pipes, they shall be handled with the utmost care.

- Pipe connections are made by :
  - welding
  - flanges
  - sealing rings in elastomer

When connecting by heating and welding under pressure, it shall be carried out strictly in accordance with the manufacturer's prescriptions and recommendations as far as the weakening temperature and the welding pressure are concerned.

For the connection of pipes by means of flanges, the use of fixed flanges is not advised because the fitting of the pipes could create unwanted tensions into the material. The 2 flanges can eventually be replaced by 2 shells.

The sealing rings shall be made of compact elastomer (NBN T 32-002). Except when specified otherwise on the drawings and/or Particular Technical SPECIFICATION (if any), only the elastomer types SBR and EPM/EPDM are allowed. When the sealing rings have to fulfil special requirements for resistance to fluids, the elastomer shall be specified on the drawings and/or the Particular Technical SPECIFICATION. The source certificate shall give information about the hardness.

The connection of PE pipes with the manholes shall be carried out by elastic sealing joints.

9. TESTING

9.1. GENERAL

All sewers, manholes and appurtenances shall be tested for water tightness.

The tests shall be carried out before the pipes are haunched (if applicable) and before the trenches are backfilled.

The tests shall be performed by the CONTRACTOR who shall also provide the required testing equipment.

Whenever the OWNER'S REPRESENTATIVE has reason to believe that a pipe line has become defective due to backfilling operations he may order retesting.

Sewer lines may be tested separately from the rest of the lines in a circuit to avoid delays in backfilling.

Tests and inspections shall be conducted during daylight and dry weather.

Water, the test media, shall never be used when the temperature is below 3°C.

Sewer lines and appurtenances shall be tested hydrostatically for leakage by the exfiltration method. The system being tested is filled with water to produce a 1.00 m (minimum), 2.00 m (maximum) head on the invert of the pipe at the midpoint elevation of the system.

The acceptable leakage rates for sanitary and process sewers, excluding hydrocarbon sewers, shall not exceed one litre per hour per 10 m^2 of wet surface. This leakage allowance shall be increased by 10 % for each additional 80 mm that the actual head exceeds the basic 1.00 m head.

Acceptable leakage rates for hydrocarbon sewer shall be zero.

- Acceptable leakage rates for carbon steel or stainless pipe-sewer shall be zero.

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Any part in which leakage is detected shall be repaired to the satisfaction of the OWNER'S REPRESENTATIVE, after which the test shall be repeated.

Smoke test, dye test, or visual inspection shall not be performed in lieu of the hydrostatic exfiltration test, but shall be used as required for establishing system continuity only.

Testing of above ground piping and building plumbing systems shall be performed separately.

9.2. HYDROSTATIC EXFILTRATION TEST

9.2.1. Manholes shall be tested as follows

a) Plug all inlet and outlet pipes.

b) Fill manhole with water to 1.00 m above highest plug but not higher than 300 mm below grade.

c) Observe two hour absorption period then refill to test depth.

d) Observe one hour test period, refill to test level and record volume of water used.

e) Allowable leakage shall not exceed one litter per hour per 10 m^2 of wet surface (based on 1.00 m depth of test water above bottom of manhole).

9.2.2. Sewer section between two manholes shall be tested as follows

a) Plug discharge end of sewer pipe under test at lower manhole.

b) Plug all inlet pipes of upper manhole.

c) Fill the system through upper manhole with water to test depth.

d) Observe two hour absorption period then refill the system to test depth.

e) Observe one hour test period refill to test level and record volume of water used.

f) Subtract manhole exfiltration loss to determine actual pipe leakage.

9.2.3. System of drain cups and drain pipes discharging into a catch basin or manhole shall be tested as follows

a) Plug discharge end of drain system under test at connection to catch basin or manhole.

b) Seal all drain cups with plugs fitted with ½" vent cocks, except one, and to this attach a temporary stand pipe for filling and obtaining the required test head.

c) Fill the system through the stand pipe and bleed all branches, starting with the longest reach, opening to vent cocks until all entrained air has escaped, making sure that throughout the bleeding process water level in the stand pipe is maintained above the highest vent cock. After the system is bled and the last vent cock has been closed, adjust the water level in the stand pipe to the test level.

d) Observe one hour test period refill the system to test level and record the volume of water used.

9.3. TESTING DOCUMENTS

Records shall be maintained of all performed tests with the following minimum information documented :

a) date of test

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b) system tested

c) test section identification within the system

d) test fluid

e) test fluid head

f) allowable leakage

g) observed leakage within each test section

h) repairs

i) retesting

j) inspector

10. REINFORCED CONCRETE STRUCTURES

This wording covers the reinforced concrete structures such as basins, inspection chambers, manholes, coverplates, etc.

For the erection and construction of these reinforced concrete structures, reference is made to the General Technical SPECIFICATION - Structural Concrete.

11. BACKFILLING

After the pipe has been embedded and tested, additional bedding material shall be added to a point 300 mm above the top of the pipe. Due care shall be taken to prevent lateral displacement of pipes.

This bedding material shall be placed in layers of maximum 150 mm thoroughly compacted by hand with care given when compacting the material under the pipe barrel.

Backfill material shall consist of native or imported compatible material free of rocks larger than 100 mm, vegetable or organic matter, or soil with exceptionally high void content.

When placing backfill material, the finer material shall be placed first.

Backfill compaction by the water tamping method shall not be used.

Timber sheeting shall be removed from the trench before backfilling.

The moisture content of the filling material shall be adjusted to within 2 % of its optimum moisture content. In wet weather, when the moisture content cannot be reduced to the specified amount by aeration alone, then filling and compaction shall be suspended.

All soft areas, developed during compaction shall be removed and replaced with approved material. The surfaces of raised areas of fill shall be maintained at sufficient cross fall to shed water and prevent ponding.

Backfill shall be placed in layers not exceeding 250 mm in loose depth and each layer compacted, by means of approval mechanical plant, until a density of 90 % of the maximum dry density is achieved. The maximum possible density shall be defined by the Modified Proctor test in the laboratory.

Tests shall be taken each 200 m of trench at various layers in the vertical sense as directed by the OWNER'S REPRESENTATIVE.

The CONTRACTOR shall have the required Modified Proctor tests (IS : 2720) performed by an approved

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specialist and shall supply the OWNER'S REPRESENTATIVE with two copies of all relevant test certificates.

Backfill compacted to a degree lower as specified will have to be redone without any compensation to the CONTRACTOR.

All backfill, at the end of the contract, shall conform to the lines and levels shown on the drawings and due allowance shall be made for possible consolidation and shrinkage in this respect.

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SITE PREPARATION

EXCAVATION WORKS & BACK FILLING

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1. GENERAL

1.1. Scope

This SPECIFICATION covers the mandatory requirements governing the Site Preparation Excavation, General Earthworks & Back Filling.

1.2. References/Codes

The following Regulations & CODES will be referred to in this specification :

Indian CODES	Subject
IS:2720-(Part-VIII)	Modified Proctor test
IS:2720-(Part-VII)	Sand Replacement Method
IS:2720-(Part-VII)	Californian bearing ratio test
Indian Labour Laws	

and all derived CODES.

2. SITE CONDITION

The description of soil types expected at the site and the results of field and laboratory tests are given in the available soil report, if the Geo-technical investigation is not in scope of Contractor.

The Contractor shall study the soil report to ensure that the equipment to be deployed shall be submitted by the Contractor to the OWNER/OWNER'S REPRESENTATIVE for approval.

2.1. Site data

Prior to excavation or filling work commencing, the levels existing at the site shall be agreed between the OWNER/OWNER'S REPRESENTATIVE and Contractor.

The Contractor shall set-out and construct any permanent base lines and datum monuments (Bench Mark) indicated on the drawings or requested by the OWNER/OWNER'S REPRESENTATIVE.

Temporary bench marks to facilitate construction shall be constructed and established based from existing bench marks and shall have to be approved by the OWNER/OWNER'S REPRESENTATIVE.

Such reference bench marks shall be located where they will be unlikely to be damaged through out its use during construction shall be properly identified as directed by the OWNER/OWNER'S REPRESENTATIVE.

2.2. Setting out

The OWNER'S REPRESENTATIVE will provide the required bench marks at the plant battery limits.

The CONTRACTOR shall perform the necessary surveying and staking to complete the work to the required limits and levels. It shall be the responsibility of the CONTRACTOR to preserve all reference points and bench marks.

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After setting-out any part of the work, the CONTRACTOR shall notify the OWNER'S REPRESENTATIVE and give him sufficient time to check the setting-out before that part of the work is started. Any assessed discrepancies shall be corrected. Despite any checking, the CONTRACTOR remains responsible for the exactness of the setting-out and for completing the work to the specified limits and level.

The setting-out of site preparation and earthworks shall be positioned from the setting-out points and data provided. Dimensions shall be correct to the following tolerances:

- Dimensions less than 15m shall be correct to 12mm.
- Dimensions over 15m shall be correct to 30mm.
- Cumulative Tolerance shall not be permitted.

3. SITE PREPARATION

Site preparation shall consist of the site clearance, the grubbing, the removal and disposal of unwanted material, the stripping and storage of top soil, the general site grading and filling.

3.1. Site dewatering

Where water courses or ponds have to be removed the channel or pond shall be cleared from all vegetable matter, silt and organic material. Excavation should go beyond the bed into soil, where no deposit of silt or organic matter is present. The silty organic soil shall be disposed of as directed by OWNER'S REPRESENTATIVE.

3.2. Site clearance

All existing constructions such as, but not limited to, foundations, paving, trees and shrubs including stumps and roots shall be completely removed from the site on instructions of OWNER/OWNER'S REPRESENTATIVE.

The site-area shall be cleared. This shall include the removal of all trees, bushes and other vegetation, to within 300 mm below the natural grade level. It shall also include the removal of dense growths of ground plants, matted dead vegetation, and rubbish resting on natural grade.

All cleared material, including trees, stumps, roots, and brush shall be removed from the site. Material may be burnt if authorised in writing by the OWNER'S REPRESENTATIVE, in areas and at times indicated on the written document of approval.

3.3. Removal of top soil

The top layer, likely to contain organic matter, shall be stripped from the site of the works and shall be either set aside carefully in separate spoil heaps when needed for re-use, or removed from the job site.

The topsoil shall be stockpiled in areas shown on the OWNER'S REPRESENTATIVE'S drawings.

Stored topsoil shall be mounted and shaped to shed rain water without deep erosion. Stored areas should be graded to drain surface water away from mounted topsoil.

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Precautions shall be taken to prevent stored topsoil being contaminated by sub-soil, cement, lime, broken concrete, aggregate or similar material or by petrol, diesel and lubricating oil or other substances likely to impair its growing qualities.

3.4. Soil preparation

After the site area has been fully cleared and grubbed, the complete area shall be scarified for a depth of 200 mm, and compacted to 95 % of the maximum density at optimum moisture content obtained by the :

Modified Proctor Test -	[IS:2720-(Part-VIII)]

The prepared subgrade shall be tested by in-situ CBR or plate tests, as required in this SPECIFICATION.

All unacceptable material shall be removed to tip area.

Unacceptable material is all soil with a CBR of less than 2 % (after compaction), as defined in clause 4.2.3 of this SPECIFICATION.

Rough grading of all areas within the project, including excavated and filled sections and adjacent transition areas shall be reasonably smooth, compacted, and free from irregular surface changes. The degree of finish shall be such as obtained usually by a blade-grader or a scraper, except as otherwise specified. The finished surface shall generally be within a vertical tolerance of 50 mm of final lines, grades and slopes; the tolerance for areas with 3 metres of buildings and all areas to be paved shall be within 30 mm of final lines and grades.

Final grading shall comply with paragraph 4.5 of this SPECIFICATION.

3.5. Site access

The CONTRACTOR shall clear, grade and maintain an access road to the work area(s) so that the passage of cars and trucks is guaranteed at all times.

The CONTRACTOR shall also grade and maintain an access road on the site for picking up, transporting and removing the unwanted stored material areas, equipment or others from the site (hauling operation). When such a road is no longer required, the CONTRACTOR shall reinstate the ground to the satisfaction of the OWNER'S REPRESENTATIVE.

Existing surfaced and paved roads used by the CONTRACTOR shall be repaired whenever damaged at his own cost. This requirement applies equally for both public and private roads.

The CONTRACTOR shall conduct his grading and hauling operations in an orderly and safe manner, and he will take the necessary measurements for protecting other CONTRACTORS (if any) or a travelling public (if any). The CONTRACTOR'S equipment applied for works on public roads or streets shall comply with all the applicable regulations. No payment, if any, on this account shall be made to the contractor.

The CONTRACTOR shall take particular care to avoid spillage on roadway on which he passes with his equipment. All material, dropped onto the roads, shall be promptly removed by sweeping and/or flushing with water. A general dust condition on the roads, due to the travelling of the CONTRACTOR'S equipment, shall be cleaned at regular intervals by flushing with water to prevent it from becoming annoying for the traffic and adjacent properties.

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4. GENERAL EARTHWORKS

4.1. Excavations required for the permanent work

The CONTRACTOR shall carry out all excavations required for the permanent works in whatever material he may encounter. He shall provide all labour and plant, including all necessary excavating, transporting, lifting, hauling, and transport equipment to deal with any kind of material.

All excavating and earth moving plant and machines shall be of a type approved by the OWNER'S REPRESENTATIVE and they shall be maintained operational throughout the civil works.

Excavations shall include the removal and transportation of all excavated material from the point of excavation to the point of final use or disposal in accordance with the lines, grades and dimensions shown on the drawings or prescribed by the OWNER'S REPRESENTATIVE.

The CONTRACTOR shall submit to the OWNER'S REPRESENTATIVE his proposed method of excavation, spoil disposal, pumping arrangements and methods of supporting excavations or angles of side slopes for open cuts.

Excavation shall only be carried out in open cut with the approval of the OWNER'S REPRESENTATIVE. Where necessary, guard railings and toe boards shall be provided for safety protection around excavations and all necessary ladders, staging and walkways shall be provided for access. All earthworks shall be properly protected in such lengths and depths at one time as the OWNER'S REPRESENTATIVE may approve.

The CONTRACTOR shall fully co-operate with the OWNER'S REPRESENTATIVE, especially in regard with the sequence and timing of trench excavation, placing of spoil and backfilling to ensure the most efficient execution of the work. All drainage work and piping shall be completed before any construction of roads or paved areas.

The CONTRACTOR shall notify the OWNER'S REPRESENTATIVE when any excavation is complete and no soil fill or concrete shall be placed until the OWNER'S REPRESENTATIVE has inspected and approved the excavation. The free space after removal of unsuitable soil by the CONTRACTOR and any holes or depressions below the required subgrade shall be filled with approved materials placed and compacted in layers in accordance with this SPECIFICATION.

Over-excavation and any damage to finished surfaces by the CONTRACTOR shall be filled and restored to the correct lines and levels by the CONTRACTOR at his own expense using materials approved by the OWNER'S REPRESENTATIVE.

Trenches for pipes and excavations for manholes and catchbasins shall be excavated with vertical sides unless otherwise demanded or permitted by the OWNER'S REPRESENTATIVE. The width of the pipe trenches shall be adequate to permit the satisfactory laying and jointing of pipes.

4.1.1. Water in Excavations

All excavations shall be kept free of water at all times until the construction and backfilling within the excavations is completed. The CONTRACTOR shall provide all pumping, temporary drains, cuts and sumps as may be required for this purpose according to the OWNER'S REPRESENTATIVE. All such cuts and sumps shall be filled in with concrete or other suitable filling as directed by the OWNER'S REPRESENTATIVE. Water pumped from excavations shall be directed either onto the adjoining ground after obtaining prior consent from the Land Owner or into an near by permanent drainage system as directed by the OWNER'S REPRESENTATIVE. Adequate precautions shall be taken to ensure that existing drainage systems are protected from blockage by the ingress of materials.

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4.1.2. Excavation Supports

All excavations shall be fully supported to prevent movement of adjacent ground, structures or other works and to prevent any materials from falling into it by timbering, steel trench sheeting, steel sheet piling, or other means. Where necessary, the CONTRACTOR shall submit drawings and calculations with his proposals for supporting the excavations and they shall be subject to review by the OWNER'S REPRESENTATIVE. Counter shores shall be placed, as necessary, before the original supports to sides of excavations are removed to make way for the construction of the permanent work. When placing or removing counter shores or other supports, care must be taken to avoid pressure being brought onto the permanent work before it is capable of withstanding such pressure.

The CONTRACTOR shall be held entirely responsible for any damage to or settlements of any adjacent buildings, foundations, etc., and repairs of any such damage shall be at the CONTRACTOR'S expense. If the OWNER'S REPRESENTATIVE thinks it is necessary, a record shall be drawn up to establish the existing situation prior to the starting works. The form of the record may be photographs and/or glass telltale rods to detect any movement. The OWNER'S REPRESENTATIVE shall have authority, as the work proceed, to instruct the CONTRACTOR to put in additional timbering or shoring if he considers the timbering to be unsatisfactory and such additional timber shall be put in at the CONTRACTOR'S expense. The OWNER'S REPRESENTATIVE'S authority to call for extra timber shall not in any way relieve the CONTRACTOR from his responsibilities.

All temporary sheeting, timbering, and shoring, shall be removed when the Permanent Works are completed, unless otherwise directed.

4.2. Materials

Earthworks materials to be used in the Civil Works shall be one of the following general classifications :

(i) Acceptable Material : material excavated from within the site area, or imported on the site which meets the requirements of paragraph 4.2.1 and 4.2.2 of this SPECIFICATION for acceptability for use in the Permanent Works.

(ii) Unacceptable Material : as defined in paragraph 4.2.3 of this SPECIFICATION which shall not be used in the Permanent Works.

4.2.1. Acceptable Material, excavated from within the site area

The natural occurring in-situ material within the site area (excluding top soil and unacceptable material) shall be used as general fill for the site preparation and grading required for the overall site development.

4.2.2. Acceptable Imported Fill Material

The fill material shall be granular, well graded, compactable, and possess good drainage characteristics, and no swelling properties. It shall be free of vegetation, any organic matters and other impurities. In extraordinary circumstances expansive soil of free swell index, less than 50% may be used, however approval shall be sought from the Owner/Owner's Representative.

The proposed fill material shall be tested to determine its suitability. However, filling material shall have Liquid limit between 20-35 and Plasticity index shall not be more than 12.

4.2.3. Unacceptable Material

The following type of material will be considered unsuitable for filling:
Material with vegetation and shrubs.

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1. Material in frozen condition or susceptible to combustion.
2. Material resulting in leaching.
3. Any material which classifies as CH, OH, OI, LI as per IS:1498.
4. Material with swelling index more than 50.

4.3. Filling

4.3.1. Preparation of Ground for Fill

Prior to placing the filling material upon any area, all clearing operations shall have been completed in accordance with paragraph 23. All sod, grass and vegetable matter shall be removed from the ground surface and the ground shall have the required form and level. The top surface shall be prepared in accordance with paragraph 3.4.

Where areas of wet soil exist, on which the fill is to be placed, they shall be drained and if necessary, excavated, as directed by the OWNER'S REPRESENTATIVE.

4.3.2. Placing Area Fill

Area fill shall be placed in accordance with the following requirements :

All fill shall be placed in layers approximately parallel to the final rough grade. Fill shall be constructed to elevations shown on the OWNER'S REPRESENTATIVE'S drawings to an accuracy of ± 50 mm.

Layers shall be placed within 24 hours of moisture treatment and compaction.

Loose fill layers shall be 200 to 400 mm thick prior to compaction, depending on the compaction equipment and nature of filling material.

The CONTRACTOR shall provide a system of temporary drainage at his own expense to prevent localised ponding of rainwater. A plan of temporary drainage structures shall be submitted for approval before construction. The system should conform with the final surface drainage system for the area as shown on the drawings.

4.4. Compaction

- For each Type of fill material and for each source, compaction shall be carried out to achieve 95 % of the maximum dry densities of the material, at optimum moisture content obtained by

Modified Proctor Test -	[IS 2720 (PART VIII)]

When the fill type and its proposed method of laying have been approved by the OWNER'S REPRESENTATIVE, this method shall be used for the actual filling operations and no changes in the material properties, their sources of supply or their placement method shall be allowed without further compaction trials.

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- The construction of foundations bearing on or within filled ground shall not start until agreed on by the OWNER'S REPRESENTATIVE.

- Suitable concrete level checking pads shall be placed in the final surface of the filling and levels shall be taken and agreed on by the OWNER'S REPRESENTATIVE at regular intervals prior to the starting of the construction.

- No part of the drains, pipelines or any other work shall be covered until they have been tested by the CONTRACTOR and approved by the OWNER'S REPRESENTATIVE.

4.5. Grading

Rough grading required for site preparation shall be carried out in accordance with paragraph 3.4 of this SPECIFICATION.

Final grading shall be carried out when all below ground works are completed and at a time agreed on by the OWNER'S REPRESENTATIVE. Final grades shall be carried out to the lines, grades, and slopes shown on the drawings, within a tolerance of 30 mm.

Finish surface to graded areas, top soil and grass, gravel, grade pavement, etc. shall be as shown on the OWNER'S REPRESENTATIVE'S drawings.

4.6. Underground obstacles

When during excavation the CONTRACTOR encounters existing underground pipes, sewers, cables or any other obstructions he shall immediately inform the OWNER'S REPRESENTATIVE for further instructions.

The OWNER'S REPRESENTATIVE'S drawings do not guarantee the accuracy nor the correct position of eventual underground obstacles.

The CONTRACTOR shall verify their locations before starting any work affected by the obstacles.

5. CONSTRUCTION OF BUND WALLS AND DITCHES

The site grading slopes and bunds shall be constructed in acceptable material (paragraph 4.2) and placed and compacted in accordance with the paragraphs 4.3 and 4.4.

The slopes of temporary and permanent bunds shall be as shown on the OWNER'S REPRESENTATIVE'S drawings.

Earthen bund walls, and slopes to both embankments and cuttings shall be protected against erosion.

6. EARTHWORKS FOR ROADS

This paragraph deals with the preparatory works regarding the earthworks for roads.

6.1. Earth subgrade for roads

Earth subgrade for roads shall include common excavation or fill and rough grading of roads and

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embankments with their attendant shoulders and ditches.

The top 500 mm of subgrade shall be compacted to a minimum of 95 % of the maximum density at optimum moisture content obtained by means of

Modified Proctor Test -	[IS 2720 (PART VIII)]

Unacceptable material shall be removed prior to the placement of the filling, sub-base or base course materials.

6.2. Road Embankments

All road embankments shall be constructed in layers parallel to the finished grade of the road bed. During the construction of embankment, a smooth grade having an adequate crown shall be maintained to provide drainage. Embankments shall be constructed to the required grade and the completed embankments shall correspond to the required grade as well as to the shape as shown on the drawings.

Embankments shall be filled with general fill material (paragraph 4.2) from designated or other approved sources. Embankments shall be constructed in successive layers, over the full width of the cross section and on such lengths as are suited for the applied compaction and watering methods. The layers shall not exceed 200 mm in depth prior to compaction.

The surface of the road embankment shall be constructed to an accuracy of + 20 mm to permit the construction of sub-base and base to the required thickness, surface tolerance and specified compaction.

Before placing the sub-base, the compacted surface should be levelled and checked by the OWNER'S REPRESENTATIVE.

Road embankments shall be compacted to an average dry density equal to 95 % of the maximum dry density as determined by :

Modified Proctor Test -	[IS 2720 (PART VIII)]

If necessary, and before being compacted, each layer shall be processed as required to bring the moisture content to not more than 2 % dry of optimum so as to warrant its compaction to the required density. The material shall be so worked as to have a uniform moisture content through the entire layer.

Each material layer shall be compacted uniformly by use of adequate and appropriate compaction equipment. The compaction shall be done in a longitudinal direction along the embankment and shall generally begin at the outer edges and progress towards the centre line in such a manner that each section receives equal effort from compaction.

7. TESTING OF SOIL IN EARTHWORKS

When there is reasonable doubt as to the adequacy of the work carried out, the earthworks shall be tested by means of one or more of the following methods :

The compaction of filling shall be tested generally by the :

Sand Replacement Method -	[IS 2720 (PART VII)]

for determining dry density and moisture content. Where it is important to test one layer of fill before it is covered

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by successive layers, and time is an important factor, the compaction shall be tested by means of an approved nuclear-electronic instrument. This instrument shall be operated strictly in accordance with the Manufacturer's instructions.

The optimum dry density and moisture content for the compaction of any particular soil shall be determined by means of the :

Modified Proctor Test -	[IS 2720 (PART VIII)]

For large areas of bulk excavation and filling, preliminary site tests shall be carried out to determine the method for achieving the required compaction with plant available. These tests shall be carried out by laying strips of filling material approximate 18 m long and 4.5 m wide in varying thicknesses. The strips shall then be compacted with the plant to be used, with varying numbers of passes.

Compaction tests shall then be made for each strip, either in-situ, or by taking samples for laboratory testing. The results of these tests shall determine the method to be adopted for the compaction of filled areas.

The OWNER'S REPRESENTATIVE may at any time carry out field dry density testing on materials which he considers not to be compacted adequately. The CONTRACTOR shall carry out any necessary works to achieve a satisfactory state of compaction. This additional work shall be at the CONTRACTOR'S expense if the inadequate compaction does not comply with this SPECIFICATION due to his failure.

If the test results show that the required state of compaction is consistently not being achieved, the OWNER'S REPRESENTATIVE shall require further trial compaction to be carried out to establish a successful method of compaction.

8. BEARING TESTS

Soil, either in fill or excavation, shall be tested for bearing, using one or more of the following methods, if a soil report is not available.

8.1. Direct loading method

A concrete slab of suitable size shall be cast either on the surface or at the required depth and when sufficiently hardened, it shall be loaded with kentledge at intervals.

Readings of load and deflection shall be taken at each interval until failure of the soil under the base.

Alternatively, the slab may be loaded as for a pile test, using jacks.

8.2. Californian bearing ratio test

The CBR test shall be carried out in accordance with IS :2720-Part VII.

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STANDARD FIELD QUALITY PLAN

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S.No	Component Operation & Description of Test	Sampling Plan with basis	Ref. Document & acceptance norms	Testing Agency	Remarks	Check
1.	CHECKING OF FOUNDATION MATERIALS					
A.	CEMENT					
i ii iii iv v	Fineness Compressive Strength Initial & final setting time Soundness Heat of Hydration for low heat cement (Not Applicable for OPC & PCC)	One sample per lot of 100 MT or part thereof from each source for MTCs and one sample per lot of 200 MT or part thereof from each source for site testing.	IS:456, IS:269, IS:8112, IS:12269, IS: 4489 & TECPL Specification	Manufacturer approved lab	Review of manufacturers test certificates (MTCS) and laboratory test results by TECPL	B
vi	Chemical Composition of Cement	One sample per lot of 100 MT or part thereof from each source fro MTCs.	IS:456, IS:269, IS:8112, IS:12269, IS: 4489 & TECPL Specification	Manufacturer	Review of manufacturers test certificates by TECPL	B
B.	COARSE AGGREGATES					
i. ii iii iv v vi vii viii ix	Determination of Particle size (Sieve Analysis) Flakiness Index Crushing Value Specific Gravity Bulk Density Absorption Valve Moisture Content Soundness of Aggregate Presence of detections materials	One sample per lot of 100 cubic meter or part thereof from each source for each source for each size	IS: 383, IS: 2386 and TECPL specification	TECPL approved lab. However, Moisture content test for design mix concrete shall be done on all days of concreting at site.	Each source to be approved by TECPL. Review and acceptance of test result by TECPL	B

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C	FINE AGGREGATE					
i	Gradation/Determination of Particle size(Sieve Analysis)	One sample per lot of 100 cubic meter of part thereof from each source	IS:383, IS:2386, IS:456 and TECPL specification	TECPL approved lab. However, Moisture content test for design mix concrete shall be done on all days of concreting at site.	Each source to by approved by TECPL. Review and acceptance of test result by TECPL	B
ii	Specific Gravity and density.					
	Moisture content*					
	Absorption Value*					
iii	Bulking					
iv	Silt Content Test					
v	Presence of deleterious materials					
vi						
D	BRICKS					
i.	Dimensional tolerance	As per enclosed Annexure-II	CPWD & TECPL specification	TECPL approved Lab.	Approved by TECPL	B
ii	Compressible Strength					
	Water Absorption					
	Efflorescence					
E	WATER					
i	Cleanliness (Visual Check)	Random	IS: 456, IS: 3025 and TECPL specification. The water used for mixing concrete shall be fresh, clean and free from oil, acids and alkalis, organic materials, or other deleterious materials.	Contractor	Each source to be approved by TECPL	B
ii	Chemical and physical properties of water for checking its suitability for construction purposes	One sample per source	IS:456, IS:3025 and TECPL specification	Contractor/ TECPL approved lab.	Approved by TECPL	B

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2.	REINFORCEMENT STEEL					
i.	Identification & size	Random	IS:432, IS:1139, IS:1786 & TECPL specification	Contractor	Approved by TECPL	B
ii.	Chemical Analysis Test	One sample per heat	IS:432, IS:1139, IS:1786 & TECPL specification	Manufacturer	Review of manufacturers test certificates by TECPL	B
iii iv v	Tensile Test Yield stress/ proof stress Percentage Elongation	One sample per lot of 40 MT or part thereof for each size of steel conforming to IS:1139 and 5 MT or part thereof for HDS wire for each size of steel as per IS:432. For steel as per IS:1786 under 10mm 1 sample for each 35 MT or part thereof. Over 16m , 1 sample for each 45 MT or part thereof.	IS:432, IS:1139, IS:1786 & TECPL specification	Manufacturers / TECPL approved Lab	Review of manufacturers test certificates as well as lab test result by TECPL	B
vi	Bend/Rebend Test	One sample per lot of 20 MT or part thereof for each size of steel as per IS:432, IS:1139. For steel as per IS:1786 under 10mm- 16mm, 1 sample for each 25 MT or part thereof 10mm-16mm 1 sample for each 45 MT or part thereof.	IS:432, IS:1139, IS:1786 & TECPL specification	Manufacturers / TECPL approved Lab	Review of manufacturers test certificates as well as lab test result by TECPL	
vii	Reverse Bend Test for HDS wire.	One sample per lot of 5 MT or part thereof for each size	IS:432, TECPL specification	Manufacturer/ TECPL approved lab.	Review of manufacturers test certificates as well as lab test result by TECPL	

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3.	STRUCTURAL STEEL USED IN CABLE TRENCHES & FOUNDATIONS					
i.	Dimensional Check	Random	TECPL specification & approved drawing	Contractor	Checklist to be prepared and signed jointly.	B
ii.	Visual Check for damages, resting, pitting etc.	100%	TECPL specification & approved drawing	Contractor	Checklist to be prepared and signed jointly.	C
iii	Visual Check for welding, defects, primer coating and painting/ galvanizing as applicable	Sample per lot of 40 MT or part thereof for tensile tests and 1 sample per lot of 20 MT or part thereof for bend test for each size.	IS:2062, TECPL Specification & approved drawings	Manufacturer/ TECPL approved lab	Review of Mtgs test certificates as well as lab test results by TECPL	C
iv	Physical properties of structural steel	One sample per lot of 40 T or part thereof for tensile tests and 1 sample per lot of 20 T or part thereof for bend test.	IS 2062 ,TECPL Specifications and approved drawings	Manufacturer/TECPL approved lab	Review of Mtgs test certificates as well as lab test results by TECPL	B
4.	EQUIPMENT FOUNDATION/ CABLE TRENCH					
A	BEFORE EXCAVATION					
i	Checking of pegs condition as per line and alignment	100% on each location	IS:4091, IS:3764 & TECPL approved drawing/ specification	Contractor	Approved by TECPL	C
ii.	Checking of pit making as per drawing & RL.	100% on each location	IS:4091, IS:3764 & TECPL approved drawing/ specification.	Contractor	Approved by TECPL	C

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B	EXCAVATION					
i.	Dimensional conformity	Each location	IS:4091, IS:3764 & TECPL approved drawing/ specification.	Contractor	Approved by TECPL	B
ii	Verticality/slopes & Square ness of each pit	Each location	IS:4091, IS:3764 & TECPL approved drawing/ specification.	Contractor	Approved by TECPL	B
iii	Vertification & classification of foundation wherever application.	Each location	IS:4091, IS:3764 & TECPL approved drawing/ specification.	Contractor	Approved by TECPL	B
C	**FOUNDATION BOLTS/ MATALLIC INSERTS** Check for proper identification foundation bolts w.r.t. type of foundation		TECPL specification & approved drawings			
i.	Visual check for mechanical damage and galvanizing/ painting it applicable for metallic insert	100%	TECPL specification & approved drawings	Contractor	Checklist to be prepared & signed jointly.	C
ii.	Alignment & Level	100%		Contractor	Checklist to be prepared & signed jointly.	C
iii.	Grouting/ Underpinning of foundation base plate.	100%	TECPL specification & approved drawings	Contractor	Checklist to be prepared & signed jointly.	B
iv	P.C.C. PADDING	100%	TECPL specification & approved drawings.	Contractor	Checklist to be prepared & signed jointly.	C
			IS:456 and			

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			TECPL approved foundation drawings & Specification		Approval by TECPL	
D.	SHUTTERING (Formwork) Check for materials, breakage or damage.	For all locations		Joint Inspection by TECPL and Contractor.		B
E.	Check for plumb, alignment parallelism, squareness and		IS: 456, TECPL specification / approved drawings.		Approval by TECPL	
i.	equidistance from stub. Dimensional check	100%	IS:456, TECPL Specification/ approved drawings.	Joint Inspection by TECPL and contractor	Approval by TECPL	C
ii.	Check for level & height.	100% casting	TECPL Specification/ approved drawings	Joint Inspection by TECPL and contractor.	Approval by TECPL	B
iii.	Check for rigidity of frame/ tightness	100% before casting	TECPL Specification/ approved drawings	Joint Inspection by TECPL and contractor	Approval by TECPL	B
iv	Cleaning and oiling	100% before casting	TECPL Specification/ approved drawings	Joint Inspection by TECPL and contractor	Approval by TECPL	B
v.	Diagonal bracing if required as per drawings/ site conditions	100%	TECPL Specification/ approved drawings	Joint Inspection by TECPL and contractor	Approval by TECPL	B
vi	Checking of joints to avoid undue loss of cement slurry.	100%	TECPL Specification/ approved drawings	Joint Inspection by TECPL and contractor	Approval by TECPL	B
vii	PLACEMENT OF REINFORCEMENT STEEL Check the steel bars for rust, cracks, surface flaws, laminate etc.	100%	TECPL Specification/ approved drawings	Joint Inspection by TECPL and contractor	Approval by TECPL	C

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	(Visual check)					
viii		100%		Joint Inspection by TECPL and contractor		C
	Check as per the bar bending schedule before		IS:456 and TECPL Specification/ approved drawings			
F.	placement of concrete.				Approval by TECPL	
				Joint Inspection by TECPL and contractor		
i.	Checking cutting tolerance for bars as per check list/ drawings.	100%	IS:456 IS:2502 and TECPL Specification/ approved drawings			C
	Check whether all the bent bars and lap lengths are as per approved bar bending schedule.			Joint Inspection by TECPL and contractor	Approval by TECPL	
ii.		For all locations				C
	Check whether all joints & crossing of bars are tied properly with right guage & annealed wire as per specification		IS:456 , IS:2502 and TECPL Specification/ approved drawings		Approval by TECPL	
	Check for proper cover			Joint Inspection by TECPL and contractor		
iii	distance spacing of bars, spacers & chairs after the reinforcement cage has been put inside the formwork.	For all locations	IS:456 , and TECPL Specification/ approved drawings			B
	Check whether tapping of bars are tied properly with right guage and annealed wire as per			Joint Inspection by TECPL and contractor	Approval by TECPL	
iv	specification.	100%	IS:456 , and TECPL Specification/ approved drawings			C
	Anchor bolts if applicable			Joint Inspection by TECPL and contractor.	Approval by TECPL	
	Level, center-to-center distance of bolts.					
v.		100%	IS:456 , and TECPL Specification/ approved drawings			C
	Visual check for galvanizing.			Joint Inspection by TECPL and contractor.	Approval by TECPL	
vi.		100%				B
	CONCRETING					

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viii	APPROVAL OF MIX DESIGN		TECPL approved pile foundation drawings/ specification.	Joint Inspection by TECPL and contractor.	Checklist to be prepared and signed jointly.	
a)	BATCHING, MIXING & PLACING OF CONCRETE AND COMPACTING.	100% on each location	TECPL approved pile foundation drawings/ specification.	TECPL approved by Lab	Checklist to be prepared and signed jointly.	B
b)	PLACING CONCRETE AND COMPACTING.	100% on each location.	IS:456 & TECPL drawings/ specification.	Joint Inspection by TECPL and contractor.	Approved by TECPL	B
5.			IS:456 & TECPL approved pile foundation drawings/ specification	Joint Inspection by TECPL and contractor.		
a)		Each Mix.			Approved by TECPL	A
B)		100%	IS:456 & TECPL approved pile foundation drawings/ specification		Min gap between boxes and reinforcement bars should be maintained.	B
C)		100%			Approved by TECPL.	B
D)	CONCRETE TESTING					
i.	Slump Test	One sample per casting	IS:456, IS 516, IS: 1199 and TECPL specification.	Contractor	Approved by TECPL	B
ii	Check for quantities for cement, fine aggregate, coarse aggregate and	100% on all locations	IS:456, IS 516, IS: 1199 and TECPL	Contractor	Checklist to be prepared and signed	B

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	water while batching		specification.		jointly.	
E.	CONCRETE CUBE TESTING					
i.	Compressive Strength	One sample for every 20 Cum of concreting or part thereof for each days concreting (one sample consists of min. 3 test cubes for 28 days strength)	IS:456, IS 516, IS: 1199 and TECPL specification.	TECPL approved lab	Approval by TECPL Cubes must be tested within a week after 28 days curing period and test results should be approved.	A
F.	CHECK FINISHING, DIMENSIONAL CONFORMITY AND WORKMANSHIP BEFORE & AFTER BOX REMOVAL.	100%	IS:456, IS 516, IA: 1199 and TECPL specification.	Contractor	Approval by TECPL	B
6.	BACKFILLING					
i.	Check for thickness of layer & watering	100%	TECPL specification and approved drawings.	Contractor	Approved by TECPL	C
ii.	Visual check for correction/ ramming.	100%	TECPL specification and approved drawings.	Contractor	Approved by TECPL	C
iii.	Compaction test (percentage of max. dry density)	Samples for each pit. Equipment & other foundation 20% at random	TECPL Specification	TECPL approved lab	Review of lab test results by TECPL. Elevation for testing to be decided by TECPL.	B

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6.	BRICK-WORK & TILING WORK					
i.	Mortar mix/ proportion	Random	IS:2250, TECPL specification & CPWD specification.	Contractor	Approval by TECPL	B
ii.	Plumb & Alignment	Random	TECPL specification & CPWD Specification	Contractor	Approval by TECPL	B
iii	Joints	Random	TECPL specification & CPWD Specification	Contractor	Approval by TECPL	B
iv	Water absorption Test	Random	TECPL specification & CPWD Specification	Contractor	Approval by TECPL	B
7.	PLASTERING					
i.	Plastering thickness and evenness	Random	TECPL specification & CPWD Specification	Contractor	Approval by TECPL	B
ii.	Mortar mix./ proportion	Random	TECPL specification & CPWD Specification	Contractor	Approval by TECPL	B
8.	SITE SURFACING					
i.	Levelling	100%	TECPL specification & CPWD Specification	Contractor	Checklist to be prepared and signed jointly	B

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Section: GENERAL GUIDELINES FOR IMPLEMENTATION

1. Details of categories of check codes A,B &C including accepting and deviation dispositioning authorities are indicated at Annexure-1.

2. TECPL specification shall mean TECPL technical specification, approved drawings/ data sheets and LOA provisions applicable for the specific contract.

3. Accepting criteria and permissible limits for certain tests are indicated at Annexure -II. For balance tests, site to verify the same with respect to TECPL specification, relevant Indian Standards and/or prevalent code of practice.

4. It is clarified that the tests indicated at column 2 of this F.Q.P. i.e. against column " Component Operation & Description of Test," are only generally required to be conducted. However, TECPL reserves the right to carryout any additional tests at any stage if the situation so warrants.

5. TECPL site representative shall witness all the tests conducted by the contractor as mentioned in this F.Q.P. However, in case of tests conducted in the TECPL approved lab, it is preferred to witness the tests in the lab itself, if possible.

6. TECPL shall approve testing laboratory before accepting the test results from the lab.

7. TECPL shall approve the sources for cement, coarse aggregate, fine aggregate & water before actual utilization.

8. All the testing & measuring equipment used by the contractor for testing are required to be calibrated. A copy of valid calibration report shall be retained by TECPL as records.

9. Classification of foundations shall be approved by TECPL based on the Joint Inspection Report & Soil investigation reports.

10. Curing of concrete work should be continued for a minimum period of 10 days.

11. ZONE-IV FINE AGGREGATE.

a. Zone-IV line aggregate shall be used for nominal mix. Reinforced cement concreting work.

b. Zone-IV line aggregate shall be avoided for design mix. Reinforced cement concreting work unless tests have been done to ascertain the suitability of proposed mix proportion with the prior approval TECPL site.

12. Bricks shall be free from cracks, flaws and modules of free lime. They should have smooth rectangular faces with sharp corners and should be uniform in colour.

13. CEMENT

a. In case supply of cement is in the scope of the contractor, the same shall be procured from sources approved by TECPL site and got tested at site on sample basis for specified acceptance tests as specified in the F.Q.P. at a reputed Third Party Lab approved by TECPL site.

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b. The samples of cement for site testing shall be taken within three weeks of the delivery and all the tests shall be commenced within one week of sampling, if the cement remains in store for a period of more than six month. All the site tests are required to be repeated before usage.

14. REINFORCEMENT STEEL & STRUCTURAL STEEL USED IN CABLE TRENCHES AND FOUNDATIONS.

a. In case supply of steel is in the scope of the contractor, the same shall be procured from the main producers i.e. SAIL, TISCO, IISCO or Rashitriya Ispat Nigam or the rerollers approved by main producers. The steel shall be got tested at site on sample basis of specified acceptance tests as specified in this F.Q.P. at a reputed Third Party Lab approved by TECPL site.

b. The results of the testing of cement and reinforcement steel referred to in 13.a and 14.a above shall be got approved from TECPL site before cement and reinforcement steel are put to use. However, in exceptional cases due to exigencies of work. TECPL site may authorize the contractor to use Cement and Reinforcement Steel even before the test results are received. However, in all such cases, if the test results subsequently received are found to be not complying with the specified acceptance criteria, the contractor shall have to dismantle and recast all such foundations cast with such non-conforming materials at his own cost. Confirmation to this effect shall be obtained from the contractor by the Project authorities beforehand in all such cases.

15. The contractor shall submit welding procedure specification (WPS) including the type of electrode used for approval of TECPL site before starting the welding work.

16. Approval/ acceptance of individual test results by TECPL in the course of execution of contract will not relieve the contractor of his contractual obligations and responsibilities, nor does it limit the Owner's right under the contract.

17. In case, requirement of special items like Super Sulphated Cement, Corrosive Resistant Reinforcement Steel (CRRS) etc arise due to site conditions, the specific approved of TECPL may be obtained before using the same and all the tests as per relevant standards shall be carried out.

18. All the materials shall be stored by the contractor in a manner affording convenient access for identification and inspection at all times. Storage of material shall be in accordance with IS:4032 (Latest Edition).

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ANNEXURE -1

ACCEPTING AND DEVIATION DISPOSITION AUTHORITIES FOR DIFFERENT CATEGORIES OF CHECKS AS ENVISAGED IN FIELD QUALITY PLAN

Category	**Type of Check**	**100% Checking/ Witnessing by**	**Counter Check/ Surveillance check by**	**Accepting Authority, it Test Results are within permissible limits**	**Deviation Dispositoning Authority.**
'A'	Critical	Executing Deptt. Plus F.Q.A. Representative	F.Q.A Representative	TECPL site office Head	TECPL Site Head required.
'B'	Major	Executing Deptt.	F.Q.A. Representative	TECPL site office Head	TECPL Site Head required.
'C'	Minor	Contractors Representative	Executing Deptt.	TECPL site office Head	TECPL Site Head required.

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ANNEXURE-2

ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR FOUNDATION MATERIALS & CONCRETE.

A. CEMENT

Description of the Test	**33 Grade OPC as per IS:269**	**43 Grade cement as per IS:8112**	**PPC as per IS:1489**	**Low Heat Cement**
i) Fineness (min)	225 m^2/Kg	225 m^2/Kg	300 m^2/Kg	225 m^2/Kg
ii) Compressive Strength (min) 72 ± 1 hours 168 ± 2 hours 672 ± 4 hours	 160 kgf/cm^2 220 kgf/cm^2 -	 23 MPa 33 MPa 43 MPa	 16 Mpa 22 Mpa 33 Mpa	 100 kgf/cm^2 160 kgf/cm^2 350 kgf/cm^2
iii) Initial Setting Time (Min)	30 Minutes	30 Minutes	30 Minutes	30 Minutes
iv) Final Setting Time (Max.)	600 Minutes	600 Minutes	600 Minutes	600 Minutes
v) Soundness (Le chatelier Method)	Max 10 mm expansion	Max 10 mm expansion	Max 10 mm expansion	Max 10 mm expansion
vi) Heat of hydration (Max.)	-	-	-	Max. 65 cal/gm for 7 days cal/gm for 28 days
vii) Chemical Composition	As per IS	As per IS	As per IS	As per IS

B. COARSE AGGREGATE

(i) Sieve Analysis

IS SIEVE Designation	Percentage passing for Graded aggregate of nominal size		Percentage passing for single sized aggregate of nominal size	
	40 mm	20 mm	40 mm	20 mm
63 mm	-	-	100	-
40 mm	95 to 100	100	85-100	100
20 mm	30 to 70	95 to 100	0-20	85-100
10 mm	10 to 35	25 to 55	0-5	0-20
4.75 mm	0 to 5	0 to 10	-	0-5

(ii) Flakiness Index — Not to exceed 25%

(iii) Crushing Value — Not exceed 45%

(vi) Soundness of aggregate applicable for concrete — Loss of weight after 5 cycle to exceed 12% when tested with Sodium sulphate and 18% when tested

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works subject to froast action | with magnesium sulphate.

(v) Deleterious material — Not to exceed 5% of the weight of aggregate when tested as per IS:2386 Part-II (1963)

C. FINE AGGREGATE

(i) Sieve Analysis — Shall confirm to Zone II or Zone III.

IS Sieve designation	Percentage Passing for			
	Grading zone-I	Grading zone-II	Grading zone-III	Grading zone-IV
10 mm	100	100	100	100
4.75 mm	90-100	90-100	90-100	95-100
2.35 mm	60-95	75-100	85-100	95-100
1.18 mm	30-70	55 – 90	75 – 100	90- 100
600 Micron	15-34	35-59	60-79	60-100
300 Micron	15-20	8-30	12-40	15-50
150 Micron	0-10	0-10	0-10	0-15

(ii) For guidance of adjusting sound in mix of concrete, the following table may be used.

Moisture Content %	Building % by volume
2	15
3	20
4	25
5	30

(iii) Silt Content Test: Shall not exceed 4% when tested for building work and shall not exceed 10% as per procedure specified CPWD specification when tested.

(iv) Deleterious Materials: Total deleterious material shall not be more than 5% by weight.

(D) REINFORCEMENT STEEL: As per relevant Indian Standards.

(E) CONCRETE CUBE TEST

For nominal (volumetric) concrete mixes, compressive strength for M20 (1:1½:3 (cement: sand:Coarse aggregate) concrete shall be 265 kg/ cm^2 for 28 days.

(F) ACCEPTANCE CRITERIA BASED ON 28 DAYS COMPRESSIVE STRENGTH FOR NOMINAL MIX CONCRETE.

(a) The average of the strength of three specimen be accepted as the compressive strength of the

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concrete, provided the strength of any individual cube shall neither be less than 70%, nor higher than 130% of the specified strength.

(b) If the actual average strength of accepted sample exceeds specified strength by more than 30%, the Engineer-in-Charge, if he so desires, may further investigate the matter. However, if the strength of any individual cube exceeds more than 30% of specified strength, it will be restricted to 30% only for computation of strength.

(c) If the actual average strength of accepted sample is equal to or higher than specified strength upto 30%, than strength of the concrete shall be considered in order and the concrete shall be accepted at full rates.

(d) If the actual average strength of accepted sample is less than specified strength but not less than 70% of the specified strength, the concrete may be accepted at reduced rate at the discretion of Engineer-in Charge.

(e) If the actual average strength of accepted sample is less than 70% of specified strength, the Engineer-in-Charge shall reject the defective portion of work represented by sample and nothing shall be paid for the rejected work. Remedial measures necessary to retain the structure shall be taken at the risk and cost of contractor. If, however, the Engineer-in-Charge so desires, he may order addition to tests to be carried out to ascertain if the structure can be retained. Al the charges in connection with these additional tests shall be borne by the Contractor.

(G) ACCEPTANCE CRITERIA FOR DESIGN MIX CONCRETE SHALL BE AS PER IS:456.

(H) SAMPLING PLAN FOR BRICK- WORK

Scale of sampling and permissible number of defectives for visual and dimensional characteristics.

No of bricks in the lot	For Characteristics specified for individual bricks		For dimensional characteristics for group of 20 bricks. No. of bricks to be selected.
2001-10000	20	1	40
1001-35000	32	2	60
35001-50000	50	3	60

Note : In case the lot contains 2000 or less bricks the sampling shall be as per decision of the Engineer-in-Charge.

ii) Scale of sampling for physical characteristics

Lot size	Sampling size for compressive strength water absorption and efflorescence	Permissible No. of defectives for efflorescence
2001-10000	5	0
10001-35000	10	0
35001-50000	15	1

Note : In case the lot contains 2000 or less bricks, the sampling shall be as per decision of Engineer-in-Charge.

iii) Water absorption Test.

Water absorption after 24 hours immersion shall not exceed more than 22 percent by weight.

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STEEL/ALUMINIUM DOORS, ALUMINIUM DOORS, WINDOWS AND VENTILATORS

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1. GENERAL

Reference shall be made to the following Indian Standards for any further information etc. not covered in the specification. In case of any conflict/contradiction, the provision of this specification shall override.

IS:6248	Specifications for metal rolling shutters and rolling grill.
IS:1081	Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators.
IS:4351	Specifications for steel door frames.
IS:1948	Specifications for Aluminium doors, windows and ventilators.
IS:1361	Specifications for steel windows for industrial buildings.
IS:1038	Specifications for steel doors, windows and ventilators.
IS:1200	Method of measurement of glazing.
IS:3614	Specification for fire check doors.
IS:7452	Specification for hot rolled steel sections for doors, windows and ventilators.
IS:2835	Flat transparent sheet glass.
IS:5437	Wired and Figured glass.
IS:2553	Safety glass.

2. PRESSED STEEL DOOR/WINDOW/VENTILATOR FRAME

Pressed steel door/window/ventilator frame shall conform to IS:4351.

The frames shall be of specified sectional size, dimension and profile. The frames shall be made of 16 gauge pressed steel bent to shape using bending machine, and mitred with square edges. The frames shall be provided with spacers by welding 50 mm x 5 mm flats to the portion of the frame in contact with the wall jambs @ 600 mm vertical spacing.

The frame shall be fixed to the masonry by means of 300 mm x 25 mm x 6 mm hold fast welded to the spacers and grouted with M-15 grade concrete in minimum 350 mm x 100 mm x 100 mm sized hole in the masonry.

In case of concrete, the frames shall be fixed by 96 mm long, 12 mm dia metallic counter sunk type dash fasteners through the frame and spacers.

Provisions of hinges, locking arrangement and other hardwares shall be provided in the frames by machine cutting required size cutout on the frame body and welding/screwing to 3 mm thick MS pad plates already welded over the cut out from behind.

The frame surface shall be thoroughly cleaned of rust, mill scale, dirt, oil etc. and then finished with painting (by priming with red oxide zinc chromate primer conforming to IS:2074 and painting conforming to IS:1477, Part (II) or by approved shade electrostatic powder coating (25 micron).

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3. PRESSED STEEL DOOR SHUTTER

Pressed steel shutters shall be hollow type with 18 gauge pressed steel sheet welded at meeting of the sheets with pad plate of MS flat 3 mm thick all along perimeter. The cavity shall be packed with rigid phenolic foam board adequately cut into shape to fully fit into the box cavity without gaps.

The shutter shall be formed by machine bending of 18 gauge pressed steel sheet in form of hollow box making an overall thickness of 40 mm forming truly square edge in accordance with the shutter profile. It shall further be braced with channel shaped horizontal stiffeners formed by folding 16 gauge MS sheets (35 mm wide) @ 500 mm maximum and fixed by flush riverting. 3 mm thick MS pad plates shall be welded inside at required locations for fixing of hardwares such as tower bolt, aldrop etc.

For double shutter doors, an MS angle 25 mm x 45 mm x 3 mm thick shall be welded to one of the shutters providing a minimum 25 mm wide rebate for the other shutter at the meeting point during closed condition.

The shutter surfaces shall be painted with electrostatically powder coating/two coats of synthetic enamel paint over a priming coat of red oxide zinc chromate conforming to IS:2074/IS:1477 (Part-II) as specified.

The shutters shall be fixed to the door frame by means of heavy duty MS butt hinges of 150 mm size conforming to table 6 of IS:1341 @ 600 mm.

In case of air tight door shutters, approved quality continuous neoprene rubber beading shall be provided continuously along the door frame rebate fixed with neoprene rubber adhesive of approved make.

In case of partly glazed door shutter, Glass as specified shall be fixed with glazing clips and solid drawn 10 mm x 10 mm, MS beading backed with putty and fixed by countersunk screws. Necessary rebate for fixing the glass shall be provided by arranging the shutter bracing accordingly.

The overall shutter shall ensure smooth operation, proper sizing and shaping as per drawings.

The shutters shall be provided with locking device, handle and other hardwares as specified.

4. STEEL WINDOWS AND VENTILATORS

Steel windows, ventilators shall in general conform to IS:1081, IS:1038 and IS:7452.

4.1. Materials

4.1.1. Rolled Steel Section

Rolled steel sections for the fabrication of steel windows, ventilators shall conform to IS:7452.

4.1.2. Glass Panels

Glass panels for glazing purpose shall be as specified. All glass panes shall have properly squared corners and straight edges. Glass panes shall be of following types as specified.

- 4 mm thick transparent sheet glass conforming to IS:5437 (wt. 7.2 kg/Sq.M.)
- 5.5 mm thick wired glass conforming to IS:5437.
- 6.3 mm thick laminated safety glass conforming to IS:2553.

4.2. Workmanship

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The profile and type of windows, ventilators (glazed, partly glazed/louvered, side hung/ top hung/fixed shutter, composite) shall be as per drawings.

The frames shall be constructed of sections cut to size and mitred. Corners shall be welded to form a fused welded joint. Process of welding shall be flush butt welding. The welded joints shall be grinded to square and flat edges.

Where larger units are to be formed by coupling individual units, the mullions, transoms shall be bedded in mastic to ensure weather tightness. Mastic shall be applied liberally to the channels of the outside frame sections before assembly, and the two units being coupled shall be drawn together tight with clamps, the mastic being squeezed out and cut off neatly when the units shall be screwed together tight.

Where fixed glazing units are placed over openable units a push fit weather bar shall be provided.

Before glazing is fixed, all opening parts shall be checked for their operational smoothness. The frame shall be completely cleaned and bedding putty shall be placed in the rebate before glazing. Glass shall be cushioned into the bedding and putty shall be applied in a manner so as to enable the painting to be done upto the site line. The back putty oozing out over the glazing rebate shall be cut off square and smoothed down.

For panels exceeding 600 x300 mm in size, glass shall be secured by special glazing clips inserted in holes already provided in the steel sections, before applying the front putty.

For glazing of very large areas, rust proof steel beading with mitred corners shall be provided with screws @ 10 cm. from each corner and @ 20 cm. apart from each other. Putty shall be provided to the face of the bead in contact with glass, in addition to back putty.

Side hung shutters shall be connected to the frame by means of friction hinges. The handle for side hung shutters shall be of pressed brass mounted on a steel handle plate welded to the opening shutter frame. The handle shall have a two point nose which shall engage with a brass striking plate on the fixed frame in a slightly open as well as in a fixed position.

Top hung shutters shall be provided with steel butt hinges welded to the fixed frame after cutting a slot in it. Top hung casements shall be provided with peg stay of 3 holes of pressed brass, 300 mm long which when closed shall be held tightly by the locking bracket fitted to the fixed frame or to the window.

Before fixing the frames, the size of the opening shall first be checked and cleaned of all obstructions. The positions of the unit in the reveal shall be taken off the drawings and shall be marked on the reveal at the jambs using a plumb line.

In case of fixing with masonry, holes for fixing the lugs/hold fasts shall be cut at required locations.

In case of concrete or stone, the frames shall be fixed by means of dash fasteners.

In case of masonry, the lugs shall be grouted in the holes with cement concrete, M-15 Grade when fixing to steel work, mastic shall be applied to the sill of the opening and the unit shall be placed on it with the jambs and head buttered with mastic and the unit shall be fixed with special fixing dips or with nuts and bolts.

The windows/ventilators shall be checked to ensure smooth operation, perfect level and plumb.

All the steel surfaces shall be thoroughly cleaned free of rust, mill scale, dirt, oil, etc. by sand and shot blasting and then finished with painting by priming with red oxide zinc chromate primer conforming to IS:2074 and painting conforming to IS:1477 (Part II) or by hot dipped galvanizing conforming to IS:1477 (Part I). Putty shall also be provided with painting in a manner so as to seal the putty glass junction. Surfaces not meant for painting shall be cleaned of any strains of paint.

5. ALUMINIUM GLAZED DOORS/WINDOW/VENTILATORS

5.1. General

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Aluminium glazed doors/window/ventilators shall be of specified sectional size, dimension and profile as per drawing.

5.2. Materials

All Aluminium sections shall be extruded sections of "INDAL" aluminium alloy as per IS:733 and IS:1285. Aluminium sections shall be anodised as per IS:7088 or electrostatically powder coated to minimum 25 microns as specified.

Glass used for glazing shall be of following types as specified.

- 4 mm thick transparent sheet glass conforming to IS:5437 / Frosted glass.
- 5.5 mm thickwired glass conforming to IS:5437.
- 6.3 mm thick laminated safety glass conforming to IS:2553.
- 5.5 mm thick transparent sheet glass conforming to IS:2835 (wt. 7.2 kg/Sq.M.).

5.3. Workmanship

Frames shall be square and flat, the corner of the frame being fabricated to true right angles. Details of construction of frames, shutters etc. shall be as per drawings.

Side hung window shutters shall be fixed to the frame with pivots, or aluminium alloy friction hinges. For fixing the hinges, slots shall be cut in the fixed frames and the hinges inserted inside may be riveted to the frame. The handles for side hung shutters shall be of cast aluminium conforming to IS designation A-5-M of IS:617 or chromium/cadmium plated brass/bronze cup pivots riveted to the outer and inner frames to permit to swing through an angle of 85°. Cast aluminium (conforming to IS designation A-5-M of IS:617) or chromium/cadmium plated bronze spring catches shall be fixed in the centre of the top bar of the shutter. The spring catch shall be secured to the frame by screwing/riveting to the frame and shall close into an aluminium catch plate riveted/welded to the outside of the outer shutter frame bar. Aluminium or cadmium plated brass chord pulley wheel in an aluminium bracket shall be fitted at the sill of the shutter with Aluminium or galvanized/cadmium plates steel screws.

The door shutters shall be fitted with pivots as specified.

The handles for doors shall be of Aluminium and as per design. The door shutters shall be provided with locking device, floor spring, door closer and any other hardwares as specified.

In case of composite Door/window/ventilator units, the units shall be coupled as per drawing. Weather bar shall be provided whenever a coupling member is fitted over an external opening shutter.

Glazing shall be fixed to the extruded sections by means of extruded aluminium beading. Glass panes shall be provided with EPDM gasket/rubber lining before fixing.

The aluminium frames shall be fixed to the masonry by means of aluminium lugs fixed to the frame (by counter sunk brass machine screws) and grouted with M-15 grade concrete in the hole in the masonry as per drawing.

In case of concrete wall, the frames shall be fixed by 96 mm long, 12 mm dia metallic dash fasteners. Any steel material coming in contact with aluminium shall be galvanished.

The windows/ventilators/doors shall be checked to ensure smooth operation, perfect level and plumb.

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6. MEASUREMENT AND RATE

Measurement and rates for item rate tender shall be on Sq.M. basis as per item description.

Area shall be measured correct upto two places of decimal. Dimensions shall be measured correct upto 0.5 cm.

A composite unit of various designations shall be first measured over all as a unit of predominant designations and measurement for remaining designations shall be deducted from the overall measurement of the composite unit in order to arrive at the quantities for various designations. Mullions/Transoms/Coupling bars etc. at the meting points of various designations shall be equally distributed to al such designations for measurement and rates.

Rate shall include cost of all materials, specified hardwares, labour, erection, hoisting, scaffolding, removal of scaffolding, protective measures, conveyance, handling, loading/unloading, storing etc. required for proper completion of the item of work in accordance with the specification.

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STRUCTURAL CONCRETE

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1. GENERAL

This general technical SPECIFICATION is based on Indian CODES.

1.1. Definitions

Subject to the requirements of the context, the terms (hereafter listed in alphabetical order) used in this document are given the following meaning :

AGREEMENT	Designates the agreement concluded between the OWNER and the CONTRACTOR, under which the latter undertakes to the former the GOODS and/or SERVICES according to the stipulations which are agreed and specified in the form of an order.
OWNER	Designates the purchaser of the GOODS and/or SERVICES which are the subject of the AGREEMENT.
CODE	Designates a set of systems and rules or international standardization documents for materials, tests, etc.
CONTRACTOR	Designates the individual or legal entity with whom the order has been concluded by the OWNER. The term "CONTRACTOR" may be used indifferently for a supplier, a manufacturer, an erection contractor, etc.
DAYS - WEEKS - MONTHS	Specify the number of calendar days, weeks or months and not of working days, weeks or months.
OWNER'S REPRESENTATIVE	Designates the individual or legal entity to which the OWNER has entrusted various tasks in relation with the carrying out of his PROJECT.
GOODS and/or SERVICES	Designate, depending on the case, all or part of the drawings or documents, substances, materials, equipment, structures, plant, tools, machinery,... to be studied, designed, manufactured, supplied, erected, built, assembled, adapted, arranged, commissioned and put into service by the CONTRACTOR under the AGREEMENT, including all the studies, tasks, works and services specified by the order. The terms GOODS or SERVICES may be indifferently used one for the other as required by the context.
PROJECT	Designates the aggregate of GOODS and/or SERVICES to be provided by one or more CONTRACTORS.
STANDARD	Designates a set of models or references, corresponding to common practice and generally used by the OWNER'S REPRESENTATIVE. This can be : typical standard drawings or documents.
SPECIFICATION	Designates a document describing in some details general or particular requirements for specific type of works.

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1.2. Codes, Standards And Legal Requirements

The design, construction, materials, testing shall be in accordance with the CODES and STANDARDS mentioned in the present SPECIFICATION and with the CODES, STANDARDS and legal requirements listed in the Particular Technical SPECIFICATION (if any) for the PROJECT.

1.3. Scope

This SPECIFICATION covers :

a) materials for, and the batching, mixing, transporting, placing, compacting, curing and protecting of, all concrete for use in the Civil Works;

b) materials for, and the construction of, all formwork for cast in situ concrete:

c) materials for, and the bending and fixing of, steel reinforcement for concrete;

d) the finishing of formed and unformed surfaces of concrete;

e) the casting, handling and placing of precast concrete units;

f) materials for, and the use or application of, mortars, grout and rendering.

1.4. Review And /OR Approval

Whenever a OWNER'S and/or an OWNER'S REPRESENTATIVE'S review and/or approval of a document, to be submitted by the CONTRACTOR, is requested or before an action is implemented by the CONTRACTOR, the review and/or the approval shall always be requested in writing by the CONTRACTOR to the OWNER and/or to the OWNER'S REPRESENTATIVE before any action subject to this review and/or approval has been taken.

A OWNER'S and/or an OWNER'S REPRESENTATIVE'S approval shall always be given in writing.

1.5. References

The CODES referred to in this section are :

Subject	**Indian CODES**
Sand	IS 2116 : 1980
Testing aggregates	[IS 2386 : 1963]
Cement & methods for testing cement	[IS 8112 : 1989] [IS 269 : 1989]
Concrete & methods for testing concrete	[IS 516 : 1959]
Reinforcement	[IS 1786 : 1985 IS 432 : 1982]
Aggregates for concrete - determination chloride content	[IS 383 : 1999 & IS 2386 : 1963]
CODE for Labour Protection	[Indian labour Laws]

and all derived CODES.

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1.6. Submittals

1.6.1. Product Data

1.6.1.1. General

In accordance with the requirements of this SPECIFICATION, the CONTRACTOR shall submit the details specified in the following paragraphs regarding the materials covered by this SPECIFICATION.

1.6.1.2. Cements

Before orders are placed, the CONTRACTOR shall submit details of the proposed cement manufacturers with, at the same time, sufficient information on the proposed methods of transport, storage and certification of the cement to enable the OWNER'S REPRESENTATIVE to convince himself that the required quantity and quality can be supplied and maintained throughout the period of construction.

Having obtained the OWNER'S REPRESENTATIVE'S approval of the source(s) of supply, and the methods of transport, storage and certification of the cement, the CONTRACTOR shall not modify or change the approved arrangements without first having obtained the permission of the OWNER'S REPRESENTATIVE.

1.6.1.3. Aggregates

The CONTRACTOR shall submit the following details regarding the aggregates which are proposed to be used in the concrete :

source(s)

petrological type(s).

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1.6.1.4. Admixtures

The CONTRACTOR shall submit the following details regarding the admixtures which are proposed to be used in the concrete :

source(s)

types(s)

manufacturer's technical details.

1.6.1.5. Water

The CONTRACTOR shall submit the following details regarding the water, proposed to be used, for the mixing and/or curing of concrete, mortar, grout and rendering :

source(s)

chemical analysis

physical analysis.

1.6.1.6. Reinforcement

The CONTRACTOR shall submit the following details regarding the reinforcement which is proposed to be used :

source(s).

1.6.1.7. Curing compounds

The CONTRACTOR shall submit the following details regarding the curing compounds, proposed to be used :

source(s)

types(s)

manufacturer's technical details.

1.6.1.8. Sealing compounds

The CONTRACTOR shall submit the following details regarding the sealing compounds proposed to be used :

source(s)

type(s)

manufacturer's technical details.

1.6.1.9. Reinforcement Couplers

The CONTRACTOR shall submit the following details regarding the reinforcement couplers, for connecting bars in tension and compression, proposed to be used :

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source(s)

type(s)

manufacturer's technical details.

1.6.2. Test reports

In accordance with the requirements of paragraph 1.2. of this SPECIFICATION the CONTRACTOR shall submit, as soon as possible after their completion, reports on the tests specified in paragraphs 1.6 and 3.2 of this SPECIFICATION.

1.6.3. Certificates

The following requirements shall be applicable only if specifically requested by the AGREEMENT constituent documents.

1.6.3.1. General

In accordance with the requirements of this SPECIFICATION the CONTRACTOR shall submit certificates of compliance with the specified CODES regarding the materials mentioned in the following paragraphs.

1.6.3.2. Cement

All cement shall be certified by the manufacturer as complying with the requirements of the appropriate CODES.

1.6.3.3. Reinforcement

The CONTRACTOR shall submit to the OWNER'S REPRESENTATIVE copies of the manufacturer's certificates of tests for all supplied reinforcement.

1.6.4. Samples

The following requirements shall be applicable only if specifically requested by the AGREEMENT constituent documents.

1.6.4.1. General

In accordance with the requirements of this SPECIFICATION, the CONTRACTOR shall supply the samples specified in the following paragraphs.

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1.6.4.2. Cements

If requested by the OWNER'S REPRESENTATIVE, the CONTRACTOR shall deliver samples of cement(s) to an approved laboratory for the further analysis and testing envisaged in paragraphs 1.6 and 3.2 of this SPECIFICATION.

1.6.4.3. Reinforcement

If requested by the OWNER'S REPRESENTATIVE, the CONTRACTOR shall deliver samples of steel reinforcement to an approved testing agency for the independent tests envisaged in paragraphs 1.6 and 3.2 of this SPECIFICATION.

1.6.4.4. Aggregates

The CONTRACTOR shall deliver, to the OWNER'S REPRESENTATIVE'S site laboratory or to an approved testing agency, as directed by the OWNER'S REPRESENTATIVE, samples of all aggregates in such quantities sufficient for carrying out the tests as described in paragraphs 1.6 and 3.2 of this SPECIFICATION.

1.6.5. Drawings and other details

1.6.5.1. General

In accordance with the requirements of this SPECIFICATION, the CONTRACTOR shall submit the drawings and other details specified in the following paragraphs.

For the paragraphs, marked with (*), the requirements shall be applicable only if specifically requested by the AGREEMENT constituent documents.

1.6.5.2. Formwork (*)

The CONTRACTOR shall submit details of the methods and materials proposed for the formwork for each element of the works.
Details of formwork for producing special finishes shall be submitted for approval to the OWNER'S REPRESENTATIVE before any materials are brought on site.

The CONTRACTOR shall submit for approval complete construction drawings, including method diagrams and full supporting calculations (when required by the OWNER'S REPRESENTATIVE) of the formwork for each major structural element of the works.

1.6.5.3. Concrete placing and curing

The CONTRACTOR shall submit details of his proposed construction sequence and method including :

a) Positions of construction joints additional to those shown on the drawings

b) Pour size and sequences

c) Methods for controlling concrete temperature

d) Methods for concrete compaction

e) Curing procedures.

1.6.5.4. Bar schedules (*)

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Bar schedules shall be submitted to the OWNER'S REPRESENTATIVE. The layout and typical content of bar bending schedules shall be submitted to the OWNER'S REPRESENTATIVE prior to issue them with the drawings.

1.6.5.5. Plant details

The CONTRACTOR shall submit details of the types and sizes of items of equipment proposed to be used for the transport, placing and compacting of concrete and of the proposed manner of their use. For concrete mixes to be used in the works which may have a relatively low workability and a large maximum size of aggregate, all plant and operating procedures shall be adapted to be made suitable.

1.6.5.6. Mix proposals

Before any concrete is poured, the CONTRACTOR shall submit to the OWNER'S REPRESENTATIVE for approval full details of the mixes he proposes to be used for each grade of concrete together with their anticipated average target strengths.

1.6.5.7. Precast concrete

The CONTRACTOR shall submit to the OWNER'S REPRESENTATIVE for approval full details of all his proposed arrangements for casting, handling and placing precast concrete units.

1.6.5.8. Concrete documentation

The CONTRACTOR shall send daily to the OWNER'S REPRESENTATIVE a return showing the quantities of cement, per grade of concrete, used in the permanent works and in temporary works, of the previous day.

1.6.5.9. Temperature records

The CONTRACTOR shall record the daily maximum and minimum ambient shade and unshaded air temperatures adjacent to those parts of the works where concrete is being placed or cured. The CONTRACTOR shall send a copy of these records to the OWNER'S REPRESENTATIVE every week.

1.6.5.10. Calibration of weighing equipment

The CONTRACTOR shall submit to the OWNER'S REPRESENTATIVE, as soon as possible after their completion, the results of the calibration checks specified in paragraph 2.2.6 of this SPECIFICATION.

1.7. Delivery, Storage and Handling

1.7.1. Cement

See also :

[IS 8112 : 1989]

The cement shall be delivered to the site in bulk or in sound, properly-sealed and marked bags. While being loaded or unloaded and during transit to the concrete mixers, whether conveyed in vehicles or by mechanical means, cement shall be protected effectively from the weather. Mechanical transfer systems shall be fully enclosed and bagged cement shall be protected by tarpaulins or other effective coverings.

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If the cement is delivered in bulk, the CONTRACTOR shall provide approved silos of adequate sizes to store a sufficient amount of cement to ensure the continuity of the works and the cement shall be placed in those silos immediately after it has been delivered to the site. Approved precautions shall be taken during unloading to ensure that the resulting dust does not constitute a nuisance or health hazard.

If the cement is delivered in bags, the CONTRACTOR shall provide perfectly waterproof and well ventilated sheds having a floor of wood or concrete raised clear of the ground.

The sheds shall be large enough to store a sufficient amount of cement to ensure the continuity of the work and to enable the OWNER'S REPRESENTATIVE to determine the suitability of the cement before being used.

Each consignment shall be stacked separately therein to permit easy access for inspection, testing and approval. When delivered at the site the cement shall immediately being placed in the above mentioned sheds and it shall be used in the order in which it has been delivered.

The CONTRACTOR shall ensure that the arrangements for the storage of the cement at the site are sufficient for the separation and identification of each consignment until the results of the sampling and testing referred to in paragraph 1.6.4 and 2.2.1 of this SPECIFICATION are available.

1.7.2. Aggregates

See also :

[IS 383 : 1999]

All aggregates for concrete shall be stored in concrete-based bins or on stages designed to prevent intermixing of different aggregates and to avoid the inclusion of dirt and other foreign materials in the concrete. Each size of aggregate shall be stored separately.

The storage bins shall be emptied and cleaned and the grading of the aggregates checked at intervals, subject to the approval of the OWNER'S REPRESENTATIVE.

1.7.3. Reinforcement

All reinforcement shall be stored above ground, racked systematically as necessary and protected from all aggressive elements to the approval of the OWNER'S REPRESENTATIVE.

1.8. Quality Assurance

1.8.1. General

The materials mentioned below shall be tested at the place of manufacturing (or elsewhere if convenient and appropriate) by an approved testing agency to ensure that they comply with the requirements of this SPECIFICATION.

The OWNER'S REPRESENTATIVE may agree on the fact that the routine tests, carried out by the manufacturers, fulfil all or part of the requirements of this paragraph, provided that he is satisfied with the manufacturer's testing procedures.

1.8.2. Cements

Cements from all proposed sources shall be tested for compliance with all the requirements and by the

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methods, set out in paragraph 2.1.1 of this SPECIFICATION.

Where necessary the OWNER'S REPRESENTATIVE may require further representative samples of the proposed cement(s) to be taken and forwarded to an approved laboratory for analysis and testing before the source(s) is/are approved.

All cement(s) delivered to the site shall be tested on a routine basis to enable the CONTRACTOR to submit the certificates required by paragraph 1.6.3 of this SPECIFICATION. The CONTRACTOR'S testing program shall ensure that any cement delivered on site from bulk storage elsewhere, satisfies the requirements of paragraph 2.1.1 of this SPECIFICATION.

1.8.3. Reinforcement

All reinforcement delivered to the site shall be tested on a routine basis to enable the CONTRACTOR to submit the certificates required by paragraph 1.6.3 of this SPECIFICATION.

The OWNER'S REPRESENTATIVE may, however, order independent tests to be performed and any steel which does not comply in all respects with the appropriate CODES will be rejected.

1.8.4. Reinforcement couplers

The CONTRACTOR shall prepare and test three connections for each diameter and type of the reinforcement bar to be coupled in such a way as to demonstrate compliance with paragraph 2.1.13 of this SPECIFICATION.

Test specimens shall be prepared using the materials, equipment and personnel to be applied during the works, and they shall be prepared, as far as possible, under the conditions similar to the ones likely to be encountered during the works.

1.8.5. Aggregates

Tests to assess the suitability of the aggregates proposed to be used in concrete for the permanent works shall be carried out as follows :

a) Grading

b) Magnesium Sulphate Soundness

c) Specify Gravity and Water Absorption

d) Clay, Silt and Dust Content

e) Organic Impurities

f) Sulphate and Chloride Content

g) Aggregate Crushing Value

h) Elongation and Flakiness Determination

i) Potential Alkali Reactivity, chemical and petrographic examination

These tests shall be carried out in accordance with the appropriate Belgian CODES or foreign CODES and the results shall comply with the limits given therein or as otherwise stated in this SPECIFICATION.

1.8.6. Water

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Water proposed to be used for the production and/or curing of concrete, mortar, grout and rendering, shall be in accordance with :

[IS 456 : 2000 / IS : 3025]

1.9. Site Conditions

The attention of the CONTRACTOR is drawn to the paragraphs 3.1.4, 3.1.5 and 3.1.6 of this SPECIFICATION regarding the requirements for concreting in specific environmental conditions.

2. PRODUCTS

2.1. Materials

2.1.1. Cement

In principle, the cement to be used throughout the works shall be (Ordinary) Portland cement and it shall comply with the requirements of :

[IS 8112 : 1989 IS 269 : 1989]

For applying special types of cements, refer to relevant Indian Codes i.e. :

[IS 12330 : 1988]

for Sulphate-resisting Portland cement

The particular technical SPECIFICATIONS might refer to other specific types of cement.

In order to ensure that all visible exposed faces of concrete have a uniform colour, the CONTRACTOR shall take all necessary steps to ensure the supply of cement of uniform colour.

2.1.2. Aggregate sources

Aggregates for concrete shall be obtained from sources to be approved for this purpose by the OWNER'S REPRESENTATIVE. The CONTRACTOR shall be responsible for selecting suitable aggregates and samples of sand and stone for the specified tests to be carried out, before any arrangements of obtaining aggregates from new or alternative sources are approved by the OWNER'S REPRESENTATIVE. Laboratory check tests of the aggregates will be performed at regular intervals to confirm their suitability for concrete and the consistency of the grading.

Aggregates shall be produced to the sizes and grading specified for the various concrete mixes. If instructed by the OWNER'S REPRESENTATIVE the CONTRACTOR shall carry out investigations to convince the OWNER'S REPRESENTATIVE that there are sufficient quantities of suitable aggregates available to complete the works.

The CONTRACTOR shall be responsible for all arrangements and costs involved in the exploitation of quarries and borrow pits and he shall carry out any boring and investigations he deems necessary to determine the precise location of the working and the manner in which the quarries and borrow pits may be exploited efficiently and economically.

Quarries shall be run in a safe manner and on completion of the works they shall be left in a tidy state. No rocks shall be left overhanging except with the approval of the OWNER'S REPRESENTATIVE. The

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aggregate winning and processing operations shall be such that they do not constitute a danger to health either during their operation or after completion of the works.

The CONTRACTOR shall ensure that his activities in no way interfere with existing operations being carried out by others, and he shall be responsible for providing his own local accesses and all plant's facilities.

2.1.3. Aggregates - General

Aggregates for concrete, mortar or for any other purposes shall always be free from earth, clay, loam, soft, clayey, shaley or decomposed stone, organic matter and other impurities and shall be hard and dense. The percentage of hollow shells shall be limited to an approved level compatible with the production of dense concrete to the satisfaction of the OWNER'S REPRESENTATIVE.

Aggregates for use in concrete shall be, in all respects, in accordance with :

[IS 2386 : 1963, IS 383 : 1999]

except where specifically indicated otherwise (below).

Sand for use in mortar shall be, in all respects, in accordance with :

[IS 2116 : 1980]

Aggregates shall not contain any materials that are deleteriously reactive with the alkalis in the cement, or any alkalis which may be additionally present in the aggregates or in the mixing water, or in water in contact with the concrete or mortar, in amounts sufficiently to cause an excessive local or general expansion of the concrete or mortar.

In order to ensure that all visible exposed faces of concrete have a uniform colour, the CONTRACTOR shall take all necessary steps to ensure a supply of aggregates of uniform colour.

Aggregates for concrete in the permanent works shall, wherever practical, have characteristics best suited to the minimisation of drying shrinkage and thermal shrinkage of the concrete. Such aggregates would have :

a) Low drying shrinkage

b) Low modules of elasticity

c) High tensile strength

d) Low thermal expansion.

2.1.4. Fine Aggregate

The fine aggregate for concrete shall be conform to :

[IS 383 : 1999]

The appropriate grading zone shall be selected by the CONTRACTOR and approved by the OWNER'S REPRESENTATIVE after carrying out tests of trial concrete mixes, to determine workability and density. The grading of fine aggregate shall be such as to produce the maximum concrete density compatible with the desired workability.

Crushed sand may be added to natural sand in proportions approved by the OWNER'S REPRESENTATIVE in order to achieve the required grading. Crushed sand alone may only be used with the approval of the OWNER'S REPRESENTATIVE.

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The amount of material passing a 75 micron fine test sieve, when tested in accordance with :

[IS 2386 : 1963]

shall not exceed 2 % by weight for river sand and 3% for quarry sand.

Fine aggregate shall not contain appreciable amounts of flaky and/or elongated particles.

2.1.5. Coarse Aggregate

The term "coarse aggregate" means an aggregate retained on a 5,00 mm test sieve. The grading of the coarse aggregate shall be within the limits prescribed in :

[IS 383 : 1999]

and shall be such that when the coarse aggregate is combined with the approved fine aggregate and cement it shall produce a concrete of maximum density consistent with the required workability. Minimum values of densities of the various grades of concrete will be fixed by the OWNER'S REPRESENTATIVE after tests have been carried out on the site.

The amount of material passing a 75 micron fine test sieve, when tested in accordance with :

[IS 2386 : 1963]

shall not exceed 1 % by weight for coarse aggregate for all concrete (including granolithic concrete).

The flakiness index and elongation index of the predominant-size fractions in each single-sized coarse aggregate, determined in accordance with :

[IS 2386 : 1963]

shall not exceed 35 % by weight.

Aggregate for use in concrete which is subject to abrasion and impact shall be tested in accordance with :

[IS 2386 : 1963]

2.1.6. Grading of Combined Aggregate

The CONTRACTOR shall be responsible for ensuring that the combined grading of the aggregates is constant.

The required percentage to pass any sieve size as determined by approved trial mixes shall be the target grading for all concrete of that type. The combined grading of the used concrete shall not vary by more than $\pm$ 4 % from the one from the trial mixes. If the estimated or measured combined grading of the permanent concrete does not meet this requirement then a new trial mix shall be prepared for the approval of the OWNER'S REPRESENTATIVE.

If at any time samples are proven to be unsatisfactory, the CONTRACTOR shall be required, at his own expenses, either to change to a new supply or to make arrangements acceptable to the OWNER'S REPRESENTATIVE to cure the situation.

2.1.7. Admixtures

Admixtures shall only be used in the concrete or mortar with the explicit permission of the OWNER'S REPRESENTATIVE or when specified and in no circumstances will the admixtures, containing chlorides or other corrosive agents, be allowed.

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Air-entraining agents shall consist of neutralised vinsol resin or other approved products.

2.1.8. Water

The CONTRACTOR shall make his own arrangements for providing fresh water for the mixing and curing of concrete and mortar and it shall be subject to the OWNER'S REPRESENTATIVE for approval.

In general, water to be used for the mixing and/or curing of the concrete, mortar and grout shall be fresh and free from all sediment and dissolved or suspended matter which may be harmful to the manufacturi ng of concrete, mortar and grout.

The OWNER'S REPRESENTATIVE may request analysis of water samples to be taken from the intended source of supply before any concrete work is started and he may request this at intervals throughout the duration of the AGREEMENT. If, at any time, the samples are proved to be unsatisfactory, the CONTRACTOR will be requested, at his own expenses, either to change to a new supply or to make arrangements, acceptable to the OWNER'S REPRESENTATIVE, to remove the offending matter.

2.1.9. Steel Reinforcement

Steel reinforcement, other than steel for pre-stressing, used in reinforced concrete shall comply with :

[IS 1786 : 1985]

and with the following CODES as appropriate :

a) Hot rolled steel bars for the reinforcement of concrete shall comply with the requirements of :

[IS 1139 : 1966]

b) Cold worked steel bars for the reinforcement of concrete shall comply with the requirements of :

[IS 1786 : 1985]

2.1.10. Control of Chlorides in Hardened Concrete and its Constituents

Ordinary Portland cement concrete:For concrete manufactured with ordinary Portland cement the levels of equivalent acid-soluble chlorides as NaCl shall generally not exceed the values specified below. The levels are indicative for the indivi dual constituents of the mix and are subject to the overriding maxima specified for the total mix, which shall not be exceeded.

i. Coarse aggregate

   a. reinforced concrete 0,03 % by weight

   b. mass concrete 0,10 % by weight

ii. Fine aggregate

   a. all concrete 0,10 % by weight

Testing of chlorides content of aggregates shall comply with :

[IS 2386 : 1963]

The total estimated chloride content of any mix, including the one, present in the cement, shall not exceed

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the following : (expressed as a percent by weight of cement).

1) Prestressed concrete 0.4 %

2) Conventionally reinforced concrete 0.6 %

in a moist environment and exposed to chloride.

Acceptable levels of chlorides in concrete and its constituent materials shall be reduced to two-thirds of the values specified in paragraphs 1 and 2 above, where sulphates are present in concentrations greater than 50 % of those allowable.

Sulphate-resisting Portland cement concrete

For concrete manufactured with sulphate-resisting Portland cement the NaCl max. content by weight of cement in the hardened concrete shall not exceed 0,10 %.

Testing by the OWNER'S REPRESENTATIVE

Independently from the CONTRACTOR'S QC (Quality Control) testing the OWNER'S REPRESENTATIVE will carry out selective tests at intervals during the production of concrete to check that these criteria are being achieved consistently.

2.1.11. Control of sulphates in hardened concrete and its constituents

The levels of acid-soluble sulphates (as SO_3) shall generally not exceed the values specified below. The levels are indicative for the individual constituents of the mix and are subject to the overriding maxima specified for the total mix, which shall not be exceeded :

a) Coarse aggregate 0,4 % by weight

b) Fine aggregate 0,4 % by weight

The total estimated sulphate content (as SO_3) of any mix, including the one, present in the cement, shall not exceed 4 % by weight of cement in the mix.

Independently from the CONTRACTOR'S QC (Quality Control) testing (the) OWNER'S REPRESENTATIVE will carry out selective tests at intervals during the production of concrete to check that these criteria are being achieved consistently.

2.1.12. Acceptable level of chlorides and sulphates in any concrete

The acceptable level of chlorides and sulphates quoted in the above paragraphs shall not be considered as mean values for the whole of the Works, but shall be deemed to apply to any concrete.

2.1.13. Mechanical coupling of reinforcement

Where specified, directed, or approved by the OWNER'S REPRESENTATIVE, mechanical coupling of reinforcement may be used. Proprietary mechanical coupling systems shall meet the requirements of this paragraph and shall be subject to the approval of the OWNER'S REPRESENTATIVE.

The couplers for tension connections shall have a yield strength and ultimate tensile strength at least 1.2 times the characteristics strength yield strength and ultimate tensile strength respectively of the bars being coupled.

In case the loadings are not predominantly static, the CONTRACTOR shall demonstrate that the coupling s can resist loading of a cyclic and dynamic nature.

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Couplers designed for use with bars in compression only, may be used at locations where the OWNER'S REPRESENTATIVE agrees that in no case, the bar will be required to resist a tensile load.

All fixing of mechanical couplers shall be carried out either by the manufacturer's personnel or by CONTRACTOR'S staff trained by the manufacturer. Fixing of couplers shall be carried out in accordance with the manufacturers instructions and recommendations.

2.2. Mixes and Mixing

2.2.1. Concrete Mixes

Concrete for construction shall be as detailed in the Table of Concrete Mixes and as shown by test cube results as specified. This list may be extended by the addition of other mixes as required and to the approval of the OWNER'S REPRESENTATIVE.

The criteria stated in the Table of Concrete Mixes are designed to produce concrete of the required strength and durability.

The specified characteristic strength is for concrete which has been cured at a temperature of 20° C $\pm$ 1° C. The term "characteristic strength" represents the value of the strength of concrete corresponding to the probability that, for a normal statistic distribution of the test results for determining the strengths by compression tests, only 5 % of the test results have a value lower than the one determined in this way.

The mixes shall be designed to have mean strengths that are greater than the specified characteristic cube strengths by a margin of 1.64 times the standard deviation expected from the concrete batching plant, except that no standard deviation of less than 3.5 N/mm^2 shall be used as a basis for designing a mix.

Mixes shall be designed with due regard for minimum workability necessary to allow the CONTRACTOR to place and compact the concrete as specified with the equipment he proposes to use in any particular situation.

TABLE OF CONCRETE MIXES

Concrete grade	Minimum quantity of cement kg/m³	Maximum free water-cement ratio	Character. strength (cube) 150 mm Cube
			28 days N/mm²
M20	300	0.55	20
M25	300	0.50	25
M30	320	0.45	30
M35	340	0.45	35
M40	360	0.40	40

Where air-entrainment is specified the average air content as measured in accordance with relevant Indian

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Codes:

shall be as follows :

a) Concrete containing

40 mm max. size aggregate 4.0 % ± 1.0 %

Concrete containing

20 mm max. size aggregate 5.0 % ± 1.0 %

These air contents are applicable at the time of concrete placing.

Concrete for paving or non structural precast units shall have a minimum flexural beam strength of 3.5 N/mm^2 at 28 days.

2.2.2. Water-cement ratio

The water-cement ratio for the various mixes of concrete shall be determined by the preliminary trial mixes and shall not exceed the values given in the Table of Concrete Mixes.

Effective means shall be provided for determining the moisture content and water absorption value of the fine and coarse aggregates at all times. The CONTRACTOR will be required to have an accurate knowledge of the moisture content and water absorption values of all fine and coarse aggregates as they reach the mixer and if necessary, he shall make adjustments to the mix by changing the moisture content and water absorption values of all aggregates.

2.2.3. Use of admixtures

In the event of the OWNER'S REPRESENTATIVE'S permission being obtained for the use of a proposed admixture, the concrete tests described in this section shall be carried out with the correct proportion of admixture incorporated in the concrete to ensure that the specified strengths are achieved. Comparison shall be made with concrete manufactured without the admixture to prove that the densit y has not been reduced. If air-entraining agents are used the density shall not be reduced by more than 5 %.

When admixtures are used in the concrete very strict control shall be maintained to ensure that the correct quantity of admixture is used at all times. The equipment to be used for dispensing and the method of incorporating the admixture in the concrete shall be submitted to the OWNER'S REPRESENTATIVE for approval. The dispensing unit shall be translucent such that the operator can see the discharge of the admixture.

2.2.4. Laboratory concrete trial mixes

The below described procedure is not applicable when the concrete is supplied by a ready mix plant which has been approved by the OWNER'S REPRESENTATIVE or when evidence exists about a previous testing campaign of the same nature.

Preliminary laboratory tests shall be carried out by the CONTRACTOR in the presence of the OWNER'S REPRESENTATIVE to determine the mixes which will satisfy the SPECIFICATION, with the available materials.

Laboratory trial mixes of concretes for use in the permanent works shall, wherever practical, be designed in such a manner as to minimise drying shrinkage and thermal shrinkage of the concrete. Such mixes would have :

a) the largest practical maximum size of aggregate,

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b) the lowest practical sand content,

c) the lowest practical slump,

d) the lowest practical temperature,

e) the lowest practical cement content,

f) the lowest practical water content.

To facilitate the above and to minimise the temperature rise within large concrete pours, water reducing and/or air entraining admixtures may be included in the mix design subject to the approval of the OWNER'S REPRESENTATIVE.

2.2.5. Initial concrete field tests

Following the results of laboratory trial mixes, trial mixes shall be prepared under full scale site conditions and tested in accordance with relevant Indian Codes :

During the course of these tests, panels of concrete containing representative samples of reinforcing details shall be cast and investigated, before hardening by the use of hand tools and after hardening by means of coring, as outlined in paragraph 3.2.5 of this SPECIFICATION, to assess the suitability of the mixes.

Representative samples of the materials to be used shall be taken and three trial mixes using the proposed proportions shall be made on different days. The workability of each of these three trial mixes shall be the designed target value and a batch of six cubes from each mix shall be made, three for test at 28 days and three for test at 7 days. The OWNER'S REPRESENTATIVE will normally approve the proposed mix proportions provided the average 28-day strength of the three trials mixes is not less than the designed mean strength and subject to the conditions noted below.

Further trial mixes shall be made if the range, that is the maximum minus the minimum of the three cube results in any batch, exceeds 15 % of the average of that batch, or if the range of the three batch averages exceeds 20 % of the overall average of the batches.

In addition to tests for properties specified in this SPECIFICATION, tests shall be carried out jointly by the CONTRACTOR and the OWNER'S REPRESENTATIVE on field trial mixes to determine the following properties :

a) Air content (where air entrained concrete is specified) ;

b) Free water-cement ratio ;

c) Workability ;

d) Wet and dry densities.

Should any of the values obtained in the above tests be unacceptable, according to the OWNER'S REPRESENTATIVE, the mixes shall be re-designed.

2.2.6. Batching and mixing

Batching

The aggregates and cement shall be batched by means of efficient weigh-batching machines except as otherwise approved by the OWNER'S REPRESENTATIVE. The machines shall be carefully maintained

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and cleaned. They shall be provided with simple and convenient means of checking the accuracy of weighing mechanism, and they shall be checked and adjusted when required by the OWNER'S REPRESENTATIVE.

When volumetric batching is permitted, the constituents shall be measured by volume in a suitable gauge box and the volumes used shall be based on a whole bag mix.

The temperature of the cement shall be kept as low as possible by adequate shading, good air circulation and reflective protection to the storage silos, but all never exceed 40°C at the time of incorporation into the mix.

A simple and convenient system of accurately varying the water supply to the concrete mixers shall be installed, with a suitable metering system to ensure that the amount fed into the machine can be easily controlled, ascertained and recorded.

Accuracy of scales

The divisions on direct reading scales for cement, aggregate and water (if the latter is measured by weight) shall be readily discernible and not less than 2.5 mm in width. They shall represent a weight not greater than 0.5 per cent of the nominal capacity of the appropriate weighing hopper or compartment. Digital readouts should display to 0.1 per cent of the nominal capacity of the appropriate weighing hopper or compartment.

At the time of installation or reconditioning, the indicated weight, shall not vary from the correct weight by more than 0.5 per cent of the actual scale reading in the range quarter-scale to full scale capacity. For indicated weights of less than quarter-scale capacity, the variation shall be not greater than 0.5 per cent of quarter-scale reading. At any time of operation, the indicated weight at any point of the scale shall not vary from the correct weight by more than 1.0 per cent of the actual scale reading in the range quarter -scale to full scale capacity. For indicated weights of less than quarter-scale capacity, the variation shall be not greater than 1.0 per cent of the quarter-scale reading.

Accuracy of batching

See also :

[IS 4925 : 1968, IS 456 : 2000]

Batched materials shall be measured out within the following tolerances and shall be discharged into the mixer without loss :

Cement ± 2 % of the weight of the cement in the batch;

Aggregate ± 2 % of the weight of each aggregate in the batch;

Water ± 2 % of the weight of water added to the batch;

Calibration of weighing equipment

Sufficient test weights shall be kept available at the site for checking the accuracy of all scales. The scales shall be checked at the commencement of preliminary concrete tests and checks shall be carried out at intervals as directed by the OWNER'S REPRESENTATIVE but in any case not greater than 2 weeks.

The results of these checks shall be recorded and submitted to the OWNER'S REPRESENTATIVE.

All scales shall be inspected and checked over their complete range by a specialist at least every three months, the results being recorded and submitted to the OWNER'S REPRESENTATIVE.

With admixture dispensers, the accuracy of measurement shall be checked at least once each month with a calibrated container, the results being recorded and submitted to the OWNER'S REPRESENTATIVE.

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Mixing concrete by machine

Concrete shall be mixed in batches in machines of approved type. All the concreting materials including the water shall be mixed together thoroughly between the time of their deposition in the mixer and before any portion of the mixture is discharged.

The machines shall be capable of discharging their contents while running.

Transfer of concrete

The concrete shall be discharged from the mixers and transported to the Works by means which shall be approved by the OWNER'S REPRESENTATIVE and which shall prevent contamination (by dust, rain or other causes), segregation or loss of ingredients. The means of transport shall ensure that the concrete is of the required workability at the point and time of placing and is transported and placed with the minimum of delay.

2.2.7. Ready-mixed concrete

Ready-mixed concrete shall not be used unless previously approved by the OWNER'S REPRESENTATIVE and, where used, shall comply with all the requirements specified herein and any additional requirements of :

[IS 4926 : 1976]

Ready-mixed concrete plants and mixer trucks shall be subject to the approval of the OWNER'S REPRESENTATIVE which approval may be withdrawn in the event of non-compliance with the requirements of this SPECIFICATION.

3. EXECUTION

3.1. Execution of Concrete Works

3.1.1. General

Except where otherwise specified herein, or directed by the OWNER'S REPRESENTATIVE, concrete workmanship shall conform to the recommendations of :

[IS 2386 : 1963]
current at the time of execution of the work.

3.1.2. Placing of concrete

The concrete shall be placed in the positions and, where shown, in sequences as indicated on the drawings, in the SPECIFICATION or as directed by the OWNER'S REPRESENTATIVE. Except where otherwise directed, the pouring shall not start until the OWNER'S REPRESENTATIVE has examined and approved the positioning, fixing and condition of reinforcement and any other items to be embedded, and the cleanliness, alignment and suitability of the containing surfaces or formwork. A period of not less than 24 hours notice shall be given to the OWNER'S REPRESENTATIVE to allow for his examination and, if satisfactory, approval of the reinforcement and formwork prior to the placing of the concrete.

The CONTRACTOR shall make due allowance in his concreting program for the period of the OWNER'S REPRESENTATIVE'S examination.

The limit of individual pours and the height of lifts shall be subject to the approval of the OWNER'S

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REPRESENTATIVE.

The length of element that may be poured in one operation and the elapsed time between adjacent pours in the horizontal direction shall be subject to the prior approval of the OWNER'S REPRESENTATIVE. The sequence of pours shall be arranged to minimise thermal and shrinkage strains.

Slabs and roof pours shall be made in an approved sequential fashion. Concrete shall not be placed in adjacent bays until 7 days, or another period of time to be approved by the OWNER'S REPRESENTATIVE, has elapsed.The CONTRACTOR shall take all necessary measures to ensure that newly placed concrete, and particularly the one in large pours, is protected against the effects of thermal shrinkage. The aim shall be to achieve a maximum temperature differential of 20°C within the concrete and between the concrete and the surrounding air. The CONTRACTOR shall propose suitable insulation for the formwork and exposed surfaces of the pour.

The concrete shall be deposited as nearly as possible in its final position without rehandling or segregation and in such a manner as to avoid displacement of the reinforcement, or other embedded items or the formwork.

Wherever possible concrete shall be placed by pumping or bottom-opening skips. Where chutes are used to convey the concrete, their slopes shall not be such as to cause segregation, and suitable spouts or baffles shall be provided where necessary. Concrete shall not be dropped through a free height greater than 2.0 m except with the approval of the OWNER'S REPRESENTATIVE. Where the work requires the concrete to be deposited from a height exceeding 2.0 m, chutes to the OWNER'S REPRESENTATIVE'S approval shall be used to prevent segregation of materials. Concrete shall not be placed in standing water or running water unless specified or approved by the OWNER'S REPRESENTATIVE. If this is the case, the concrete shall be placed in accordance with the requirements of paragraph 3.1.7 below.

All concrete and mortar shall be placed and compacted within 30 minutes of water being added to the mix or otherwise included through damps aggregates, unless admixtures are in use. If an admixture is used, tests shall be carried out jointly by the CONTRACTOR and the OWNER'S REPRESENTATIVE to determine the initial set time. No partially set material shall be used in the works.

Placing of concrete in each section of the work shall be carried out as a continuous operation between construction joints. The CONTRACTOR shall make adequate arrangements for standby equipment. If the placing of concrete is unavoidably delayed due to mechanical or other breakdown then the CONTRACTOR shall as directed by the OWNER'S REPRESENTATIVE either :

a) erect stop ends and form a construction joint,

b) or

c) remove the concrete already placed and restart the operation after the breakdown has been rectified.

3.1.3. Compacting of concrete

Except where otherwise permitted by the OWNER'S REPRESENTATIVE, concrete shall be compacted during placing by approved pattern internal vibrators. The vibrators shall operate at a frequency of not less than 100 Hz and shall be designed for continuous operation. The performance of vibrators shall be such as to suit the working conditions and they shall be selected accordingly. For normal use, they shall be not less than 75 mm diameter and shall be subject to the OWNER'S REPRESENTATIVE for approval. The radius of influence shall be at least 300 mm.

The vibrators shall be disposed in such a manner that the whole of the mass of concrete under treatment shall be compacted adequately at a speed commensurate with the supply of concrete from the mixers and to the satisfaction of the OWNER'S REPRESENTATIVE.

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Internal vibrators shall penetrate the full depth of the layer of concrete placed and just into the layer below and shall be withdrawn slowly so as to avoid the formation of voids.

Vibration shall not be applied directly or indirectly to masses of concrete after the initial set has taken place but, subject to the approval of the OWNER'S REPRESENTATIVE, revibration of the upper lift of a concrete pour may be employed as late as the concrete will respond to the vibration in order to close settlement cracks.

Vibration shall not be used to make the concrete flow in the formwork.

3.1.4. Concreting in adverse weather

No concreting will be allowed to take place in the open during storms or heavy rains. In places where such conditions are likely to occur the CONTRACTOR shall arrange for adequate protection of the materials, plant and formwork so that the work may proceed under proper cover.

Where strong winds are likely to appear, additional precautions shall also be taken to ensure protection from driving rain and dust.

The OWNER'S REPRESENTATIVE may withhold approval of the starting of concreting until he is satisfied with the full and adequate arrangements being made.

3.1.5. Concreting at night or in the dark

Where approval has been given to the carrying out of concreting operations at night or in places where daylight is excluded, the CONTRACTOR shall provide adequate lighting at all points where mixing, transporting, placing and compacting of concrete shall take place.

3.1.6. Concrete placing temperatures

Concrete is to be manufactured, transported and placed at all times in accordance within the limitations set out in the following paragraphs.

The temperature of the concrete shall not exceed 30°C at the time of placing.

The CONTRACTOR shall take the following measures in order to control the temperature of concrete at time of hot weather :

a) effectively shade aggregate stockpiles, cement silos, water tanks and concrete handling plant;

b) run all concrete handling plant with flake ice to reduce the temperature of the machinery before mixing/transporting concrete;

c) add flake ice to the mixing water;

d) concrete at night, if approved by the OWNER'S REPRESENTATIVE.

The following measures shall be taken :

e) all forms, moulds, reinforcement and other embedded parts, mixed and placed concrete shall be shaded from sunlight and protected from any drying wind;

f) transit time shall be restricted to a minimum to be agreed in advance between the OWNER'S REPRESENTATIVE and the CONTRACTOR taking into account the use of admixtures etc.

The size of concrete pours may be restricted if the OWNER'S REPRESENTATIVE decides that shrinkage and other factors are a consideration for particular elements of the construction.

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The CONTRACTOR shall follow the requirements of :

[IS 7861 : 1981]
for concreting during cold weather.

3.1.7. Deposition concrete under water

The arrangement for depositing concrete under water shall be such that there shall be, at all times, a minimum of disturbance of the water. Running water crossing or entering areas where concrete is to be de posited shall be brought under control before concreting starts. The concrete to be deposited under water shall be of the grade shown on the drawings and specified in the Table of Concrete Mixes.

The concrete mix design shall be such that the concrete shall be sufficiently fluid to flow freely. Concrete shall be deposited under water by means of hopper pipes or bottom dump skips, or other method approved by the OWNER'S REPRESENTATIVE. The method and rate of deposition shall ensure that no segregation shall occur. Concreting shall be carried out in sections previously ordered or approved by the OWNER'S REPRESENTATIVE and shall proceed continuously in each section until completed and no interval shall be allowed to elapse while the work is in hand.

If concreting under water is done by hopper pipe, the bottom of the hopper pipe shall always be buried in the concrete and care shall be taken not to allow the pipe to empty as it is moved over the area. If concreting under water is carried out by bottom dump skip, canvas or other approved covering shall be used to cover the surface of the concrete in the skip before it is lowered into the water. The doors of the skip shall be opened only when the skip is resting on the bottom with no tension in the support cable. After opening, the skip shall be lifted gradually so that the concrete flows out steadily.

3.1.8. Formwork

General

Forms shall be constructed from sound materials of sufficient strength, and shall be properly braced, strutted and shored, to ensure rigidity throughout the placing and compacting of the concrete. Forms shall be constructed in such a way that they can be removed without shock or vibration to the concrete. Internal ties shall be made of metal and shall either be capable of complete removal without damage to the concrete or, if remaining permanently embedded in the concrete, be no nearer to any finished surface than the largest value of 50 mm or the specified cover to reinforcement. The resulting cavity shall be so formed as to permit satisfactory filling as specified hereafter.

All joints shall be close fitting to prevent leakage of grout and at construction joints the formwork shall be secured tightly against previously-cast or hardened concrete to prevent stepping or the formation or ridges on exposed surfaces.

Formwork shall be constructed to provide the correct shape, lines and dimensions of the concrete shown on the Drawings. Due allowance shall be made for any deflection which will occur during the placing of concrete within the forms.

Panels shall have true edges to permit accurate alignment and to provide a neat line with adjacent panels and at all construction joints. All panels shall be fixed with their joints either vertical or horizontal, unless otherwise specified or approved. When chamfers are to be formed the fillets shall be cut accurately to the correct sizes to provide a smooth and continuous chamfer.

The CONTRACTOR shall make due allowance for the renewal and/or repair of formwork in case it has to be re-used.

Rough formwork

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Where rough formwork is specified, the form may be constructed of plain, butt-jointed properly-seasoned sawn timber unless otherwise instructed by the OWNER'S REPRESENTATIVE.

The tolerances are stated here below. The minimum specified cover to the reinforcement shall be maintained at all points. Abrupt irregularities or surface discontinuities shall not exceed 5 mm in height.

Wrought formwork

Where wrought formwork is specified, the forms shall be of steel or properly-seasoned plywood and shall be such as to produce a smooth and even surface free from irregularities, with joints flush with the surface. The minimum specified cover to the reinforcement shall be maintained at all points.

Lined formwork

Where lined formwork is specified the forms shall be lined with clear lacquered extra-hard hardboard, or other similar lining which will produce a finish acceptable to the OWNER'S REPRESENTATIVE. The panels of the lining material, and the forms, shall be fixed with close flush joints.

Formwork tolerances

- Wall thickness

  The tolerance, expressed in cm, on each linear dimension e (in cm) is equal to $\pm 1/3^{3}\sqrt{e}$ and anyhow limited to 4 cm.

Exposed surfaces of concrete

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The finished faces of all concrete work shall be sound, solid and free from defects. All exposed arises shall have a 25 mm x 25 mm chamfer unless otherwise specified.

No rendering of imperfect concrete faces will be allowed and any concrete that is defective in any way, including colour, shall be cut out and replaced to such depths, or be improved in such a way as directed by the OWNER'S REPRESENTATIVE.

Preparation of formwork for concreting

The formwork shall be coated with an approved mould oil and all excess shall be removed carefully. Mould oil shall not be allowed to come into contact with concrete already placed or with reinforcement.

Before concrete is placed, all formwork and supports shall be cleaned thoroughly. Temporary openings shall be provided to assist in the removal of the rubbish.

Concrete shall not be placed until the relevant formwork has been inspected and approved by the OWNER'S REPRESENTATIVE although the giving of this approval does not relieve the CONTRACTOR from his responsibilities concerning the requirements of soundness, finish and accuracy, specified elsewhere.

A period of not less than 24 hours notice shall be given to the OWNER'S REPRESENTATIVE to allow for his examination and, if satisfactory, approval of the reinforcement and formwork prior to the placing of the concrete.

Removal of formwork

Forms shall be removed in such a way that they do not damage the concrete. No forms shall be removed until the concrete has gained sufficient strength to support itself. Centres and props may be removed when the member being supported has gained sufficient strength to carry itself and the load to be supported on it with a reasonable safety factor.

The following table is a guide to the minimum periods which must elapse between the completion of the concreting operations and the removal of formwork. Notwithstanding this table, no prop nor formwork shall be removed without the permission of the OWNER'S REPRESENTATIVE and this permission shall not relieve the CONTRACTOR from his responsibilities for the safety of the structure.

- Vertical sides of beams, walls, columns - lift not exceeding 1.2 mm — 12 hours
- Vertical sides of beams, walls, columns - lift exceeding 1.2 mm — 36 hours
- Soffits of beams and main slabs (props left under) — 5 days
- Beams and main slabs - removal of props — 18 days

After removal of formwork no remedial works shall be attempted until the work has been inspected by the OWNER'S REPRESENTATIVE. If, according to the OWNER'S REPRESENTATIVE, any defect cannot be cured to his satisfaction, he may direct the CONTRACTOR to replace such work at the CONTRACTOR'S expense.

3.1.9. Reinforcement

Preparation and fixing of steel reinforcement

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Steel rod reinforcement shall be cut, bent and fixed in accordance with :

[IS 2502 : 1963]

Generally it shall be bent cold in a manner which will not damage the material. Bending hot at a cherry red heat (i.e. not exceeding 840°C) may be allowed except for bars which depend for their strength on cold working. Bars bent hot shall not be cooled by quenching.

Bends, cranks or other labours on reinforcing bars shall be formed carefully in accordance with :

[IS 2502 : 1963]
and with the working drawings.

The length of laps shall be calculated in accordance with :

[IS 456 : 2000]

The number, size, form and position of all steel reinforcing bars, ties, links, stirrups and other parts of the reinforcement shall be in accordance with the Drawings.

All parts of the reinforcement shall be maintained in the correct position in the forms without displacement during the process of vibrating, tamping and ramming the concrete in place. The CONTRACTOR shall provide all necessary distance pieces and spacer bars to maintain the reinforcement in the correct position. Any ties, links or stirrups connecting the bars shall be tied so that the bars are properly braced and the inside of bends shall be in contact with the bars around which they are intended to fit. Bars shall be bound together with best black annealed mild steel wire approximately 1.5 mm diameter or other approved binders. Wire binding shall be twisted tight with proper pliers. The free ends of the binding wire shall be bent inwards.

Before any steel reinforcement is embedded in the concrete any loose rust and any oil, grease, salt contamination, products and causes of pitting, or other deleterious matter shall be removed from it, by grit blasting, mechanical wirebrushing and/or washing. The method of removal to be adopted will depend on the degree of contamination and/or corrosion and shall be to the approval of the OWNER'S REPRESENTATIVE. Partially-set concrete which may have adhered to exposed bars during previous concreting operations shall likewise be removed.

Reinforcement left projecting temporarily from the concrete at construction or other joints shall not be bent out of position during the period in which concreting is suspended, except with the approval of the OWNER'S REPRESENTATIVE. When such approval is given the reinforcement shall be bent out over a suitably-sized former to prevent any damage to, or over-stressing of, the reinforcement.

Electric arc welding may be permitted in some locations for joining bars, subject to the approval of the OWNER'S REPRESENTATIVE.

Cover to reinforcement

The concrete cover to reinforcement shall be in accordance with the drawings. If no cover is specified on the drawings, the CONTRACTOR shall refer this matter to the OWNER'S REPRESENTATIVE.

No pieces of steel, timber blocks or materials other than approved concrete or plastic spacers shall be permitted for use as cover blocks or spacers.

Where concrete spacing blocks are used, they shall be of similar quality to the concrete specified for the particular element of the structure. For concrete having a characteristic strength of 30 N/mm^2 or greater, the spacing blocks shall comply with the requirements of this SPECIFICATION for water absorption and the ties shall be made from non-metallic material.

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The cover to mechanical couplers shall be in accordance with this paragraph.

3.1.10. Construction joints

Concreting shall be carried out continuously up to construction joints, the position and arrangement of which shall be as indicated on the drawings or as approved previously by the OWNER'S REPRESENTATIVE. The CONTRACTOR shall allow for working beyond the ordinary working hours where necessary in order that each section of concrete may be completed without any lapse while the work is in hand.

All construction joints shall be formed square to the work. Keyways shall be formed in all horizontal and vertical construction joints except where ordered to be omitted by the OWNER'S REPRESENTATIVE.

Construction joints shall be located, and the sequence of concreting arranged, to minimise the effect of shrinkage and thermal strains in the setting and hardened concrete and in subsequent pours.

When work is resumed on a surface of concrete which has set, the whole surface shall be roughened or scabbed thoroughly with suitable tools so that no smooth skin of concrete which may be left from previous work is visible and that all aggregates and solid matrix around them are exposed.

If according to the OWNER'S REPRESENTATIVE any deleterious materials have come into contact with the concrete of the construction joint the concrete shall be cut back to such depth as the OWNER'S REPRESENTATIVE shall direct and the roughened surfaces shall be brushed and watered immediately before depositing concrete.

If according to the OWNER'S REPRESENTATIVE doubt exists about the soundness of the joint, then the CONTRACTOR shall take all steps considered necessary to investigate and cure any defects, to the approval of the OWNER'S REPRESENTATIVE.

In water-retaining structures all construction joints shall require the use of an approved type of waterbar and the joint shall be sealed at the liquid face(s) where no special seal coating of that face by a waterproof sealant is specified.

3.1.11. Design Joints

Contraction, expansion and other movement joints shall be positioned as shown on the drawings.

Contraction joints in non-water-retaining structures, where specified, shall be formed as deliberate planes of discontinuity in the concrete structure.

To form such a joint the face of the concrete slab or block first formed shall be painted with two coats of approved rubber bitumen paint before the adjoining slab or block is concreted.

The adjoining slab or block shall be cast with a suitable groove against the joint to accept sealant. The exposed edges of the joints shall be chamfered and sealed with an approved polysulphide rubber sealing compound applied over bond breaking tape at the black of the joint rebate.

When according to the OWNER'S REPRESENTATIVE a contraction joint is likely to be contaminated with deleterious materials, the joint shall be sealed off immediately with an approved sealing compound as soon as striking of the formwork has been completed.

Expansion and other movement joints in non-water-retaining structures, where specified, shall be formed in the same way as contraction joints but in addition an approved compressible filler shall be placed in the joint to provide freedom for the adjacent concrete slabs to move.

The adjoining slab shall be cast with a suitable groove against the joint to accept sealant. The exposed edges of the joints shall be chamfered and sealed with an approved polysulphide rubber sealing compound.

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Where a design joint occurs in a water-retaining structure, or where otherwise ordered, the joint shall be made water-tight by the provision of a continuous waterstop strip as specified by the OWNER'S REPRESENTATIVE, fixed across the joint where shown on the drawings. Special care shall be taken to ensure that the concrete is well worked against the embedded parts of the strips and is free from honeycombing.

Precautions shall be taken to protect any projecting portions of the strips from damage during the progress of the works and, in the case of rubber and plastic, from light and heat.

In the case of copper waterstop where directed bituminous painting shall be applied to the lips of the loop and the loop shall be filled with a bituminous compound, these applications being made before the strip is buried in the concrete.

The method of jointing waterstops shall be in accordance with the manufacturer's instructions and to the approval of the OWNER'S REPRESENTATIVE.

3.1.12. Reinforced concrete and mass concrete - general

Concrete shall be of the grades specified on the drawings and detailed in the Table of Concrete Mixes.

Concrete shall be placed generally as specified in the relevant clauses. It shall be placed in small quantities and shall be compacted thoroughly. The concreting of individual members shall be continuous without stoppage up to a pre-arranged construction joint or until the member is completed. Concreting shall be finished off in such manner that each member shall be monolithic with the adjoining members and with any concrete to which it is connected.

The concrete shall be well protected against the action of the weather.

Where new concrete is to be deposited on concrete already set, the surface of the latter shall be prepared as specified in paragraphs 3.1.10 and 3.1.13 of this SPECIFICATION.

All reinforced concrete work shall be matured for such a period as the OWNER'S REPRESENTATIVE may direct before it is charged with loads of any kind.

3.1.13. Preparation of surfaces to receive concrete

Before concrete for reinforced concrete work is deposited on a natural formation, a screed of blinding concrete (lean concrete), as specified on the Drawings and detailed in the Table of Concrete Mixes, shall be placed over the ground below the underside level of the reinforced concrete to form a hard even surface on which to construct the latter.

Immediately before depositing concrete on or against a surface of masonry, brickwork, old concrete or the like, the following preparation shall be done. All loose material shall be removed and the surface washed down; all seepages of water emerging at the surface shall be stopped as far as possible or suitably channelled or piped away from the work. On upward facing horizontal or near horizontal surfaces a layer of 2:1 sand-cement mortar shall be spread over the surface of the section to be concreted if so directed by the OWNER'S REPRESENTATIVE.

3.1.14. Mass concrete backing to masonry or brickwork

The water-cement ratio of mass concrete backing to masonry or brick facing shall be increased compared with that of concrete mixed for placing against timber forms by such an amount as necessary according to the OWNER'S REPRESENTATIVE to compensate for the absorption of moisture by the masonry or brickwork. Before any concrete is placed, the mortar joints in the facework shall have thoroughly hardened, and the back of the facing shall be thoroughly wetted. The concrete shall be tamped carefully round any ties or bond stones, and mortar from the concrete shall be worked carefully into the open joints in the back of the facework.

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3.1.15. Curing and protection

Immediately after compaction and for at least 7 days thereafter all concrete shall be protected against harmful effects of sunshine, drying winds, cold, rain or running water to the satisfaction of the OWNER'S REPRESENTATIVE. During this period the measures given in this clause shall be taken to prevent the loss of moisture from the concrete and to minimise thermal stresses caused by the difference in temperature between the surface of the concrete and the core of the concrete mass. No other methods shall be employed except with the OWNER'S REPRESENTATIVE'S approval.

Unless otherwise agreed by the OWNER'S REPRESENTATIVE, curing of horizontal surfaces shall be carried out as follows :

a) Polythene sheeting shall be placed immediately after finishing.

b) After final set has taken place, the polythene shall be replaced by wet hessian which shall then be immediately covered with polythene.

c) Measures shall be taken to ensure that the hessian is always damp.

d) After 7 days the hessian and polythene may be removed and an approved aluminised or white pigmented resin based curing compound sprayed on the surface, as an alternative to retaining the hessian and polythene in place for at least another 7 days.

e) Concrete shall be shaded as approved by the OWNER'S REPRESENTATIVE.

f) Where specific surface textures are required (e.g. brush finishing on road slabs) then alternative methods of curing may only be employed with the approval of the OWNER'S REPRESENTATIVE.

Unless otherwise agreed by the OWNER'S REPRESENTATIVE curing of vertical surfaces shall be carried out as follows :

g) Immediately after the stripping of formwork, the member shall be wrapped with wet hessian and then covered with polythene which shall be held, firmly in place.
The hessian shall not be allowed to dry out.

h) After an initial curing period of 7 days the hessian and polythene may be removed. Without undue delay the concrete surface shall be sprayed with an approved aluminised or white pigmented resin-based curing compound as an alternative to retaining the hessian and polythene in place for at least another 7 days.

Where water is to be used for curing concrete it shall be fresh water in accordance with the requirements of this SPECIFICATION.

Where the use of a curing compound is proposed, the particular compound and method of application shall be subject to the approval of the OWNER'S REPRESENTATIVE. The rate of application of an approved compound shall be strictly in accordance with the manufacturer's recommendations.

Where timber or other insulating formwork is used it shall either be struck in accordance with the SPECIFICATION or be left in place until such time after the temperature peak is reached as the OWNER'S REPRESENTATIVE may direct.

Air circulation shall be prevented as far as possible along the exposed faces of concrete during the curing period.

All joints which are to be filled with sealing compound, or surfaces formed as construction joints, shall be protected in a manner which will ensure that no curing compound is placed on the bonding surface, e.g. by placing wet hessian.

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The protection shall be such as will ensure proper curing of the joint surface and adjacent concrete.

All concrete shall be protected from anything likely to interfere with the process of setting. No load of any kind shall be imposed upon any concrete member until the concrete has hardened sufficiently to resist the imposed load.

The surfaces of the concrete shall be protected from contamination of any sort.

When curing membranes are used they shall be compatible with waterproofing or other materials that may be applied subsequently to the surface of the concrete.

3.1.16. Concrete surface finishes

Absence of defects

All concrete shall be dense, sound, even textured and free from defects both internally and externally.

Fine face finish to formed surfaces

Where a formed surface of concrete is required to have a "fine face finish", the formwork used shall be lined formwork. On removal of the formwork the face of the concrete shall be rubbed smooth with Carborundum blocks whilst the concrete is green and all small holes shall be stopped with cement mortar of such a mix as to dry out with the same colour as the adjacent concrete.

Finishes to concrete surfaces without formwork

Where, on an upward facing horizontal or near horizontal surface which does not require formwork and which will neither be exposed to view nor receive any subsequent surface treatment, no particular finish is called for. The surface shall be that produced by the proper placing and compacting operations without further labours, provided a reasonably plane surface is produced.

Screeded finish

Where a screeded finish is specified, it shall obtained by screeding. This shall be done, immediately after the compacting of the concrete, by the slicing and tamping action of a screed board running on the top edges of the formwork, or on accurately-set screeding guides, to give a dense concrete skin, true to line and level. The finished surface shall be plain or with an even texture of parallel ribs as may be directed by the OWNER'S REPRESENTATIVE.

Floated finish

Where a floated finish is specified, it shall be obtained by first screeding the concrete as described in the preceding paragraph then leaving it until the concrete has stiffened and the moisture film has disappeared. Floating shall then be carried out with a steel or wooden float to produce either a "glossy" surface or a "sand paper" surface as required. Working shall be kept to a minimum compatible with a good finish. The surface shall be true to the required profile to fine tolerance. Whenever necessary a properly-constructed overhead cover shall be erected before the work is commenced to prevent the finished surface from being marred by raindrops or dripping water.

A floated finish shall be provided to all concrete surfaces which may be exposed to view in the finished works except where otherwise shown on the drawings.

Exposed aggregate finish

Where an exposed aggregate finish is specified, then immediately after removal of the forms the surface of the concrete shall be well scrubbed down by means of stiff wire brushes and water or other approved methods to remove the cement slurry from the surface and expose the aggregate.

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Bush hammered finish

Not less than 3 weeks (for ordinary Portland or sulphate-resisting Portland cement concrete) after pouring has been completed, the exposed surface shall be bush hammered to remove the cement from the surface and expose the aggregate. Bush hammers shall be of an approved type, and they shall be worked to within 12 mm of all corners and arises, the treatment of the remaining 12 mm borders being by means of suitable hand chisels to produce an effect similar to that of the adjoining bush-hammering.

Bush hammers shall be kept perpendicular to the surface being worked and care shall be taken to ensure that only the surface mortar and the irregular projections of the aggregate are removed without any fracturing or loosening of the portions left embedded. As the bush-hammering is completed, the surface so treated shall be washed with water and scrubbed down with a stiff brush. All finished surfaces shall be of an even and uniform appearance with the exposed aggregate clean and free from film.

Use of chemical surface retarders

The use of a chemical surface retarder will only be permitted as an alternative means of producing a decorative exposed aggregate finish subject to the OWNER'S REPRESENTATIVE'S approval of the type and rate of application of the retarder and to demonstration by the CONTRACTOR that a finish can be achieved which is deemed acceptable by the OWNER'S REPRESENTATIVE, without detriment to the durability of the concrete which remains at the exposed surface.

Specimen panels of concrete

Where required by the OWNER'S REPRESENTATIVE, the CONTRACTOR shall construct and treat specimen panels of concrete to the finish required, in order to satisfy the OWNER'S REPRESENTATIVE as to the suitability and effectiveness of the proposed method of treatment.

3.1.17. Special Concretes

Where so directed by the OWNER'S REPRESENTATIVE, the CONTRACTOR shall add approved compounds to the concrete materials before mixing, or apply them to the surface after completion, to give a concrete with improved dust-proof and oil-proof qualities. Such compounds shall be used in accordance with the instructions of the manufacturer.

Where placed on set concrete, granolithic type concrete paving shall be placed in panels not exceeding square 3 metres. Contraction joints of an approved type shall be provided around the perimeter of each panel.

Carborundum finish concrete

Concrete described as having a Carborundum finish shall be finished by sprinkling and working in Carborundum grit to form a non-slip surface. The Carborundum grit shall vary in size between 1.18 mm mesh and 0.600 mm mesh. It shall be distributed from a 1.18 mm mesh hand screen at the rate of 2.15 kg/m¨ and shall be worked into the concrete by means of a wooden float.

3.1.18. Precast Concrete

All precast concrete units shall be cast on a properly-constructed bed which shall not be liable to settlement and which shall have a smooth, hard and truly-levelled top surface.

No precast units shall be removed from the casting beds until the flexure test beams representing them reach a strength such that the OWNER'S REPRESENTATIVE is satisfied that the units can be handled and stacked without detriment to the units.

Similarly, no units shall be set in place until the cubes representing them reach a strength not less than that specified as the minimum works cube strength at twenty-eight days for the grade of concrete concerned. All units shall be

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marked clearly with a serial number and date of casting.

The CONTRACTOR shall submit to the OWNER'S REPRESENTATIVE for approval his proposed method of lifting precast units and the proposed positioning of lifting points.

Precast concrete units which are of symmetrical section but in which the reinforcement is not symmetrical shall be marked clearly to show the face which will be uppermost when the unit is in its correct position in the Works.

Wherever possible the marks shall be so located that they are not exposed to view when the unit is in its permanent position.

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3.1.19. Mortars and rendering

Cement mortar shall, unless otherwise specified or ordered, consist of one part of cement to three parts of fine sand by volume mixed and thoroughly incorporated together with just enough water to render it workable.

Rendering shall consist of three parts of fine sharp sand to one part of cement and be applied in two 10 mm coats and one 5 mm finishing coat giving an overall thickness of not less than 25 mm, the finishing coat being of a colour to be approved by the OWNER'S REPRESENTATIVE.

All cement mortar and rendering shall be used whilst freshly mixed and no softening or re-tempering will be allowed.

Acid resistant epoxy mortar shall be obtained from an approved manufacturer and shall be used strictly in accordance with the manufacturer's instructions.

3.1.20. Grouting

3.1.20.1. General

This paragraph covers the mandatory requirements for the supply and installation of all grouting work related to :

- structural steel or supports baseplates
- equipment bed plates or skids
- base rings for towers

The type, thickness and areas of grout shall be in accordance with the OWNER'S REPRESENTATIVE'S construction drawings.

Proprietary products considered by the CONTRACTOR to meet this section shall be submitted for approval to the OWNER'S REPRESENTATIVE with the CONTRACTOR'S report and recommendation, and shall be approved before use.

3.1.20.2. Types of grout

The compressive strengths of the grout types listed below are based on 40 mm x 40 mm x 160 mm test prism, tested in accordance with relevant Indian Codes.

3.1.20.3. Type G1

This is a proprietary, non-shrink, non-metallic, fluid grout. 'Master Flow 713' by Master Builders or an approved equal shall be used.

3.1.20.4. Type G2

This is a cement/sand grout. The ratio of cement to sand in the mix shall be :

- 1:1 for bedding thickness not greater than 25 mm
- 1:2 for bedding thickness not greater than 50 mm

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- 1:3 for screeding and dry packing.

When Type G2 grout is to be used over a large area, a suitable plasticiser approved by the OWNER'S REPRESENTATIVE may be added in accordance with the manufacturer's instructions.

The ratio of water to cement shall not be greater than 0.5 and seven day compressive strengths shall not be less than :

- 1:1 mix - 25 N/mm^2
- 1:2 mix - 20 N/mm^2
- 1:3 mix - 15 N/mm^2

Three Test cubes are to be tested for each 1 m^3 of Type G2 grout that is used.

3.1.20.5. Type G3

This is a proprietary epoxy grout and selected aggregate, "Escoweld 7505" by Esso Chemicals or an approved equal, used and mixed strictly in accordance with manufacturer's instructions.

3.1.20.6. Materials

3.1.20.6.1. Cement & sand

Cement shall conform to paragraph 2.1.1 of this SPECIFICATION.

Sand shall conform to paragraph 2.1.3 of this SPECIFICATION.

Admixtures

A water reducing plasticiser may be used, only where approved by the OWNER'S REPRESENTATIVE. Admixture containing calcium chloride shall not be used. Where approved admixtures shall be used strictly in accordance with the manufacturer's instructions and shall comply with :

[IS 9103 : 1999]

3.1.20.6.2. Handling and storage of Materials

a/ Cement

Bagged cement shall be stored in waterproof, ventilated sheds, and the floors of the sheds shall be kept clear of the ground or otherwise protected from dampness. The cement shall be stored in such a way that the oldest deliveries are used first. Re-bagged cement may not be used unless permitted by the OWNER'S REPRESENTATIVE. If bulk cement is used it shall be stored in a steel bulk cement storage silo of approved design and manufacture. The CONTRACTOR shall provide the OWNER'S REPRESENTATIVE with a test certificate to the effect that the weighing mechanism is w orking correctly and he shall continue test checks at least once per week throughout the period of concreting in the presence of the OWNER'S REPRESENTATIVE.

Cement bags containing lumps that cannot be broken by a light touch of the fingers shall not be used.

Quantities of cement shall be stored on site as are considered sufficient by the OWNER'S REPRESENTATIVE to ensure continuity of work, taking in account the transport and climatic

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conditions, etc. No cement shall be kept on the site longer than 3 months.

b/ Sand

The CONTRACTOR shall ensure that adequate supplies of the approved sand is available prior to commencing work and shall at all times maintain on site quantities sufficient to ensure continuity of work.

Sand shall be separately transported and stored, and shall not be contaminated with any other types of aggregate or other material. The floor of storage areas shall be of concrete or other approved material having sufficient slope to ensure drainage of surplus water. Regular cleaning of sand bins shall be carried out to remove accumulated dust. Wet sand shall be kept on site for at least 24 hours to ensure adequate drainage before being used for grouting.

c/ Proprietary Materials

All other materials shall be stored in a similar manner to cement to protect them from deterioration and contamination from whatever source, to the approval of the OWNER'S REPRESENTATIVE.

3.1.20.7. Preparation

- Concrete surfaces which are to receive grout shall be finished level and reasonably smooth by tamping. When the concrete has become firm but is still green, it shall be hosed and lightly brushed to remove laitance and expose the aggregate without disturbing it.
- The surface shall be cleared of all defective concrete and laitance, oil, grease and other chemicals and dirt, and shall be approved by the OWNER'S REPRESENTATIVE.
- Bolt sleeves shall be freed of all static water, polystyrene formers and foreign matter.
- All grout shall be placed within shuttering. Shuttering shall be of adequate strength and securely fixed to withstand the pressure of the grout and be sealed to prevent leakage.
- Grout shall be placed as soon as possible after the erection of the equipment or steelworks as directed by the OWNER'S REPRESENTATIVE.
- Proprietary grouts shall be mixed and prepared strictly in accordance with the manufacturer's instructions.
- Foundations to receive water-mix grout shall be kept wet for 24 hours before the grout is placed.

3.1.20.8. Mixing and placing

- Grout shall be mixed in equipment capable of continuous mechanical mixing and agitation that will produce uniform distribution of material.
- Surfaces to receive or be in contact with any grout shall not exceed 32 °C or be less than 10 °C. Care shall be taken to ensure that the grout completely fills the void to be groute d and is thoroughly compacted and free from air pockets. Any areas or pockets which are not to receive grout shall be sealed with an approved material.
- Grout may be placed either by pouring or pumping. The grout shall be applied under a suitable head and worked until the space is completely filled. Exposed surfaces shall receive a steel trowel finish and be sloped to allow drainage.
- All bolt holes and sleeves shall be filled adequately and pressure grouting used where directed by the OWNER'S REPRESENTATIVE. Steel shims shall be encased by grout with at least a 20 mm cover.
- All proprietary grouts shall be placed strictly in accordance with the manufacturer's installation procedure.

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- All exposed cement based grouts must be correctly cured. Twenty-four hours after placing the grout the shuttering shall be removed and the grout cured with an approved agent or wet hessian and polythene sheet. Grouts shall be cured for a minimum of 3 days.

3.1.20.9. Finishing

- After a period to be determined by the OWNER'S REPRESENTATIVE, the work shall be neatly pointed and trowelled off and left in a workmanlike manner.
- Exposed edges shall be protected adequately against damage and the effects of the elements during the curing period.

3.1.21. Protection to concrete

Where detailed, concrete structures shall be protected internally or externally with an approved proprietary waterproofing membrane or coating, and fixed to the concrete surfaces required to be protected. The protection shall be placed in accordance with the drawings and the manufacturer's instruction.

Membranes and coatings which are to have concrete, backfill or other material placed against them shall be protected as soon as practicable after application.

Horizontal surfaces shall be protected with mortar or concrete as shown on the drawings.

Vertical surfaces shall be protected with hardboard or other approved material, which shall be left as permanent protection.

3.1.22. Tolerances of concrete surfaces

The acceptable tolerances of concrete surfaces shall be in accordance with the requirements of paragraph 3.1.8.

Notwithstanding the above specified tolerances no concrete surface shall intrude within the structure gauge and easement.

3.2. Field Quality Control

3.2.1. Testing of cement

Notwithstanding the submission by the CONTRACTOR of the certificates required by paragraph 1.6.3 of this SPECIFICATION, the OWNER'S REPRESENTATIVE may, at his discretion, decide that any consignment of cement, on arrival at the site and also after it has been stored at the site prior to use, be subjected to the whole of the tests and analyses required by this SPECIFICATION and no cement of that consignment shall be used in the works until it has been tested by the OWNER'S REPRESENTATIVE and accepted by him as satisfactory.

3.2.2. Testing of Reinforcement

Notwithstanding the submission by the CONTRACTOR of the certificates required by paragraph 1.6.3 of this SPECIFICATION, the OWNER'S REPRESENTATIVE may, at his discretion, decide that any consignment of reinforcement be subjected to independent tests and no reinforcement of that consignment shall be used in the works until it has been tested by the OWNER'S REPRESENTATIVE and accepted by him as satisfactory.

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3.2.3. Testing of Aggregates

The grading of aggregates shall be tested at least at weekly or at 100 m^3 intervals whichever is the sooner when concrete is being produced on a regular basis or before the start of production when the production of concrete is irregular.

The moisture content and water absorption value of all fine and coarse aggregates shall be tested by the CONTRACTOR at such frequent intervals as will enable him to comply with the requirements of paragraph 2.2.2 of this SPECIFICATION.

3.2.4. Testing of Concrete - General

Sampling of concrete for test purposes shall be carried out in accordance with the requirements of :

[IS 1199 : 1959]

Concrete specimens shall be manufactured and cured in accordance with the requirements of :

[IS 9013:1978, IS10086 : 1982]

Compression tests of concrete which has a maximum size aggregate of more than 40 mm shall be carried out as required in paragraphs 2.2.5 and 3.2.5 however by first sieving and discarding prior to moulding all aggregate that is larger than 50 mm.

3.2.5. Permanent works concrete quality control

Test cubes shall be made, cured, stored, transported and tested in compression in accordance with :

[IS 10086 : 1982]

Cubes shall be manufactured on the site at the location where the concrete is being placed.

A sample of concrete shall be taken at random on eight separate occasions during each of the first five days of using a mix. The standard deviation shall be calculated from at least 40 individual test results each representing separate batches of similar concrete produced by the same plant and under the same supervision. Thereafter samples will be taken at random at the frequencies given below :

Type of Structural Element	Sampling frequency (m^3 per sample)
• Precast concrete elements	10
• Normal structural elements such as columns, walls, slabs	25
• Heavy base and roof slabs, thick walls	50

The samples shall be taken for the concrete produced by each batch plant, for each grade of concrete and at least one sample shall be taken on each day on which any concrete of a particular grade is made.

From each sample two cubes shall be made for testing at 28 days and one for testing at 7 days for control purposes.

Each 28-day test result shall be the mean of the cube strengths of the two cubes made from the same sample.

If three or more results in 40 consecutive tests are below the characteristic strength or if one result in 40 consecutive tests is less than 85 % of the characteristic strength the OWNER'S REPRESENTATIVE may

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order any or all of the following actions to be taken:

a) the adjustment of the mix and/or improvement to the standard of quality control;

b) the cutting of test cores from the concrete for examination and testing of specimens prepared therefore;

c) the carrying out of load tests on areas or structural members containing the suspect concrete;

d) the cutting out and replacement of such volumes of concrete as, at his discretion, he considers to be defective;

e) the carrying out of non-destructive tests to assess the in-situ quality of the suspect concrete.

The procedure outlined above shall be repeated whenever a change in materials to be used or mix design is intended.

If the range of individual cube strengths made from the same sample exceeds 15 % of the mean then the method of making, curing and testing cubes shall be examined thoroughly.

In the event of a result having a range exceeding 20 % the result shall be unacceptable and the OWNER'S REPRESENTATIVE may order any of the actions outlined above to be taken.

Where the OWNER'S REPRESENTATIVE orders the cutting of test cores from the concrete, the CONTRACTOR shall cut cores from locations selected by the OWNER'S REPRESENTATIVE. If the strength of these cores, when corrected by the reduction for each week of age in excess of 28 days is less than 75 % of the specified characteristic cube strength then the concrete shall be cut out and replaced to the extent directed by the OWNER'S REPRESENTATIVE unless the OWNER'S REPRESENTATIVE orders otherwise.

In addition to the works test cubes described above, the OWNER'S REPRESENTATIVE may order additional cubes and tests :

f) to determine stripping times for formwork;

g) to determine the duration of curing;

h) to check testing and sampling errors.

When air entrained concrete is being produced the air content shall be determined for each load of concrete produced.

This frequency may be reduced once consistency of production has been achieved.

In the early stages of permanent works concreting and, if instructed by the OWNER'S REPRESENTATIVE, when the CONTRACTOR starts to use new materials or mix design or to employ new materials or procedures of curing, the CONTRACTOR shall take measurements with resistance thermocouples or other appropriate and approved devices, and shall thereby provide the OWNER'S REPRESENTATIVE with records of the temperature variations in the centre of and at the surface of the concrete in such pours as the OWNER'S REPRESENTATIVE may direct. Such records may be used by the OWNER'S REPRESENTATIVE in order.

i) to assess the suitability of the concrete mix design;

j) to assess the suitability of and stripping times for timber or other insulating formwork;

k) to assess the suitability of the curing materials and procedures.

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3.2.6. Workability of concrete

The CONTRACTOR shall carry out compaction factor or slump tests in accordance with :

[IS 7320 : 1974]

or other workability tests as required during concreting.

The purpose of these tests is to ensure the adequate control of workability at the batching plant and the site of the pour. The degree of workability obtained when concreting the permanent works shall be in accordance with the trial mixes.

3.2.7. Chlorides in hardened concrete

Tests in accordance with relevant Indian Codes:

will be made on hardened concrete at regular intervals to determine the acid soluble chloride content.

Reinforced concrete will be judged acceptable provided that no result is greater than 0.50 % NaCl by weight of cement in the mix.

3.2.8. Sulphates in hardened concrete

Tests in accordance with relevant Indian Codes:

shall be made by the CONTRACTOR on hardened concrete at regular intervals to determine the total sulphate content as SO_3 of any mix. Notwithstanding the requirements given in paragraph 2.1.11 of this SPECIFICATION, the concrete will be judged acceptable if this does not exceed 3.7 % by weight of cement in the mix.

3.2.9. Testing of reinforcement couplers

For each 200 splices executed in the field the CONTRACTOR shall execute, under field conditions, five splices for quality control tests using representative samples of such reinforcement diameters as the OWNER'S REPRESENTATIVE may nominate.

The OWNER'S REPRESENTATIVE may increase the frequency of testing if the results are not satisfactory.

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STRUCTURAL STEEL WORKS

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1. SCOPE

This specification covers the requirements for material, storage, preparation of fabrication drawings, fabrication, assembly, tests/examinations, transportation, erection and painting of all types of bolted welded structural steel works for general construction work. Fabrication of structures shall also include fabricating:

a. Built up sections/plate girders made out of rolled section and/or plates.

b. Compound sections made out of rolled sections.

2. REFERENCE

2.1. BIS Codes

IS:800, 816, 819, 822, 919, 1024, 1261, 1323, 1477,1852, 2074, 7205,7215, 7307, 7310, 7318, 9595 and other relevant BIS Codes.

SP: 6(1)

3. MATERIALS

3.1. General

All materials shall conform to their respective specifications given in Specification. The use of equivalent or alternative materials shall be permitted only in very special cases and for all such cases prior written approval of the Owner's Representative will be obtained.

3.2. Receipt & Storing of Materials

3.2.1. Each section shall be marked for identification and each lot shall be accompanied by Manufacturer's quality certificate, chemical analysis and mechanical characteristics.

3.2.2. All sections shall be checked, sorted out and arranged by grade and quality in the store. Any instruction given by the Owner's Representative in this respect shall be strictly followed.

3.2.3. All material shall be free from surface defects such as pitting, cracks, laminations, twists etc. Defective material shall not be used and all such rejected material shall be immediately removed from the store/site. The decision of Owner's Representative in this regard shall be final and binding.

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3.2.4. Welding wires and electrodes (packed in their original cartons) shall be stored separately by quality and lots inside a dry and enclosed room in compliance with IS:9595 and as per the instructions given by the Owner's Representative. Electrodes shall be kept perfectly dry to ensure satisfactory operation and weld metal soundness.

3.2.5. Each lot of electrodes, bolts, nuts etc. shall be accompanied by manufacturer's quality/test certificates.

3.2.6. All bolts (including nuts & washers) shall be checked, sorted out and arranged diameter-wise by grade and quality in the store.

3.3. Material Tests

3.3.1. The Contractor shall submit manufacturer's quality certificates for all the materials supplied by him. In case, quality certificates are not available or are incomplete or when material quality differs from standard specifications, such materials shall not be used in the construction. However, the Contractor shall get all appropriate tests conducted in approved test houses for such materials as directed by the Owner's Representative, at no extra cost, and submit the same to Owner's Representative for his approval. The Owner's Representative may approve the use of such materials entirely at his discretion.

3.3.2. The Contractor shall ensure that all materials brought to site are duly approved by the Owner's Representative. Rejected materials shall not be used and shall be removed from site forthwith. Any material of doubtful quality for which specific tests are to be carried out as per the instruction of the Owner's Representative shall be separately stacked and properly identified and shall not be used. These shall be removed from site forthwith.

4. FABRICATION DRAWINGS

4.1. Fabrication and erection drawings shall be prepared by the Contractor on the basis of "Approved for Construction (AFC)" design drawings. These drawings shall be prepared by the Contractor or by an agency appointed by the Contractor and approved by the Owner's Representative.

4.2. Fabrication and erection drawings shall be thoroughly checked, stamped "Appro ved for Construction" and signed by the Contractor's own responsible Engineer irrespective of the fact that such drawings are prepared by the Contractor or his approved agency, to ensure accuracy and correctness of the drawings. Unchecked and unsigned drawings shall not be used for the purpose of proceeding with the work. The Contractor shall proceed with the fabrication and erection work only after thoroughly satisfying himself in this regard.

4.3. All fabrication and erection drawings shall be issued for construction by the Contractor directly to his work site. Six copies of such drawings shall simultaneously be submitted to the Owner's Representative who may check / review some or all such drawings at his sole discretion and offer his comments for incorporation in these drawings by the Contractor.

However, the Contractor shall not proceed with the fabrication of such structures whose fabrication drawings are required to be reviewed before taking up the fabrication work as noted on "Approved for Construction (AFC)" design drawings issued to the Contractor or as conveyed by the Owner's Representative. The fabrication of such structures shall be done only as per the reviewed fabrication drawings.

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The review of such drawings by Client shall be restricted to the checking of the following only:

i. Structural layout, orientation and elevation of structures/members.

ii. Sizes of members.

iii. Critical joint details.

4.4. Fabrication drawings shall be drawn to scale and shall convey the information clearly and adequately. Following information shall be furnished on such drawings:

- Reference to design drawing number (along with revision number) based on which fabrication drawing has been prepared.
- Structural layout, elevations and sections (with distinct erection marking of all members).
- Framing plans, member sizes, orientation and elevations.
- Layout and detailing of rain water pipes and gutters showing all necessary levels, connections and provisions wherever required.
- Detailing of shop/field joints, connections, splices, for required strength and erection.
- Location, type, size and dimensions of welds and bolts.
- Shapes and sizes of edge preparation for welding.
- Details of shop and field joihnts/welds.
- Bill of materials / D.O.D. lists.
- Quality of structural steel, plates etc., welding electrodes, bolts, nut and washers to be used.
- Erection assemblies identifying all transportable parts and sub-assemblies with special erection instructions, if required.
- Method of erection and special precautions to be taken during erection as required.

4.5. The Contractor shall additionally ensure accuracy of the following and shall be solely responsible for the same:

i. Provision for erection and erection clearances.

ii. Marking of members.

iii. Cut length of members.

iv. Matching of joints and holes.

v. Provision kept in the members for other interconnected members.

vi. Bill of materials/D.O.D. lists.

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4.6. Connections, splices and other details where not shown on the design drawings shall be suitably designed and shown on the fabrication drawings based on good engineering practice developing full member strength. Design calculations for such connections/ splices shall be submitted to the Owner's Representative along with the fabrication drawings.

4.7. Any substitution or change in section shall be allowed only when prior written approval of the Owner's Representative has been obtained. Fabrication drawings shall be updated incorporating all such substitutions/changes by the Contractor at no extra cost to the Owner.

4.8. In case during execution of the work, the Owner's Representative on review of drawings considers any modifications/substitutions necessary to meet the design parameters/good engineering practice, these shall be brought to the notice of the Contractor who shall incorporate the same in the drawings and works without any extra cost to the Owner. The Contractor will be totally responsible for the correctness of the detailed fabrication drawings and execution of the work.

4.9. Contractor shall incorporate all the revisions made in the design drawings during the course of execution of work in his fabrication drawings, and resubmit the drawings at no extra cost to the Owner. All fabrication shall be carried out only as per the latest AFC design drawings and corresponding fabrication drawings.

4.10. The Contractor shall supply two prints each of the final/As-built drawings along with their transparencies to Owner's Representative for reference and record. The rates quoted shall include for the same.

5. FABRICATION

5.1. General

5.1.1. Fabrication of structures shall be done strictly as per "Approved for Construction" fabrication drawings (prepared by the Contractor based on the latest design drawings) and in accordance with IS:800, 9595 and other relevant BIS Codes and BIS Hand Book SP:6(1).

5.1.2. Prior to commencement of structural fabrication undulations in the fabrication yard, if any, shall be removed and area levelled and paved by the Contractor.

5.1.3. Any defective material used in the work shall be replaced by the Contractor at his own expense. Necessary care and precautions shall be taken so as not to cause any damage to the structure during any such removal and replacement.

5.1.4. Any faulty fabrication pointed out at any stage of work by the Owner's Representative, shall be made good or replaced by the Contractor at his own cost.

5.1.5. Tolerances for fabrication of steel structures shall be as per IS:7215.

5.2. Fabrication Procedure

5.2.1. Straightening & Bending

5.2.1.1. All materials shall be straight and, if necessary, before being worked shall be straightened and/or flattened

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(unless required to be of curvilinear form) and shall be free from twists.

5.2.1.2. Bending of rolled sections and plates shall be done by cold process to shape/s as shown on drawings.

5.2.2. Clearances

The erection clearance for cleated ends of members shall be not greater than 2mm at each end. The erection clearance at ends of beams without web cleats and end plates shall be not more than 3mm at each end but where for practical reasons, greater clearance is necessary, suitably designed seatings approved by the Owner's Representative shall be provided.

5.2.3. Cutting

5.2.3.1. Prior to cutting, all members shall be properly marked showing the requisite cut length/width, connection provisions e.g. location and dimensions of holes, welds, cleats etc. marking for cutting shall be done judiciously so as to avoid wastages or unnecessary joints as far as practibcable. Marking shall be done by placing the members on horizontal supports/pads in order to ensure accuracy. Marking accuracy shall be limited to + 1mm.

5.2.3.2. Cutting may be affected by shearing, cropping or sawing. Gas cutting by mechanically controlled torch shall be permitted for mild steel. Hand flame cutting may be permitted subject to the approval of the Owner's Representative.

5.2.3.3. Except where the material is subsequently joined by welding, no loads shall be transmitted into metal through a gas cut surface.

5.2.3.4. Shearing, cropping and gas cutting shall be clean, square, free from any distortion and burrs, and should the Owner's Representative find it necessary, the edges shall be ground afterwards, to make the same straight and uniform at no extra cost to the Owner.

5.2.4. Holing

5.2.4.1. Holes for bolts shall not be formed by gas cutting process.

5.2.4.2. Holes through more than one thickness of material of members such as compound stanchions and girde r flanges shall, where possible, be drilled after the members are assembled and tightly clamped/bolted together. Punching may be permitted before assembly, provided the thickness of metal is less than 16 mm and the holes are punched 3mm less in diameter than the required size and reamed, after assembly, to the full diameter. Punching shall not be adopted for dynamically loaded structures.

5.2.4.3. Holes may be drilled in one operation through two or more separable parts and burrs removed from each part after drilling.

5.2.4.4. Holes in connecting angles and plates, other than splices, also in roof members and light framing, may be punched full size through material not over 12mm thick, except where required for close tolerance bolts or barrel bolts.

5.2.4.5. All matching holes for black bolts shall register with each other so that a gauge of 2mm less in diameter than the diameter of hole shall pass freely through the assembled members in the direction at right angle to such members. Finished holes shall be not more than 2mm in diameter larger than the diameter of the black bolt passing through them, unless otherwise specified by the Owner's Representative.

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5.2.4.6. Holes for turned and fitted bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to H8 tolerance specified in IS:919. Parts to be connected with close tolerance or barrel bolts shall be firmly held together by tacking bolts or clamps and the holes drilled through all the thicknesses in one operation and subsequently reamed to size. Holes not drilled through all the thicknesses in one operation shall be drilled to a smaller size and reamed out after assembly. Where this is not possible, the parts shall be drilled and reamed separately.

5.2.4.7. To facilitate grouting, holes shall be provided in column bases or seating plates exceeding 300mm in width for the escape of air.

5.2.4.8. To avoid accumulation of water in gusseted column bases of laced, battened or box type stanchions, suitable reverse U-type holes shall be provided at the junction of base plate and column section in the vertical gussets for draining out of any water.

5.2.5. Assembly

The component parts shall be assembled and aligned in such a manner that they are neither twisted nor otherwise damaged, and shall be so prepared that the required camber, if any, is provided. Proper clamps, clips, jigs and other fasteners (bolts and welds) shall be placed in a balanced pattern to avoid any distortion in the members and to ensure their correct positioning (i.e. angles, axes, nodes etc.). Any force fitting, pulling/stretching of members to join them shall be avoided. Proper care shall be taken for welding shrinkage and distortion so as to attain the finished dimensions of the structure shown on the drawings.

5.2.6. Welding

5.2.6.1. General

a) All joints shall be welded unless noted otherwise on the design drawings.

b) Welding shall be in accordance with IS:816, IS:819, IS:1024, IS:1261, IS:1323 and IS:9595 as appropriate.

c) The Contractor shall make necessary arrangement for providing sufficient number of welding sets of the required capacity, all consumables, cutting and grinding equipment with requisite accessories/auxiliaries, equipment and materials required for carrying out various tests such as dye penetration, magnetic particle, ultrasonic etc.

d) Adequate protection against rain, dust, snow and strong winds shall be provided to the welding personnel and the structural members during welding operation. In the absence of such a protection no welding shall be carried out.

e) It shall be the responsibility of the Contractor to ensure that all welding is carried out in accordance with the terms of this specification and relevant BIS codes. The Contractor shall provide all the supervision to fulfil this requirement.

5.2.6.2. Preparation of Member for Welding

a) Edge Preparation

Edge preparation/bevelling of fusion faces for welding shall be done strictly as per the dimensions shown in the drawings. In case, the same are not indicated, edges shall be prepared (depending on the type of weld indicated in the drawing) as per the details given in IS:9595. Bevelling of fusion faces shall be got checked and approved by the Owner's Representative. The tolerances on limits of gap, root face and included angle shall be as stipulated in IS: 9595.

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b) Cleaning

Welding edges and the adjacent areas of the members (extending upto 20mm) shall be thoroughly cleaned of all oil, grease, scale and rust and made completely dry. Gaps between the members to be welded shall be kept free from all foreign matter.

c) Preheating

Preheating of members, shall be carried out as per IS:9595 when the base metal temperature is below the requisite temperature for the welding process being used. Preheating shall be done in such a manner that the parts on which the weld metal is being deposited, are above the specified minimum temperature for a distance of not less than 75mm on each side of the weld line. The temperature shall be measured on the face opposite to that being heated. However, when there is access to only one face, the heat source shall be removed to allow for temperature equalization (1 minute for each 25mm plate thickness) before measuring the temperature.

d) Grinding

i. Column splices and butt joints of struts and compression members (depending on contact for load transmission) shall be accurately ground and close-butted over the whole section with a tolerance not exceeding 0.2mm locally at any place. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc., shall be acc urately ground so that the parts connected butt over minimum 90% surface of contact. In case of connecting angles or channels, care shall be taken so that these are fixed with such accuracy that they are not reduced in thickness by grinding by more than 2mm.

ii. Ends of all bearing stiffeners shall be ground to fit tightly at both top and bottom. Similarly, bottom of the knife edge supports along with the top surface of column brackets shall be accurately ground to provide effective bearing with a tolerance not exceeding 0.2mm locally at any place.

iii. Slab bases and caps shall be accurately ground over the bearing surfaces and shall have effective contact with the ends of stanchions. Bearing faces which are to be grouted direct to foundations need not be ground if such faces are true and parallel to the upper faces.

5.2.6.3. Welding Processes

Welding of various materials under this specification shall be carried out using one or more of the following processes.

- Manual Metal Arc Welding Process (MMAW)
- Submerge Arc Welding Process (SAW)
- Gas Metal Arc Welding Process (GMAW)
- Flux Cored Arc Welding Process (FCAW)

The welding procedure adopted and consumables used shall be specifically approved by the Owner's Representative. A combination of different welding processes or a combination of electrodes of different classes/makes may be employed for a particular joint only after qualifying the welding procedures to be adopted and obtaining the written approval of the Owner's Representative.

5.2.6.4. Approval & Testing of Welders

The Contractor shall satisfy the Owner's Representative that the welders are suitable for the work upon which they will be employed. For this purpose the welders shall have satisfied the relevant requirements of IS:7318. If the welders will be working to approved welding procedures, they shall have satisfied the relevant requirements of

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IS:7310.

Adequate means of identification shall be provided to enable each weld to be traced to the welder by whom it was made. The Contractor shall intimate the Owner's Representative sufficiently in advance, the commencement of tests, to enable him to be present to witness the same.

5.2.6.5. Approval & Testing of Welding Procedures

The Contractor shall carry out procedure tests in accordance with IS:7307 to demonstrate by means of a specimen weld of adequate length on steel representative of that to be used, that he can make welds with the welding procedure to be used for the work to the complete satisfaction of the Owner's Representative. The test weld shall include weld details from the actual construction and it shall be welded in a manner simulating the most unfavourable instances of fit-up, electrode condition etc., which are anticipated to occur on the particular fabrication. Where material analysis are available, the welding procedure shall be carried out on material with the highest carbon equivalent value.

After welding, but before the relevant tests given in IS:7307 are carried out, the test weld shall be held as long as possible at room temperature, but in any case not less than 72 hours, and shall then be examined for cracking. The examination procedure shall be sufficiently rigorous to be capable of revealing significant defects in both parent metal and weld metal.

After establishing the welding method, the Contractor shall finally submit to the Owner's Representative for his approval the welding procedure specification in standard format given in IS:9595 before starting the fabrication.

5.2.6.6. Sequences of Welding

a. As far as practicable, all welds shall be made in a sequence that will balance the applied heat of welding while the welding progresses.

b. The direction of the general progression in welding on a member shall be from points where the parts are relatively fixed in position with respect to each other towards points where they have a greater relative freedom of movement.

c. All splices in each component part of a cover-plated beam or built up member shall be made before the component part is welded to other component parts of the member.

d. Joints expected to have significant shrinkage shall be welded before joints expected to have lesser shrinkage.

e. Welding shall be carried continuously to completion with correct number of runs.

f. The Contractor shall choose the welding sequence after carefully studying each case such as to minimize distortion and shrinkage and submit the same to the Owner's Representative for comments and approval.

5.2.6.7. Welding Technique

a. After the fusion faces are carefully aligned and set with proper gaps, the root pass of butt joints shall be executed properly so as to achieve full penetration with complete fusion of the root edges.

b. On completion of each run, all slag and spatters shall be removed and the weld and the adjacent base metal shall be cleaned by wire brushing and light chipping. Visible defects such are cracks, cavities and other deposition faults, if any, shall be removed to sound metal before depositing subsequent run of weld.

c. All full penetration butt welds shall be completed by chipping/gouging to sound metal and then depositing a sealing run of weld metal on the back of the joints. Where butt welding is practicable from one side only, suitable backing steel strip shall be used and joint shall be arranged in such a way as to ensure that complete fusion of all the parts is readily obtained.

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d. While welding is in progress care shall be taken to avoid any kind of movement of the components, shocks, vibrations to prevent occurrence of weld cracks.

e. Any deviation desired from the recommended welding technique and electrodes shall be adopted only after obtaining written approval of the Owner's Representative.

5.2.6.8. Inspection & Testing of Welds

The method of inspection shall be according to IS:822 and extent of inspection and testing shall be in accordance with the relevant applicable standard or, in the absence of such a standard, as specified by the Owner's Representative. Welds shall not be painted or otherwise obscured until they have been inspected, approved and accepted.

The Owner's Representative shall have access to the Contractor's work at all reasonable times and the Contractor shall provide him with all facilities necessary for inspection during all stages of fabrication and erection with, but not limited to, the following objectives.

i. To check the conformity with the relevant standards and suitability of various welding equipments and their performance.

ii. To witness/approve the welding procedure qualification.

iii. To witness/approve the welders performance qualification.

iv. To check whether shop/field welding being executed is in conformity with the relevant specifications and codes of practice.

Inspection and testing of all fabricated structures shall be carried out by the Contractor by any, or, a combination of all the following methods as directed by the Owner's representative and no separate payment shall be made, unless otherwise mentioned, for inspection and testing of welds/fabricated structures:

A. Visual Inspection

All finished welds (i.e. 100 percent) shall be visually inspected for identification of the following types of weld defects and faults.

a. Weld defects occurring at the surface such as blow holes, exposed porosity, unfused welds, etc.

b. Surface cracks in the weld metal or in the parent metal adjacent to it.

c. Damages to the parent metal such as undercuts, burning, overheating, etc.

d. Profile defects such as excessive convexity or concavity, overlapping, unequal leg lengths, excessive reinforcement, incompletely filled groves, excessive penetration beads, root grooves etc.

e. Distortion due to welding i.e., local shrinkage, camber, bowing, twisting, rotation, wariness etc.

f. Linear eccentric, angular and rotational misalignment of parts.

g. Dimensional errors.

B. Mechanical Tests

The mechanical testing (such as tensile load tests, bend tests, impact tests etc.) shall be done in accordance with the relevant standards and as per the instructions of the Owner's Representative.

C. Magnetic Particle/Dye Penetration/Ultrasonic Examination

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The examination shall be done at random as directed by the Owner's Representative. Whenever such tests are directed, the tests shall be carried out on joints chosen by him. The tests shall be carried out by employing approved testing procedure in accordance with IS:822.

D. Radiographic Examination

Radiographic examination shall be carried out only in special cases for random joints as directed by the Owner's Representative. The Contractor shall be paid extra for such examination except for penalty radiographic tests for which the cost shall be borne by him. The Contractor shall make necessary arrangement at his own expense for providing the radiographic equipment, films and all other necessary materials required for carrying out the examination. The tests shall be carried in the presence of the Owner's Representative by employing approved testing procedure in accordance with IS:822. The Contractor shall fulfil all the statutory safety requirements while handling X-ray and Gamma-ray equipment and provide the Owner's Representative all the necessary facilities at site such as dark room, film viewer etc., to enable him to examine the radiographs.

5.2.6.9. Repair of Faulty Welds

No repair of defective welds shall be carried out without proper permission of the Owner's Representative and his approval for the corrective procedure.

Welds not complying with the acceptance requirements (as specified by BIS Codes and the Owner's Representative), as revealed during inspection and testing of welds or erection or in-situ condition, shall be corrected either by removing and replacing or as follows:

a.	Excessive convexity	-	Reduced to size by removal of excess weld metal.
b.	Shrinkage cracks, cracks in parent plates and craters	-	Defective portions removed down to sound metal and rewelded.
c.	Under cutting	-	Additional weld metal deposited.
d.	Improperly fitted / misaligned parts.	-	Welding cut & edges suitably prepared and parts
e.	members distorted the by heat of welding	-	Member straightened by mechanical means or careful application of limited amount of heat, temperature of such area not to exceed 650 degree Centigrade dull red heat).

In removing defective parts of a weld, gouging, chipping, oxygen cutting or grinding shall not extend into the parent metal to any substantial amount beyond the depth of weld penetration, unless cracks or other defects exist in the parent metal. The weld or parent metal shall not be undercut in chipping, grinding, gouging or oxygen cutting.

Any fabricated structure or its component which, in the opinion of Owner's Representative, is defective and/or beyond any corrective action shall be removed forth with from the site as instructed by the Owner's Representative without any extra claim. The Owner reserves the right to recover any compensation due to any loss arising out of such rejections.

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5.2.7. Bolting

5.2.7.1. All bolts shall be provided such that no part of the threaded portion of the bolts is within the thickness of the parts bolted together. Washers of suitable thickness shall be used under the nuts to avoid any threaded portion of the bolt being within the thickness of parts bolted together.

5.2.7.2. The threaded portion of each bolt shall project through the nut at least one thread.

5.2.7.3. Flat washers shall be circular and of suitable thickness. However, where bolt heads/nuts bear upon the bevelled surfaces, they shall be provided with square tapered washers of suitable thickness to afford a seating square with the axis of the bolt.

5.2.8. Splicing

5.2.8.1. Splicing of built up/compound/latticed sections shall be done in such a fashion that each component of the section is joined in a staggered manner.

5.2.8.2. Where no butt weld is used for splicing, the meeting ends of two pieces of joist/channel/ built up section shall be ground flush for bearing on each other and suitable flange and web splice plates shall be designed and provided for the full strength of the flange/web of the section and welds designed accordingly.

5.2.8.3. Where full strength butt weld is used for splicing (after proper edge preparation of the web and flange plates) of members fabricated out of joist/channel/angles/built up section, additional flange and web plates shall be provided, over and above the full strength butt welds, to have 40% strength of the flange and web.

5.2.8.4. Where a cover plate is used over a joist/channel section the splicing of the cover plate and channel/joist sections shall be staggered by minimum 500mm. Extra splice plate shall be used for the cover plate and joint/channel section as per clause 5.2.8.2 or 5.2.8.3.

5.2.8.5. Prior approval shall be obtained by the Contractor for locations of splices where not shown on design drawings. Only a single splice at approved location shall be allowed for members upto a length of 6 to 7m. Maximum two numbers of splices shall be allowed for members exceeding this length.

5.2.9. Machining and Grinding

5.2.9.1. All slab bases and slab caps shall be accurately machined over the bearing surfaces and shall be in effective contact with the ends of column sections (shafts).

5.2.9.2. For slab bases and slab caps, ends of column shafts shall be accurately machined. However, for gusseted bases and caps, the column shafts shall be ground flush for effective contact with parts connected together.

5.2.9.3. Gusseted bases and caps shall be ground flush for effective contact with ends of column sections.

5.2.9.4. End of all bearing stiffeners shall be machined or ground to fit tightly at top and bottom without any air gap.

5.2.9.5. While machining or grinding care shall be taken so that the length or thickness of any part does not get reduced by more than 2.0mm.

5.2.9.6. For all machining or grinding works for gassetted base and cap plates, the clearance between the parts

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joined shall not exceed 0.2mm at any location.

6. MARKING FOR IDENTIFICATION

6.1. Each component shall be distinctly marked (with paint) before delivery in accordance with the marking diagrams and shall bear such other marks as will facilitate erection.

6.2. For small members which are delivered in bundles or crates, the required marking shall be done on small metal tags securely tied to the bundle.

7. SHOP ERECTION

The steel work shall be temporarily shop erected complete or as directed by the Owner's Representative, so that the accuracy of fit may be checked before dispatch.

8. INSPECTION AND TESTING OF STRUCTURES

8.1. The Owner's Representative shall have free access at all times to those parts of the Contractor's works which are concerned with the fabrication of the steel work and shall be provided with all reasonable facilities for satisfying himself that the fabrication is being undertaken in accordance with the provisions of these specifications and other relevant BIS Codes.

8.2. Should any structure or part of a structure be found not to comply with any of the provisions of this specification (or relevant BIS Codes as referred to), it shall be liable to rejection. No structure or part of the structure, once rejected shall be resubmitted for inspection, exception cases where the Owner's Representative considers the defect as rectifiable.

8.3. Defects which may appear during/after fabrication/ erection shall be made good only with the consent of the Owner's Representative and procedure laid down by him.

8.4. All necessary gauges and templates shall be supplied free to the Owner's representative by the Contractor whenever asked for during inspection. The Owner's Representative, may at his discretion, check the test results obtained at the Contractor's works by independent tests at a test house, and the cost of such tests shall be borne by the Contractor.

9. SHOP PAINTING

9.1. All components and members of steel work shall be given one shop coat of red oxide zinc chromate primer (conforming to IS:2074) or any other primer as specified, in the tender, immediately after the surfaces have been properly prepared (i.e. degreased, derusted, descaled and cleaned) in accordance with IS:1477. The primer coat shall be applied over completely dry surfaces (using brushes of good quality) in a manner so as to ensure a continuous and uniform film without "holidaying". Special care shall be taken to cover all the crevices, corners, edges etc. However, in areas which are difficult to reach by brushing, daubers/mops shall be used by dipping the same in paint and then pulling/pushing them through the narrow spaces. The primer coat shall be air dried and shall have minimum film thickness of 25 microns.

9.2. Surfaces which are inaccessible after shop assembly, shall receive the full specified protective treatment before assembly (this shall not apply to the interior of sealed hollow sections).

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9.3. Steel surfaces shall not be painted within a suitable distance of any edges to be welded if the paint specified would be harmful to welders or impair the quality of the welds.

9.4. Welds and adjacent parent metal shall not be painted prior to deslagging, inspection and approval by the Owner's Representative.

9.5. Parts to be encased in concrete shall have only one coat of primer and shall not be painted after erection.

10. PACKING

10.1. All items shall be suitably packed in case these are to be despatched from the fabrication shop to the actual site of erection so as to protect them from any damage/distortion or falling during transit. Where necessary, slender projecting parts shall be temporarily braced to avoid warping during transportation.

10.2. Small parts such as gussets, cleats etc., shall be securely wired onto their respective main members.

10.3. Bolts, nuts washers etc. shall be packed in crates.

11. TRANSPORTATION

Loading and transportation shall be done in compliance with transportation rules. In case, certain parts can not be transported in the lengths stipulated on the drawings, the position details of such additional splice joints shall be got approved by the Owner's Representative.

12. SITE {FIELD} ERECTION

12.1. Plant & Equipment

The suitability and capacity of all plant and equipment used shall be to the complete satisfaction of the Owner's Representative.

12.2. Storing & Handling

All steel work shall be so stored and handled at site so that the members are not subjected to excessive stresses and any damage.

12.3. Setting Out

Prior to setting out of the steel work, the Contractor shall get himself satisfied about the correctness of levels, alignment, location of existing concrete pedestals/columns/brackets and holding down bolts/pockets provided therein. Any minor modification in the same including chipping, cutting and making good, adjusting the anchor bolts etc., if necessary, shall be carried out by the Contractor at his own expense. The positioning and levelling of all steel work including plumbing of columns and placing of every part of the structure with accuracy shall be in accordance with the drawings and to the complete satisfaction of the Owner's Representative.

12.4. Tolerances

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Tolerances for erection of steel structures shall be as per Appendix – 'A'.

13. SAFETY AND SECURITY DURING ERECTION

13.1. The Contractor shall comply with IS:7205 for necessary safety and adhere to safe erection practices and guard against hazardous as well as unsafe working conditions during al stages of erection.

13.2. During erection, the steel work shall be securely bolted or otherwise fastened and when necessary, temporarily braced/guyed to provide for all loads to be carried by the structure during erection till the completion, including those due to the wind, erection equipment and its operation etc. at no extra cost to the Owner. For the purpose of guying, the Contractor shall not use other structure in the vicinity without prior written permission of the Owner's Representative.

13.3. No permanent bolting or welding shall be done until proper alignment has been achieved.

13.4. Proper access, platform and safety arrangement shall be provided for working and inspection, (at no extra cost to the Owner) whenever required.

14. FIELD CONNECTIONS

14.1. Field Bolting

Field bolting shall be carried out with the same care as required for shop bolting.

14.2. Field Welding

All field assembly and welding shall be executed in accordance with the requirements for shop assembly and welding. Holes for all erection bolts where removed after final erection shall be plugged by welding. Alternatively erection bolts may be left and secured.

15. GROUTING

15.1. Prior to positioning of structural columns/girders/trusses over the concrete pedestals/ columns/brackets, all laitance and loose material shall be removed by wire brushing and chipping. The bearing concrete surfaces shall be sufficiently levelled, hacked with flat chisels to make them rough, cleaned (using compressed air) and made thoroughly wet. All pockets for anchor bolts shall also be similarly cleaned any any excess water removed. Thereafter, the structural member shall be erected, aligned and plumbed maintaining the base plates/shoe plates at the levels shown in the drawings, with necessary shims/pack plates/wedges.

15.2. After final alignment and plumbing of the structure, the forms shall be constructed all round and joints made tight to prevent leakage. Grouting (under the base plates/shoe plates including grouting of sleeves and pockets) shall be done with non-shrink grout having compressive strength (28 days) not less than 40N/sq.mm non shrink grout shall be of free flow premix type and of approved quality and make. It shall be mixed with water in proportion as specified by the manufacturer. Ordinary 1:2 cement/sand mortar grout shall be used only for small, isolated structures e.g. operating platforms not supporting any equipment, pipe supports, crossovers, stairs and ladders. The thickness of grout shall be as shown on the drawings but not less than 25 mm nor more than 40 mm in any case.

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15.3. The grout mixture shall be poured continuously (without any interruption till completion) by grouting pumps from one side of the base plate and spread uniformly with flexible steel strips and rammed with rods, till the space is filled solidly and the grout mixture carried to the other side of the base plate.

15.4. The grout mixture shall be allowed to harden for a period as decided by the Owner's representative. At the end of this period, the shims/wedges/pack plates may be removed and anchor bolts tightened uniformly. The alignment of the structure shall now be rechecked and if found correct, the voids left by the removal of shims/wedges/pack plates (if removed) must be filled upto with a similar mixture of grout. In case after checking, serious misalignment is indicated, the grout shall be removed completely and fresh grouting done after making appropriate correction of alignment.

16. SCHEME AND SEQUENCE OF ERECTION

The Contractor shall furnish the detailed scheme and sequence of erection to match with the project schedule and get the same approved by the Owner's Representative. All necessary co-ordination and synchornization shall be done with the Civil contractor where Civil works are not included in the scope of structural contractor at no extra cost so as to match with the project schedule.

17. PAYMENT

This clause shall apply to Item Rate tender only.

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17.1. Payment for structural steel works shall be made on the basis of admissible weight in metric tons (determined as described in clauses 17.2 and 17.3 below) of the structure accepted by the Owner's Representative. The rate shall include supplying (as per supplying conditions given in the tender) fabricating, erecting in positions (at all levels & locations), testing/examining (excluding radiography only) of bolted and/or welded structural steel works of all types (including all built up/compound sections made out of rolled sections and/or plates) including all handling, transporting, storing, straightening if required, cutting, edge preparation, preheati ng, bolting and welding of joints (including sealing the joints of box sections with continuous welding), finishing edges by grinding/machining as shown, fixing in line & level with temporary staging and bracing and removal of the same after erection, grouting with nonshrink/ordinary grout as specified, preparation of fabrication and erection drawings, and erection schedule and getting them reviewed, preparation and submission of as built drawings, preparing the surfaces for painting, surface cleaning, wire brushing, removal of mill scale, dust, rust, oil or grease and applying the coat of red oxide zinc chromate primer or any other primer as specified after fabrication, return of surplus materials to Owner's Stores and material reconciliation in the case of materials supplied by the Owner as per relevant contract conditions etc. all complete for all the operations mentioned in the foregoing clauses.

17.2. The weight for payment shall be determined from the fabrication drawings and respective bill of materials prepared by the Contractor. The bill of materials shall be checked and approved by the Owner's Representative before making the payment. The Contractor shall prepare full scale template in order to supplement/verify the actual cutting dimensions where so directed by the Owner's Representative. The weight shall be calculated on the basis of BIS Hand Book wherever applicable. In case sections used are different from BIS sections, the manufacturer's Hand Book shall be adopted. No allowance in weight shall be made for rolling tolerances.

17.3. Welds, bolts, nuts, washers, shims, pack plates, wedges, grout and shop painting shall not be separately measured. The quoted rate shall be deemed to include the same.

17.4. The rate shall include all expenses related to safety and security arrangements during erection and all plants and tools required for fabrication, transportation and erection.

18. PAINTING AFTER ERECTION

18.1. General

18.1.1. The scope of painting after erection shall be at the sole discretion of the Owner's Representative and the Contractor shall obtain written instruction in this regard sufficiently prior to taking up any procurement of paint and execution of painting work after erection of steel structures.

18.1.2. The Contractor shall carry out the painting work in all respects with the best quality of approved materials (conforming to relevant BIS Codes) and workmanship in accordance with the best engineering practice. The Contractor shall furnish characteristics of paints (to be used) indicating the suitability for the required service conditions. The paint manufacturer's instructions supplemented by Owner's Representative's direction, if any, shall be followed at all times. Particular attention shall be paid to the following:

- Proper storage to avoid exposure and extremes of temperature.
- Surface preparation prior to painting.
- Mixing and thinning.
- Applicable of paint and the recommended limit on time intervals between consecutive coats.

18.1.3. Painting shall not be done in frost of foggy weather, or when humidity is such as to cause condensation on

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the surfaces to be painted.

18.1.4. Surface which shall be inaccessible after site assembly shall receive the full specified protective treatment before assembly.

18.1.5. Primers and finish coat paints shall be from the same manufacturer in order to ensure compatibility. Painting colour code shall be as per Appendix – 'B'.

18.2. Rub Down and Primer Application

The shop coated surfaces shall be rubbed down thoroughly with emery/abrasive paper to remove dust, rust, other foreign matters and degreased, if required, in accordance with IS:1477, as applicable, cleaned with warm fresh water and air dried. The portions, from where the shop coat has peeled off, shall be touched up and allowed to dry.

Primer coat of red oxide zinc chromate primer (conforming to IS:2074) or any other primer, as specified, shall be applied by brushing/spraying over the shop coat in a manner so as to ensure a continuous and uniform film throughout. Special care shall be taken to cover all the crevices, corners, edges etc. The final primer coat shall be air dried and shall have a minimum film thickness of 25 microns or as per specifications (tolerance ± 10%) after drying, as applicable.

In case a different cleaning procedure and primer specifications are specified in the drawing/Tender, the same shall be adopted.

18.3. Final Pain Application

After the primer is hard dry, the surfaces shall be dusted off and one coat of synthetic enamel paint of approved colour and shade (conforming to IS:2932) or any other paint as per specification shall be applied by brushing/spraying so that a film free from "holidaying" is obtained. The colour and shade of first coat of paint shall be slightly lighter than the second coat in order to identify the application of each coat. The second coat of paint shall be applied after the first coat is hard dry. The minimum thickness of each film shall be 20 microns (± 10% tolerance) after drying.

In case a different type of paint and painting procedure are specified in the drawing/tender, the same shall be adopted.

18.4. Inspection and Testing of Painting Works

18.4.1. All painting materials including primers and thinners brought to site by the Contractor for application shall be procured directly from reputed and approved manufacturers and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates shall not be accepted.

18.4.2. The Owner's Representative at his discretion may call for additional tests for paint formulations. The Contractor shall arrange to have such tests performance including batch wise test of wet paints for physical and chemical analysis. All costs shall be borne by the Contractor.

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18.4.3. The painting work shall be subject to inspection by the Owner's Representative at all times. In particular, the stage inspection will be performed and Contractor shall offer the work for inspection and approval at every stage before proceeding with the next stage. The record of inspection shall be maintained. Stages of inspection are as follows:

a) Surface preparations

b) Primer applications

c) Each coat of paint

18.4.4. Any defect noticed during the various stages of inspection shall be rectified by the Contractor to the entire satisfaction of the Owner's Representative before proceeding further. Irrespective of the inspection, repair and approval at intermediate stages of work the Contractor shall be responsible for making good any defects found during final inspection/guarantee period/defect liability period, as defined in General Conditions of contract. Dry film thickness (DFT) shall be checked and recorded after application of each coat. The thickness shall be measured at as many locations as decided by the Owner's Representative. The Contractor shall provide standard thickness measuring instrument such as elkometer (with appropriate range for measuring dry film thickness of each coat) free of cost to the Owner's Representative whenever asked for.

18.5. Payment

Payment for painting of structural steel works shall be made on the basis of admissible weight in metric tons of the painted structures accepted by the Owner's Representative.

The rate shall include supplying and applying two coats of synthetic enamel paint or any other pain specified in the tender of approved quality and shade over a coat of red oxide zinc chromate pri mer or any other primer specified in the tender over one coat of shop primer already applied to structural steel works of all types/shapes at all levels, locations and positions including storage, surface preparation, degreasing, cleaning, drying, touching up of shop primer coat, providing temporary staging, testing etc. all complete to the entire satisfaction of the Owner's Representative.

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APPENDIX – 'A'
(Clause 12.4)

MAXIMUM PERMISSIBLE ERECTION TOLERANCES

A.	Columns	
1.	Deviation of column aces at foundation top level with respect to true axes.	
	i) In longitudinal direction	± 5 mm
	ii) In lateral direction	± 5 mm
2.	Deviation in the level of bearing surface of columns at foundation top with respect to true level	± 5 mm
3.	Out of plumb (Verticality) of column axis from true vertical axis, as measured at top:	
	i) Upto and including 30 m height	± H/1000 or ± 25 mm whichever is less.
	ii) Over 30 m height	± H/1200 or ± 35 mm whichever is less.
4.	Deviation in straightness in longitudinal & transverse planes of column at any point along the height.	± H/1000 or ± 10 mm whichever is less.
5.	Difference in the erected positions of adjacent pairs of columns along length or across width of building prior to connecting trusses/beams with respect to true distance.	± 5 mm
6.	Deviation in any bearing or seating level with respect to true level.	± 5 mm
7.	Deviation in difference in bearing levels of a member on adjacent pair of columns both across and along the building	± 5 mm
B.	Trusses	
1.	Shift at the centre of span of top chord member with respect to the vertical plane passing through the centre of bottom chord.	± 1/250 of height of truss in mm at centre of span or ± 15 mm whichever is less.
2.	Lateral shift of top chord of truss at the centre of span from the vertical plane passing through the centre of supports of the truss.	± 1/1500 of span of truss in mm or ± 10 mm whichever is less.
3.	Lateral shift in location of truss from its true position	± 10 mm
4.	Lateral shift in location of purlin from true position	± 5 mm
5.	Deviation in difference of bearing levels of truss from the true	level.

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C. Gantry Girders & Rails

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± 1/1200 of span of truss in mm or 20 mm whichever is less.

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1.		Shift in the centre line of crane rail with respect to centre line of web of gantry girder.	$\pm[\frac{\{\text{web thickness (mm)}\}}{2}+2 \text{ mm}]$
2.		Shift of alignment of crane rail (in plan) with respect to true axis of crane rail at any point.	± 5 mm
3.		Deviation in crane track gauge with respect to true gauge	
	i)	For track gauge upto and including 15 m.	± 5 mm
	ii)	For track gauge more than 15 m.	± [5 + 0.25 (S-15)] Subject to maximum ± 10 mm, where S in metres is true gauge.
4.		Deviation in the crane rail level at any point from true level.	± 10 mm
5.		Difference in level between crane track rails (across the bay) at	
	i)	Supports of gantry girders	15 mm.
	ii)	Mid span of gantry girders	20 mm.
6.	iii)	Relative shift of crane rail surfaces (at a joining) in plan and elevation	2 mm.

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APPENDIX – 'B'
(Clause 18.2)

PAINTING COLOUR CODE

WHICH MAY BE ADOPTED FOR STRUCTURAL STEEL MEMBERS

1.	Gantry Girder & Monorail	DARK GREEN
2.	Gantry Girder & Monorail Stopper	SIGNAL RED
3.	Building Structural Steel Columns, Brackets, Beams, Bracings, Roof Truss, Purlins, Sidegirts, Louvers, Stringers	DARK ADMIRALITY GREY
4.	Pipe Rack Structure & Trestle	DARK ADMIRALITY GREY
5.	Chequered Plate (Both Faces)	BLACK
6.	Grating	BLACK
7.	Ladder	RUNGS – BLACK VERTICALS & CAGE RED
8.	Hand Railing	
	- Handrail, Middle Rail, Toe Plate	SIGNAL RED
	- Vertical Post	BLACK

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TOPOGRAPHIC SURVEY

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	GENERAL TECHNICAL SPECIFICATION	Z/02 0033

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1.0 SCOPE

This specification covers the requirements for carrying out topographic survey which manly includes plotting of RL's , contours and ground profiles of the area on drawings, etc .

2.0 REQUIREMENTS

2.1 All survey works shall be performed under the supervision of experienced persons deputed by the CONTRACTOR.

2.2 All measurements shall be in metric units.

2.3 The reading and noting shall be neat, legible and scorings and over-writing shall be duly initialled by the Contractor.

2.4 All surveys shall be carried out using approved methodology and equipment e.g. GPS, Auto levels,High Precision Theodolite, etc.

3.0 PRELIMINARY LOCATION SURVEY

The Contractor is expected to make himself aware of the general conditions of the terrain before starting the survey.

3.1 **Alignment and location surveys**:

3.1.1 A preliminary survey for locating the outer boundary of the plot on the ground shall be carried out.

3.1.2 Contractor should check for terrain gradient by using hand Clinometer/ Total Stations.

3.1.3 Objects like, trees, poles (power, telephone and telegraph), walls, tubewells or such other structures falling within the plot boundary should be marked.

3.2 Staking of plot boundary

3.2.1 The plot boundary shall be staked by placing suitably painted marker stakes at Corners of plot and also at some Intermediate Points (IPs) between two corners.

3.3 Stakes and Markers

3.3.1 All marker stakes shall be pre-cast reinforced concrete blocks having dimensions 150x200x1000 mm deep, and shall be buried to a depth of 500 mm. The exposed surface of the blocks shall have a smooth finish and shall be painted with 'Post Office' red paint. All letters and figures shall be paint marked on the surface of the blocks in white.

3.3.2 On the top surface of the reinforced concrete blocks, a cross inside a circle shall be engraved at the centre or a nail shall be put centrally inside an engraved circle, to indicate the exact position of the Intersection Point. The circle shall be of approximately 50mm diameter.

3.3.3 Where it is apprehended that the marker may get lost, damaged, flooded or vandalised , some adjoining markers and landmark locations may also be included.

4.0 BENCH MARKS

4.1 Permanent Bench Marks (BM) approx. at every corner of the plot shall be established and described.

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4.2 Location of Bench Marks shall be established in the field by using reinforced concrete blocks. Exact position of BM shall be marked by a cross inside a circle or a nail put centrally inside an engraved circle on the top surface of the concrete block. The reduced level of the BM shall be paint marked on the concrete block. Letters "BM" shall precede the reduced level of bench mark recorded to the second place of decimal.

4.3 Accuracy of the reduced levels of the Bench Marks shall be verified wherever possible by checking levels with the nearest permanent Bench Mark established by Survey of India, which shall be connected through geocoding system.

5.0 ROAD / RAIL CROSSINGS

5.1 The Contractor shall record all crossings, property lines, utilities, roads, railways, canals, streams, etc. that are inside the plot area or in the vicinty of 50m from plot boundary. Underground utilities within the boundary of the plot shall also be located as far as possible and staked.

6.0 CHAINAGE

6.1 Generally the chain age system shall not be adopted for surveying except in special circumstances and locations where use of Total Stations/Thedolite may not be permitted.

6.2 Distance between corner points of the plot should be measured and recorded. In addition, distance between intermediate points shall also be measured and recorded.

6.3 The true bearing of all straights shall be observed and recorded.

6.4 Check on distance measurements will be stadia method and also GPS based measurements at the time of leveling.

6.5 Standard chain survey format will be used for record keeping.

6.6 Distance of centerline of road/rail/canal etc from boundary of plot should be noted.

7.0 MEASUREMENT OF HORIZONTAL ANGLES

7.1 Horizontal angles are to be measured to indicate the change in direction of plot boundary etc.

Theodolite reading direct to 10 seconds or better, shall preferably be used. Angles shall be measured clockwise from back station to fore-station. Mean of two readings-one on face left and other on face right shall be taken as the horizontal angle.

8.0 REDUCED LEVEL

8.1 When the terrain is flat, reduced levels shall be recorded at 2.0 m c/c inside the plot area.

8.2 When the terrain is undulating , observation of reduced level shall be made at a sufficient number of points so as to give an accurate plotting of the ground.

8.3 For road and railway crossings, the reduced levels shall be recorded at the centerline , at the edges and also at all points along the road/railway line wherever there is a change in slope.

8.4 Method of RISE and FALL shall be used to compute reduced levels of various points. Check on computation shall be made by using the following formula:

Back site – Fore site = Rise- Fall = First R.L. – Last R.L.

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8.5 Maximum misclosure shall not exceed 24 $K^{½}$ MM where 'K' is the distance in KMs. Maximum length of the sight shall not exceed 25 M

8.6 All levels shall be with respect to Mean Sea Level (MSL).

8.7 For river/canal crossings, the reduced levels shall be recorded at the centerline , at the edges and also at all points along the canal/river wherever there is sudden change in slope.

9.0 ACCURACIES IN MEASUREMENT

9.1 Contractor shall incorporate corrections to the linear ground measurement due to differential corrections, standard errors, and variations from standard temperature.

9.2 The error for angular closure for the work shall not exceed one minute per station and for linear measurements it shall be read to the nearest 0.005 M in case of surveys for which use of Total Stations/ high precision Theodolite is mandatory.

9.3 The error on closure for measurements on vertical distance to establish benchmarks shall not be more than 24 $(K)^{½}$ millimeters (where 'K' is the linear distance in KM). The error of mis-closure in vertical distance shall be distributed linearly.

10.0 SURVEY NOTES, OBSERVATIONS AND COMPUTATIONS

10.1 The procedures followed both for field and office calculations shall be such that the results obtained shall be readily understood and retraceable.

10.2 All up-to-date notes and observations related to the basis for determination of boundary lines and corners shall be maintained by surveyor.

10.3 Survey records must contain schematic diagrams of all horizontal controls pertinent to the project showing all existing and established control points, bench marks, any triangulation station and boundary lines.

11.0 MAPS AND DRAWINGS

11.1 All maps and drawings shall be made on standard format. Contractor shall peform mapping and drawing work so as to contain all relevant data consistent with the survey notes and observations. Apart from RL's and contour of the plot area the drawings shall also contain details of roads, streets, highways, structures, all types of crossings, terrain, and all other details which will be required for the purpose of enginnering design.Scale of the drawing shall be 1:250 or as directed OWNER/OWNER'S REPRESENTATIVE.

1  .0 PRESENTATION OF FIELD SURVEY DATA AND DRAWINGS

Survey drawings shall contain the following data as a minimum requirement.

12.1 All features including, but not limited to roads and railroads, canals, that are located within a distance of 50m from the boundary of plot.

12.2 For the entire plot area, contours shall be plotted on the at 0.5 M interval and the RL's shall be taken at all points at interval of 2m c/c. Additional information like cultivated areas, barren land, areas prone to flooding, rocky areas and forests including access path/roads shall also be shown on the maps.

12.3 RL's of centerline and edges of road/railway crossings as well as RL's of bed of canals/river/streams shall be plotted . Distance from boundary of plot to center of road/rail/river/canal etc should also be marked

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12.4 Drawing should also show location and details of other pipelines, cables (overhead and buried) utilities etc within the plot area and also in its vicinity.

12.5 In case of all rail, road, river, stream, canal, existing pipelines and utility crossings, the angle of crossing shall also be mentioned.

12.6 List of BM's and their northing/easting should be mentioned.

13.0 DOCUMENTS/DATA SUBMISSION

All drawings shall be prepared on AutoCAD/GIS based package. The documents shall be prepared on MS Office. In addition, hard copies of documents shall also be submitted.

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	GTS – UNDERGROUND C.I. PIPING SYSTEM	**Z/02 0019**

UNDERGROUND C.I. PIPING SYSTEM

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1. SCOPE

This specification covers all works involved in providing underground C.I. piping system as per drawings and specifications. All other items of work such as cutting, laying, jointing and testing etc. are included in the quoted rates. The work shall also include erection of all valves, in line instruments etc. which forms a part of the system.

2. MATERIAL

2.1. Cast Iron Socket and Spigot Pipes

All centrifugal cast (spun) iron pipes shall conform to IS:1536 class-A. The pipes shall have standard weight as specified in Indian Standard. No payment shall be made for extra weight of the pipes if any. The socket of pipe shall be of modified design such that socket and spigot shall be jointed with tyton or other similar coupling.

2.2. Cast Iron Double Flanged Pipes

All cast iron flanged pipes shall conform to IS:1537 class-A. The pipes shall have standard weight as specified in Indian Standard. No payment shall be made for extra weight of the pipes if any.

All C.I. fittings shall conform to IS;1538, Medium duty.

Rubber gasket for flanged joints shall be 3 mm thick conforming to IS;638 type-B, grade-2.

M.S. hexagonal bolts and nuts shall conform to IS:1367.

All flanges shall conform to IS:1537.

2.3. Cast Iron Sluice Valves

Cast Iron Sluice Valves are double flanged, non rising spindle type, conforming to IS:780 upto 300 mm dia and IS:2906 for more than 300 dia.

Rubber gasket for flanged joints shall be 3 mm thick conforming to IS:638.

3. EARTHWORK IN EXCAVATION, BACKFILLING AND TRANSPORTATION

3.1. All earth work involved in laying of cast iron pipes is deemed to have been included in the quoted rates for the laying of C.I. pipes.

3.2. All earthwork shall be carried out as per specification no. Z/02/0006.

4. LOWERING, LAYING AND JOINTING

4.1. General

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The trench shall be checked for proper level, gradient and alignment before lowering the pipes. The contractor shall get the trench approved before lowering the pipes.

In case of flanged pipes, it shall be checked that holes of two joining flanges are concentric.

Before laying each pipe shall be inspected carefully, broken or cracked pipes shall be rejected. The inside of the pipes shall be cleaned of all foreign materials.

4.2. Lowering

The pipe shall be lowered cautiously to prevent disturbance of the bed and sides of the trench. The heavy pipes shall be lowered by means of proper shear legs, chain pulley blocks or as directed by Owner's Representative.

4.3. Laying

Laying of pipes shall proceed upgrade of slope. In case of socket and spigot pipes, the pipes shall be laid with socket ends facing upstream. The spigot shall be pushed well home to the full depth of the socket. The collars, shall be slipped on before the next pipe is laid. Pipes shall be carefully laid over the alignment, levels and gradient as shown in the drawings. The levels shall be checked by the help of sight rails and bonning rods and with the help of levelling instrument as directed by Owner's Representative.

No sand, earth or other matter shall enter the pipes during laying. The error of grade shall not be rectified by packing up earth underneath the pipe. If required concrete M-10 shall be used for packing at Contractor's own cost.

The ends of the pipe shall be kept closed to keep dirt, mud and foreign materials out. Adequate provision shall be made to prevent floating of pipe in the event of flooding of trenches.

Contractor shall provide thrust blocks of concrete M-15 at all changes in direction or as shown on drawings.

4.4. Jointing

4.4.1. C.I. Socket and Spigot Pipes (Socket and Spigot Joints)

The socket and spigot shall be jointed with tyton or other similar make instantaneous jointing couplings. These couplings shall be used only on the manufacturer recommended brand of pipes.

4.4.2. Double Flanged C.I. Pipes (Flanged Joints)

Flanged joints shall be made by painting the facing of the flanges with red lead and bolting up evenly in all sides with packing of rubber insertion in between the two flanges. The packing shall be of full diameter with proper holes to suit the flanges bolt holes.

4.4.3. Jointing Using Lead

Best blue pig lead conforming to IS;782 latest edition shall be used for joints.

The spigot shall be carefully centered in the socket and sufficient spun yarn shall be thoroughly caulked to leave a specified depth for lead caulking. The minimum depth of joint for lead caulking shall be as per IS:3114.

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The depth left for joint shall be checked before running the lead by passing a notched wooden gauge around the pipe, the notch being held close up against the face of the socket. After checking the alignment and levels of pipe, the space left for caulking in the socket shall be filled in by pouring molten lead as per directions of Owner's Representative. The lead shall be rendered thoroughly fluid and each joint shall be caulked in three stages with proper caulking tools of increasing thickness and a hammer of 2 kgs. in weight in such a manner as to make the joint sound and water tight.

The junctions of the pipe line in the manhole/valve pit/catch basin walls shall be grouted with 1:2 cement mortar to the entire satisfaction of Owner's Representative.

5. TESTING OF CAST IRON PIPELINES

5.1. General

5.1.1. Contractor shall carry out testing of all cast iron lines laid by him as a part of the quoted rates.

5.1.2. Test manifolds, connection piping and all other necessary appurtenances for testing shall be provided and installed by the Contractor at his own cost at the time of test. Pumps, if required, for filling the line with water for the test shall also be provided and installed by the Contractor at his own cost.

5.2. Testing

5.2.1. Pressure Pipelines

C.I. double flanged and socket and spigot pressure pipe lines shall be tested in suitable sections before backfilling. After al lines are tested in sections, a final test shall be performed before commissioning the system. Test pressure shall be as indicated in drawings or specifications.

5.2.2. Gravity Pipelines

Gravity Cast Iron Pipes shall be tested in sections to a pressure of 1 kg/cm^{2}g.

5.2.2.1. Procedure

End of the pipes shall be suitably blanked and the line pressurised to 1 kg/cm^{2}g. After 1 hour repressurising upto 1 kg/cm^{2}g shall be done using a measured quantity of water which shall be less than or equal to ND/3.3 cm^3 where N is the number of joints in the pipeline and D is the diameter of the pipeline in mm.

5.2.3. Failure of Test

In case of failure of test, Contractor shall identify the reason for leakage and take action for redoing of joints at his cost.

The Contractor shall remove the water from the pipe line and clean it after testing at his own cost without flooding the adjoining areas.

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6. RESTORATION OF DAMAGED SURFACE AND CLEANING THE SITE

6.1. All pavements, structures, pipelines, cables, etc. removed, damaged or disturbed during the pipe laying work shall be restored to original condition.

6.2. Surplus excavated soil or rubbish material shall be removed to a place as directed by the Owner's Representative.

7. PAYMENT

7.1. Measurement of pipeline work for the purpose of payment shall be taken in running meters of the laid pipe measured along center line, inclusive of spigot and socket, etc. No. extra payment shall be made for providing, laying, etc. of fitting like bends: tees, flanges, etc. (except Valves) that may be necessary in work. The rate quoted shall be inclusive of excavation, lowering, laying, jointing, testing, cleaning of pipe lines, backfilling and any other operation involved in the pipeline work.

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UNDERGROUND SEWER SYSTEM - STONEWARE PIPES

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1. SCOPE

This specification covers the supply, laying, cutting, jointing and testing of the underground stone ware pipes for sanitary waste, acidic and caustic waste. The caustic and acidic wastes from plant shall be connected through salt glazed stone ware pipes to the manholes and catch basins up to neutralisation pit or the sewer beyond the battery limit of the plant.

The sanitary waste from the toilet blocks of buildings shall be discharged through HCI soil pipes to the first manhole/inspection chamber and subsequently through salt glazed pipes to the sewage pump house.

2. MATERIAL

2.1. Salt glazed stoneware pipe (for septic tanks, etc.)

The pipes shall conform to IS:651 in all respects.

The pipes shall be free from all defects like cracks, imperfect glazing etc. and shall be approved by the Owner's Representative before using them.

2.2. Chemical Resistant Salt-Glazed Stoneware Pipes

The pipes shall conform in all respects to IS:3006.

The pipes and fittings shall withstand an internal hydraulic pressure of 1.5 kg/cm ^{2} g and 0.75 kg/cm^2 g respectively without showing injury or leakage.

3. EARTHWORK IN EXCAVATION, BACKFILLING AND TRANSPORTATION

3.1. All earth work involved in laying of S.W. pipes and related works is deemed to have been included in the quoted rates for the laying of S.W. pipes.

3.2. All earthwork shall be carried out as per specification no. Z/02/0006.

4. LOWERING AND LAYING

4.1. The pipes shall be lowered when the trench is ready and the bottom has been properly gradced as per drawings.

4.2. Before lowering, the pipes shall be inspected carefully. Broken or cracked pipe shall be rejected. The inside of the pipe shall be cleaned off from sand, earth or any other matter.

4.3. The pipes shall be lowered carefully so as not to disturb the bed and sides of the trench. Heavy pipes shall be lowered with chain pully blocks or crane.

4.4. The pipes shall be carefully laid starting at the down stream and with the spigot end facing the direction of flow.

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4.5. Pipes shall be set according to line and grade. Prior to making joints all surfaces shall be thoroughly cleaned and prepared as required for the type of joint to be made. Pipes shall be carefully centered so that the completed sewer will have a smooth uniform invert.

4.6. Railway authorities or other appropriate authorities shall be consulted wherever the piie line crosses a railway line, canal etc.

4.7. Connection to existing sewer shall be done through a manhole generally.

4.8. The ends of the pipe line shall be kept sealed to prevent entry of any foreign materials. The seals will be broken before/after the testing is done.

4.9. Wherever the jointing material is cement, six or more lengths of pipe shall be laid in advance of each joint before it is finished.

5. JOINTING

5.1. Joints in the pipe lines shall be of the type shown on the drawing and conforming to relevant Indian Sandards.

5.2. Stoneware pipes shall be socket and spigot type. The jointing is done by cement, mortar and spun yarn soaked in cement slurry or tarred gasket. The socket and spigot shall be throughly wetted before joints are made.

5.3. In case of bituminous joints asphalt and sand in proportion of 1:7 shall be boiled together and filled into the socket in a molten stage with the aid of special moulds.

5.4. When stoneware pipes have to be connected to CI or concrete pipes, the joint shall be cement joints as described above.

5.5. In case of jointing chemical resistant stoneware pipes the jointing material shall be mortar made out of 70% grog having the same composition as the chemically resistant material and 30% sodium silicate or any other material approved by Owner's Representative. Alternatively acid alkali resisting cement shall be used. The method of jointing shall be same as for cement joints described above.

6. TESTING

6.1. The pipeline shall be tested for water tightness of joints. The test shall be carried out from manhole. Pipe ends shall be closed and filled with water so that water level is upto the top of the manholes.

6.2. The line shall be kept full for 24 hours. Observations shall be taken after one hour interval and if leakage is within 2.5 liters/km/hr/cm of dia of pipelines, it shall be deemed to have passed the test.

6.3. Owner's Representative may at his own discretion ask the subcontractor to test the laid pipeline in sections, in which case the sub-contractor will do the same as per the procedure to be decided by the Owner's

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Representative without any extra cost to Owner. The procedure adopted in such cases, however will be to test the pipeline according to the criteria mentioned in 6.2 above.

6.4. In case joints are found to leak, they shall be repaired or redone and test shall be repeated until the joints are approved by Owner's Representative.

6.5. After completion of the test, all temporary seals will be removed, the test water shall be drained out/pumped out and the line cleaned properly.

6.6. Before commissioning the cleanliness of the pipeline will be checked by :

6.6.1. Torch & Mirror Test

In this method of testing, a torch will be held on one end of the pipeline inside a manhole and its image through the pipeline will be reflected and seen on a mirror held at the opposite end of the pipeline, inside the next manhole. Any obstruction/debris/major mis-alignment will not give a clear image in which case the pipeline will again be cleaned/rectified and the test re-done.

6.6.2. Ring Test

In this method of testing two steel/wooden rings of suitable thickness and design shall be fixed facing each other at a distance of 2 feet or more. The block of rings shall be inserted from one end of the pipeline, inside manhole and pulled by a rope fixed to the block from the other end of the pipeline inside the next manhole. The rings shall be of dia 2" less than the inside dia of pipe under testing. The rope used for pulling the ring block may be inserted in the pipeline by the sub-contractor either during construction or afterwards by suitable means. Any obstruction debris/major mis-alignment will prevent the ring to pass through the pipeline in which case the pipeline will again be cleaned/rectified and the test redone.

The ring test shall be performed for the complete network of the sewer system before the same is put in commission.

7. RESTORATION OF DAMAGED SURFACES AND CLEARING THE SITE

7.1. All pavements, structures, pipelines, cables, etc. removed, damaged or disturbed during the pipe laying work shall be restored to original conditions.

7.2. Surplus excavated soil or rubbish material shall be removed to a place as directed by the Owner's Representative.

8. PAYMENT

8.1. Measurement of pipeline work for the purpose of payment shall be taken in running meters of the laid pipe measured along centre line, inclusive of spigot and socket. No extra payment shall be made for providing laying etc. of fittings like bends, tees etc. (except valves) that may be necessary in work. The rate quoted shall be inclusive of excavation lowering, laying, jointing, testing, cleaning of pipelines, backfilling and any other operation involved in the pipeline work.

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UNDERGROUND AND ABOVE GROUND G.I. PIPELINE SYSTEM

(WATER SERVICES)

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	GTS – UNDER/ABOVE GROUND G.I. PIPELINE SYSTEM (WATER SERVICES)	**Z/02 0020**

1. SCOPE

This specification covers the fabrication and erection of G.I. pipeline system both underground and aboveground including excavation, backfilling for the pipeline and testing of completed system. Rates shall include all incidental work such as transportation of all materials from Owner's stores, custody and fabrication and laying of G.I. piping system.

2. MATERIALS

a) All G.I. piping shall conform to IS:1239, Part-I.

b) All gun metal valves shall conform to IS:778, Class-II.

c) All G.I. fittings shall conform to IS:1239, Part-II.

The schedule of pipes and fittings shall be as per schedule of items under respective works.

3. EARTHWORK IN EXCAVATION AND BACKFILLING ETC.

All earthwork for G.I. Lines shall be governed by the provisions of specification no. Z/02/0006.

4. JOINTING AND ERECTION OF G.I. PIPING SYSTEM

4.1. Screw Scoket Joints

The screwed end of all GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead or Teflon before joining. The joint shall be made by winding a few threads of hamp round the ends of tubes and then screwing them into sockets to the full depth of threads. Exposed threads shall be coated with approved anticorrosive paint. No pipe shall be bent/offset to save fittings. The offset in GI pipes shall be made only after the permission of Owner's Representative. If threaded end of pipe is damaged, the Contractor shall cut the end with hacksaw and shall prepare new threads conforming to IS:554 to required length.

All fittings shall be malleable galvanised iron approved by the Owner's Representative. Fitting in GI line shall include all couplings, elbows, tees, bends, unions, nipples, reducers, flanges with nuts and rubber insertion and all other fittings to make a complete job.

4.2. Flanged Joints

Flanged joints shall be made by painting the faces of the flanges with red lead and bolting up evenly on all sides with compressed asbestos gasket as per piping material specification.

4.3. Valves

Flanged or screwed valves shall be installed in locations shown on the drawings as per specification for screwed or flanged joints.

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5. TESTING

All completed GI lines shall be hydrostatically tested to a test pressure of 5 Kg/cm^{2}g.

6. PAYMENT

Payment shall be made on running metre basis of finished pipeline with fitting after testing etc., complete. No separate payment shall be made for earthwork in trenching and backfill, road cutting etc. Payment for valves and flanges etc. shall be made as per schedule of items on unit rate basis. The unions shall be provided at every 50 metres unless otherwise stated in schedule of items/construction drawing.

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	GTS – WHITE WASHING, DISTEMPERING, PAINTING AND POLISHING	**Z/02 0009**

WHITE WASHING, COLOUR WASHING, DISTEMPERING, PAINTING AND POLISHING

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1. GENERAL

Reference shall be made to the following Indian Standards for any further information etc. not covered in the specification. In case of any conflict/contradiction, the provisions of this specification shall override.

IS:6278 Code of practice for white washing and colour washing.

IS:2395 Code of practice for painting concrete, masonry and plaster surfaces.

IS:712 Specifications for building limes.

IS:55 Specifications for Ultramarine blue for paints.

IS:63 Specifications for whiting for paint and putty.

IS:427 Distemper (dry), colour as required.

IS:428 Distemper (oil bound), colour as required.

IS:5411 Specification for plastic emulsion paint for interior use.

IS:2338 Code of practice for finishing of wood and wood based materials.

IS:5410 Cement paint, colour as required.

IS:2524 Code of practice for painting non ferrous metals in buildings.

IS:384 Brushes, paints and varnishes, flat.

IS:486 Brushes, sash, tool, for paints and varnishes.

IS:110 Ready mixed paint, brushing, grey filler enamels for use over primers.

IS:426 Paste filler for colour coats.

IS:345 Wood filler, transparent liquid.

IS:3585 Ready mixed paint, aluminium brushing priming water resistant for wood work.

IS:426 Paste filler for colour coats.

IS:106 Ready mixed paint, brushing, priming for enamels, for use on metals.

All materials required for the execution of painting work shall be obtained direct from approved manufacturers and shall be brought to the site in makers drums, bags etc. with seals unbroken.

In case of ready mixed paints, thinning if necessary, the brand of thinner shall be as per recommendations of the manufacturer.

Paint shall be applied by brushing or spraying. The brushing operations are to be adjusted to the spreading capacity advised by the manufacturer. During painting, every time after the paint has been worked out of the brush bristles, the bristles shall be opened up by striking the brush suitably.

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Spray machine used may be of high pressure type or low pressure depending on the nature and location of work. After work, the brushes shall be completely cleaned of paint and shall be hung in a thinner if intended to be used afterwards. The spray guns shall be cleaned thoroughly after every break in work. The paint containers, when not used shall be kept close and free from air.

After the finishing of work, the adjacent surfaces not intended to be washed/distempered/ painted/polished, shall be thoroughly cleaned of all paint patches and shall be finished in accordance with surface finishing of such surfaces.

2. WHITE WASHING

White washing in general shall conform to IS;6278.

2.1. Workmanship

2.1.1. Scaffolding

Wherever scaffolding is necessary, it shall be erected in such a way that as far as possible no part of scaffolding shall rest against the surface to be white/colour washed. For white washing of ceiling, proper stage scaffolding shall be erected.

2.1.2. Preparation of Surfaces

The surface shall be thoroughly cleaned of all dirt, dust, mortar dropping and other foreign matter before white wash is to be applied. Surfaces already white/colour washed shall be broomed down to remove all dust, dirt, loose scales of lime wash or other foreign matters.

All damaged portions of the surface plaster shall be removed to full depth of plaster in rectangular patches and plastered again after raking the joints in masonry properly. Such portions shall be wetted and allowed to dry before any operation.

All holes, cracks, patches, etc. not exceeding 0.1 sq. m. in area shall be made good with material similar to that of the surface. Surfaces affected by efflorescence, moss, fungi, algae, lichen etc. shall be treated in accordance with IS:2395.

2.1.3. Preparation of White Wash

The fat lime conforming to IS:712 shall be slaked at site and shall be mixed and stirred with about 5 litres of water for 1 kg. of unslaked lime to make thin cream. This shall be allowed to stand for a period of 24 hours and then shall be screened through a clean coarse cloth. 4 kg of gum dissolved in hot water shall be added to each cubic metre of lime cream. Approved quality ultramarine blue conforming to IS:55 @ 3 gram per kg of lime shall also be added to the solution. Whole solution shall be stirred thoroughly before use.

2.1.4. Application

White wash shall be applied with “MOONJ” brush to the specified number of coats. The operation for each coat shall consist of stroke of the brush from the top to down wards, another from the down to upwards over the first stroke, similarly one stroke horizontally from right and another stroke from the left. Each coat shall be allowed to dry before the next coat is applied. The white washing on ceiling should be done prior to that on walls.

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2.1.5. Protective Measures

Surfaces of doors, windows, floors etc. which are not to be white washed shall be protected from being splashed upon. Such surfaces shall be cleaned of white wash splashed if any.

3. COLOUR WASHING

3.1. Workmanship

3.1.1. Scaffolding

Scaffolding is necessary, it shall be erected in such a way that as far as possible no part of scaffolding shall rest against the surface to be white/colour washed. For white washing of ceiling, proper stage scaffolding shall be erected.

3.1.2. Preparation of Surface

Surface shall be thoroughly cleaned of all dirt, dust, mortar dropping and other foreign matter before white wash is to be applied. Surfaces already white/colour washed shall be broomed down to remove all dust, dirt, loose scales of lime wash or other foreign matters.

All damaged portions of the surface plaster shall be removed to full depth of plaster in rectangular patches and plastered again after raking the joints in masonry properly. Such portions shall be wetted and allowed to dry before any operation.

All holes, crackes, patches etc. not exceeding 0.1 sq. m. in area shall be made good with material similar to that of the surface. Surfaces affected by efflorescence, moss, fungi, algae, lichen etc. shall be treated in accordance with IS:2395.

3.1.3. Preparation of Colour Wash

Sufficient quantity of colour wash enough for the complete job shall be prepared in one operation to avoid any difference in colour. The basic white wash solution shall be prepared in accordance with clause 2.1.3. Mineral colours of approved shade and quality not affected by lime shall be added to the white wash solution in proportions as directed by Owner's Representative. Solid lumps etc. in the colour powder shall be ground to fine powder, sieved and mixed evenly and thoroughly to the white wash solution.

3.1.4. Application of Colour Wash

Colour wash shall be applied with "MOONJ" brush to the specified number of coats. The operation for each coat shall consist of stroke of the brush from the top to down wards, another from the down to upwards over the first stroke, similarly one stroke horizontally from right and another stroke from the left. Each coat shall be allowed to dry before the next coat is applied. The white washing on ceiling should be done prior to that on walls.

3.1.5. Protective Measure

Surfaces of doors, windows, floors etc. which are not to be white washed shall be protected from being splashed upon. Such surfaces shall be cleaned of white wash splashed if any.

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4. DRY DISTEMPERING

4.1. Workmanship

4.1.1. Scaffolding

If necessary, it shall be erected in such a way that as far as possible no part of scaffolding shall rest against the surface to be white/colour washed. For white washing of ceiling, proper stage scaffolding shall be erected.

4.1.2. Preparation of Surface

The surface shall be thoroughly brushed free from dust, dirt, grease, mortar droppings, other foreign matter and shall be made smooth by sand papering.

In case of distempering over existing distempered surface, the existing distempering shall be scrapped by steel scrappers leaving a clean surface.

All nails shall be removed. Pitting in plaster shall be made good with plaster of paris mixed with dry distemper of colour to be used. The surface then shall be rubbed down again with a fine grade sand paper and made smooth. A coat of distemper shall be applied over the patches. The surface shall be allowed to dry thoroughly before the regular coat of distemper is allowed.

The surface affected by moss, fungus, algae, efforescense shall be treated in accordance with IS:2395.

4.1.3. Priming Coat

A priming coat of whiting conforming to IS:63 shall be applied over the prepared surface. The priming coat shall be prepared by mixing 2.5 kg. of whiting and one litre of glue solution (prepared by mixing 250 gm. Glue conforming to IS:852 with boiling water) together and placing it in a covered vessel with enough water to cover the mixture which shall be left to cool until it becomes a jelly.

Priming coat shall be applied with "MOONJ" brush to the specified number of coats. The operation for each coat shall consist of stroke of the brush from the top to down wards, another from the down to upwards over the first stroke, similarly one stroke horizontally from right and another stroke from the left. Each coat shall be allowed to dry before the next coat is applied. The white washing on ceiling should be done prior to that on walls.

4.1.4. Preparation of distemper

The dry distemper of approved shade and quality conforming to IS:427 shall be stirred slowly in clean warm water using 0.6 litres of water per kg. of distemper. It shall be allowed to settle for at least 30 minutes before applying. The mixture shall be well stirred before and during use to maintain an even consistency.

4.1.5. Application of Distemper

After the priming coat has dried for at least 48 hours, the surface shall be lightly sand papered and dusted off avoiding rubbing off of the priming coat. Prepared distemper shall then be applied in minimum two coats with proper distemper brushes in horizontal strokes immediately followed by vertical ones which together shall constitute one coat. The subsequent coats shall be applied only after the previous coat has dried. The finished surface shall be even and uniform without patches, marks, distemper drops etc. The application of a coat in each room shall be finished in one operation. After each day's work, brushes shall be thoroughly washed in hot water and hung down to dry.

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4.1.6. Protective Measure

Surfaces of doors, windows, floors etc. which are not to be white washed shall be protected from being splashed upon. Such surfaces shall be cleaned of white wash splashed if any.

5. OIL BOUND DISTEMPERING

5.1. Workmanship

5.1.1. Scaffolding

Same as in clause no. 2.1.1.

5.1.2. Preparation of Surface

Preparation of surface shall in general be in accordance with clause no. 4.1.2 except that any unevenness shall be made good by applying putty made of plaster of paris mixed with water including filling up the undulation and then sand papering the same after it is dry.

5.1.3. Primer Coat

The primer coat shall be alkali resistant primer or distemper primer and shall be of the manufacture as oil bound distemper.

If the wall surface plaster has not dried completely, alkali resistant primer otherwise distemper primer shall be applied. The mixture of alkali resistant primer shall be prepared as per approved manufacturer's instructions.

Application of Primer Coat shall be in accordance with 2.1.4.

5.1.4. Preparation of Oil Bound Distemper

The distemper shall conform to IS:428 and shall be in accordance with water or any other prescribed thinner recommended by the manufacturer.

5.1.5. Application of Distemper

After the primer coat has dried for at least 48 hours, the surface shall be lightly sand papered and dusted off avoiding rubbing off of the primer coat. Minimum two coats of distemper shall be applied with brushes in horizontal strokes followed by immediate vertical strokes which together shall constitute one coat. The subsequent coats shall be applied after at least 24 hours between consecutive coats to permit proper drying of the preceding coat. The finished surface shall be even and uniform without patches, brush marks drops etc. Application of a coat in each room shall be finished in one operation. 14 cm double bristled distemper brushes shall be used. After each days work brushes shall be thoroughly washed in hot water with soap solution and hung down to dry.

5.1.6. Protective Measures

Same as in clause no. 2.1.5.

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6. WATERPROOF CEMENT PAINT

6.1. Workmanship

6.1.1. Scaffolding

Same as in clause 2.1.1.

6.1.2. Preparation of Surface

Preparation of surface shall be in accordance with clause no. 2.1.2. The surface so prepared shall be thoroughly wetted with clean water before the paint is applied.

6.1.3. Preparation of Paint

Waterproof cement paint of approved make i.e. Apex etc. shall be mixed with water and stirred to obtain a thick paste which shall then be diluted to brushable consistency. The proportion of mixture shall be as per manufacturer's recommendation. The paint shall be mixed in such quantity which can be used up within an hour of mixing to avoid setting and thickening of the paint.

6.1.4. Application of Paint

The surface shall be treated with minimum two coats of waterproof cement paint. No less than 24 hours shall be allowed between two coats and subsequent coats be applied only after the preceding coat has become hard to resist marking by subsequent brushing.

The finished surface shall be even and uniform in shade without patches, brush marks, paint drops etc. Cement paints shall be applied with a brush with relatively short stiff hog or fibre bristles.

6.1.5. Curing

Curing shall be started after the paint has hardened. Curing shall be done by sprinkling with water two or three times a day. This shall be done between coats and for at least two days following the final coat.

6.1.6. Protective Measure

Same as in clause 2.1.5.

7. PLASTIC EMULSION PAINTING

7.1. Workmanship

7.1.1. Scaffolding

Same as in clause 2.1.1.

7.1.2. Preparation of Surface

Same as in clause 5.1.2 under specification of oil bound distempering.

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7.1.3. Preparation of Paint

Plastic emulsion paint shall conform to IS:5411 (Part-1) shall be of approved shade. Preparation of paint shall be as per manufacturer's instructions.

7.1.4. Application of Paint

The paint mix. shall be continuously stirred while applying for maintaining uniform consistency. Number of coats shall be as specified. The painting shall be laid evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area with paint, brushing the surface hard at first, then brushing alternately in opposite direction 2 to 3 times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks, no hair marks, no clogging of paint puddles shall be permitted. The full process of crossing and laying off will constitute one coat. The paint shall be applied by means of brush or roller.

Before starting painting with plastic emulsion paint, the prepared surface shall be treated with two coats of primer consisting of cement, primer, whiting and plastic emulsion paint shall start only after the preceding coat has become sufficiently hard to resist brush marking. Subsequent coats of plastic emulsion paint shall also be started after the preceding coat is dried by evaporation of water content.

The surface on finishing shall present a flat, velvety smooth finish, even and uniform shade without patches, marks paint drops etc.

7.1.5. Precautions

a) Brushes shall be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the paint from hardening on the brush. Old brushes, if used shall be completely dried of turpentine/oil paints by washing in warm soap water.

b) No oil base putties shall be used in filling cracks/holes.

c) Washing of painted surface shall not be done within 3-4 weeks of application.

7.1.6. Protective Measures

Same as in clause 2.1.5.

8. ACRYLIC COPOLYMER AGGREGATE FINISH

8.1. Material

It shall be an acrylic based textured wall coating consisting of quartz and silica aggregate, inorganic pigments and other additives to form a crackfree, flexible, tough, waterproof coating.

8.2. Preparation of Surface

The surface to be coated shall be cleaned and all dirt, grease and loose particles shall be removed. Any old textured surface shall be removed with removing agent as per manufacturer's instructions.

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8.3. Application

Bonding agent and water shall be mixed first. Then the flakes/granules shall be added and mixed thoroughly and kneaded till no lumps are found. The dough shall be left for 20-30 minutes before starting application. The bonding agent, flakes/granules and water shall be mixed in different ratios for different finishes as per manufacturer's specifications.

The first application shall be by steel trowel. It shall be smoothened, if the specified finish required, by a plastic trowel.

9. PAINTING OF WOOD WORK

9.1. Preparation of Surface

Preparation of wood surface shall conform to IS:2338 (Part-I) in general. All woodwork shall be dry and free from any foreign matter. Nails shall be punched well below the surface. The surface shall be smoothened off with abrasive paper used across the grain prior to painting, with the grain prior to the staining. Any knots, resinous, or bluish sap wood, cutting out of which is not justified shall be covered with red lead conforming to IS:103.

Plywood and block board shall be treated in the same manner as for wood work.

Particle boards surface shall be filled with a thin brushable filler and finished as for solid wood.

9.2. Priming

Priming shall be in accordance with IS:2338 (Part I and II). Dirt or any other extraneous material on the surface shall be removed and the priming shall be applied by brushing.

Priming shall be done on all exposed and unexposed surfaces. Unless specified otherwise all joinery work intended to be painted shall receive at least 2 coats of primer. Type of primer shall be in accordance with Table-1 and Table-2 of IS:2338 (Part II).

9.3. Stopping and Filling

Stopping and filling shall be done after priming. Stopping shall be made to the consistency of stiff paste and shall be used to fill holes and cracks. Filler shall be used to level up slight irregularities of the surface. Filler shall be applied with a putty knife and subsequently rubbed down to a level surface with abrasive paper.

The filler coat shall be allowed to fully flatten and harden before subsequent coat is applied .

9.4. Application of Undercoat

Undercoat shall be applied after the surface has been primed, stopped and filled, and rubbed down to a smooth surface. Under coat may be brushed or sprayed. After drying the coat shall be carefully rubbed down and wiped clean before the next coat is applied.

The type of undercoat shall be depending upon the finishing and in accordance with Table-1 and Table-2 of IS:2338 (Part II).

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9.5. Finishing

The finishing paint shall be as specified and shall be applied either by the brush or by spraying.

Reference shall be made to the Table-1 and Table-2 of IS:2338 (Part II).

9.6. Application of Clear Finishes

For the application of clear finishes, the following procedures shall generally be adopted in accordance with IS:2338 (Part I).

a) Filling

b) Staining

c) Sealing

d) Finishing

9.6.1. Filling

Fillers shall be applied to prevent the excessive penetration of the finish to the surface for obtaining a smooth finish. Fillers shall be conforming to IS:345.

Fillers shall be heavily applied to the wood surface by hand, using hessian or jute rag across the grain. It shall be rubbed when still wet to get better penetration. After 5-10 minutes it shall be wiped off by hand across the grain followed by a light wipe with the grain. The filled surface shall be dried preferably over night and smoothened with abrasive paper.

9.6.2. Staining

9.6.2.1. Spirit Stains

Spirit stains are solutions of spirit dyes in Industrial methylated spirit.

9.6.2.2. Preparation of Wood for Staining

Surface intended for staining shall be kept scrupulously clean and free from greasy finger marks. It shall be prepared by careful smoothing with fine abrasive paper used in the direction of the grain. Small cracks/nail holes shall be stopped with plastic wood fine plaster of paris. The stopping shall be rubbed down with fine abrasive paper when hard and touched with a thinned knotting before staining. In case of oil staining stopping shall be done after staining using tinted putty or wood filler.

9.6.2.3. Application of Stains

Stains shall be applied by brushing and wiping or by spraying. The stain shall be so thinned that it can be applied fairly, liberally without over staining and over lapping.

9.6.3. Sealing

A suitable sealer shall be applied on the field and sanded surface to prevent absorption by the wood of the succeeding coats of finish and to seal stain and filler and thus preclude their bleeding into the finish coat.

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Sealer may be sprayed on taking care not to flood the surface and it shall be allowed to dry hard. When fully dry the surface shall be sanded taking care not to cut through at corners and edges. Dust shall be blown off and surface wiped with a clean rag.

9.6.4. Finishing

The stained surface shall be varnished, wax-polished or French polished as required after it is dried.

9.6.4.1. Varnishing

Varnishing of wood and wood based material shall be in accordance with IS:2338 (Part-I).

Surfaces to be Varnished shall be prepared to produce a smooth, dry and matt surface and all dust and dirt shall be removed from the surface.

The Varnish shall be applied liberally with a brush and spread evenly over a portion of the surface with short light strokes to avoid frothing. It shall be allowed to flow out while the next section is being laid in. Excess Varnish shall be scraped out of the brush and then the first section be crossed, re-crossed and laid off lightly. The Varnish, once it has begun to set, shall not be retouched. In case of any mistake, the Varnish shall be removed and the work shall be started afresh.

Where two coats of varnish are applied, the first coat shall be hard drying under coating or flatting varnish which shall be allowed to dry hard and then be flatted down before applying the finishing coat. Sufficient time shall be allowed in between two coats.

When flat varnishing is used for finishing, a preparatory coat of hard drying undercoating of flatting varnish shall first be applied and shall be allowed to harden thoroughly. It shall then be lightly rubbed down before the flat varnish is applied. On larger areas, the flat varnish shall be applied rapidly, and the edges of each patch applied shall not be allowed to set, but shall be followed up whilst in free working conditions.

9.6.4.2. French Polish

French polish shall conform to IS:348. Suitable pigments shall be added to get the required colour.

The surface to be French polished shall be rubbed down to smoothness with sand paper and shall be well dusted. Pores in the surface shall be filled up with fillers.

A pad of woollen cloth covered by a fine cloth shall be used to apply the finish. The pad shall be moistened with polish and rubbed hard on the surface in a series of overlapping circles applying the polish sparingly but uniformly over the entire area to give an even surface. A trace of linseed oil may be used on the face of the pad for the purpose. The surface shall be allowed to dry and the remaining coats applied in the same way. To finish off, the pad shall be covered with a fresh piece of clean fine cloth, slightly damped with methylated spirit and rubbed lightly and quickly with circular motions. The finished surface shall have a uniform texture and high gloss.

10. PAINTING OF STEEL AND OTHER METAL SURFACE

10.1. General

Reference shall be made to IS:2524 and IS:1447.

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10.2. Preparation of Surface

The surface, before paining, shall be cleaned of all rust, scale, dirt and other foreign matter with wire brushes, steel wool, scrappers, sand paper etc. The surface shall then be wiped finally with mineral turpentine which shall then be removed of grease etc. The surface then shall be allowed to dry.

In case of GI surface, surface so prepared shall be treated with Mordant solution (5 litre for about 100 sq.m.) by rubbing the solution generously with brush. After about half an hour, the surface if required shall be retouched and washed down thoroughly with clean cold water and allowed to dry.

10.3. Application of Priming and Paints

Approved quality primer and paint in specified numbers of coats shall be applied as per manufacturer's recommendations either by brushing or spraying. Each subsequent coat shall be applied only after the preceding coat has dried.

11. MEASUREMENT AND RATE

For item rate tenders, all work shall be measured in areas. Areas shall be worked out to the nearest 0.01 sq.m. and all dimensions to the nearest 0.01 metre.

Deductions shall be made in accordance with specification.

For item rate tenders, rate shall include the cost of all materials, labour, scaffolding, protective measures etc. and all works involved in specification. The rate shall also include, if not mentioned otherwise, conveyance, delivery, handling unloading, storing etc.

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	GTS - WOODWORK	**Z/02 0012**

WOODWORK

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1. GENERAL

Reference shall be made to the following Indian Standards for any further information etc. not covered in the specification. In case of any conflict/contradiction, provisions of this specification shall override.

IS:2202 Part-I	Specifications for wooden flush door shutters (solid core type) particle board and hard board face panels.
IS:202 Part-II	Specification for wooden flush door shutters (solid core type) plywood face panels.
IS:1003 Part-I	Specification for Timber panelled and glazed shutters – Door shutters.
IS:3087	Specification for Wooden particle boards (medium density) for general purposes.
IS:3097	Specification for veneered particle boards.
IS:848	Specification for synthetic resin adhesives for plywood (phenolic and amino plastic)
IS:205	Specification for non ferrous metal butt hinges.
IS:2338	Code of practice for finishing of wood and wood based materials (Part I and II).
IS:1341	Specification for steel butt hinges.
IS:4021	Specification for timber door, window and ventilator frames.
IS:303	Specification for plywood for general purposes.

2. MATERIAL

2.1. Timber

2.1.1. Teakwood

Teakwood shall be second class Indian Teakwood conforming to IS:4021 of good quality, well seasoned and free from defects such as cracks, dead knots, sapwood etc. No individual hard and sound knot shall be more than 15 sq. cm. in size and the aggregate area of such knots shall not exceed 2% of the area of the piece. The timber shall be fairly close grained having not less than 2 growth rings per cm. width in cross section.

2.1.2. Hard Wood

Hard wood shall be first class wood conforming to IS;4021 of good quality, well seasoned and free from defects such as dead knots, cracks, sapwood etc. No individual hard and sound knot shall exceed 6 sq. cm. in size with no dimension more than 50 mm and the aggregate area of such knots shall not be more than 1% of the area of the piece. There shall not be less than 5 growth rings per cm. Width in cross-sections.

2.1.3. Moisture Content in Timber

The maximum permissible percentage of moisture content for well seasoned timber shall be as per IS:287.

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2.1.4. Workmanship of Wood Work

Workmanship for wood and joinery shall be as per IS:1200 and IS:4021.

2.1.5. Painting/Polishing of Wood Work

Painting/polishing of wood work shall be in accordance with specification.

2.2. Particle Board

Particle board shall conform to IS:3097 and shall be three layer flat pressed teakwood based and of exterior grade (Grade-I), type-1, BWP type, bonded with phenol Formaldehyde Synthetic resin conforming to IS:848.

2.3. MDF (Medium Density Fibre) Board

Medium density fibre board shall conform to IS:12406 Exterior grade (EGSB). It shall be dense, homogenous and manufactured from agro based lignocellusic fibres bonded with BWP type phenol formaldehyde synthetic resin conforming to IS:848. It shall be categorised as class-1 for 'Surface of very low flame Spread' as per IS:1642.

2.4. Block Board

Block board shall conform to IS:2202 and shall be made of solid Core block board. 'T' type Teak wood beading of minimum 12 mm thickness shall be fixed to the exposed edges of the boards.

2.5. Veneers

Veneers shall conform to class-1 of IS:303 and BS:476, Part-7.

2.6. Fittings and Fixtures

2.6.1. Hinges

Hinges shall be of Extruded Aluminium Alloy and butt type conforming to IS:205. Size of hinges shall be minimum 125 mm long. Maximum spacing of hinges shall not exceed 600 mm c/c.

2.6.2. Overhead Hydraulic Door Closer

Overhead hydraulic door closers shall be of heavy duty type and shall conform to IS:3564.

2.6.3. Floor Mounted Door Closer

Floor mounted door closers shall be of heavy duty type and hydraulically operated and shall conform to IS:6315.

2.6.4. Mortice Lock

Mortice locks shall be of chromium plated brass body and shall have 6 levers and pair of handles of pressure die cast zinc alloy (satin finished). Mortice locks shall conform to IS:2209.

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2.6.5. Door Handles

Door handles shall be of pressure die cast zinc alloy and shall be chromium plated.

2.6.6. Aldrop

Aldrop shall be of anodized Aluminium in bronze colour and shall be 300 mm long and 19.05 mm dia.

2.6.7. Tower Bolts

Tower bolts shall conform to IS:204 and shall be of anodized Aluminium in Bronze colour.

2.6.8. Door Stopper

Door stoppers shall consist of heavy duty rubber shoes spring loaded type with zinc alloy pressure die cast chromium plated holders.

2.6.9. Toilet Door Latch

Toilet door latch shall be of Anodized Aluminium and shall be 75 mm long with vacant/ occupied indicator.

2.6.10. Coat and Hat Hook

Coat and Hat hooks for Toilet door shall be of chromium plated brass body.

2.7. Glazing

Glass sheets for glazing shall be (i) 4 mm thick plain glass (wt. 7.2 kg/m^2) conforming IS:2835, or (ii) 5.5 mm thick toughened glass conforming to IS:5437 as specified.

Glass sheets shall be free from flaws, scratches, cracks, bubbles etc.

3. WOODEN DOOR/WINDOW FRAME

Wooden Door/Window frame shall be made of specified wood and shall be in accordance with detailed drawings.

The wooden members of the frame shall be planed smooth and accurate to the full dimensions. Rebates, rounding, moulding etc. shall be done before the members are joined into frames.

Joints in the frame work shall be perfect with square edges and shall be pinned with hard wood/bamboo pins of 10 to 15 mm dia.

Wood work shall be painted/polished or otherwise treated as specified. All exposed portions shall be coated with wood primer and concealed surface by bituminous paints as per specification.

Before any surface treatment is applied, the wood work shall be got approved by the Owner's Representative. The frames shall be fixed to the masonry by 300 mm x 25 mm x 6 mm MS hold fasts embedded in M-15 grade concrete block 350 mm x 100 mm x 100 mm in the hole of masonry. In case of concrete, frames shall be fixed by 96 mm long, 12 mm dia metallic dash fasteners.

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4. DOOR SHUTTERS

Door shutters shall be complete with all operational fittings and fixtures like hinges, overhead hydraulic door closers, Tower bolts, Locking device, handles, door stopper etc.

4.1. Block Board Flush Shutter

Block board flush shutter shall conform to IS:2202. The shutter shall be 35 mm thick and shall be made of solid core block board. 'T' type Teak wood beading of minimum 12 mm thickness fixed to the perimeter of the shutter. The shutter shall be faced on both sides with following finishes as specified and shall be factory made.

a) 3 mm thick commercial type plywood conforming to IS:303, BS:476, Part-7 finished with 2 coats of approved quality synthetic enamel paint over primer coat or

b) Approved quality 1 mm thick teakwood veneering conforming to IS:303, BS:476, Part-7 or

c) 1 mm thick approved quality lamination of approved shade.

The edges of the shutters shall either be painted with synthetic enamel paint or French polished.

4.2. Panel Door Shutter

Panel door shutter shall be 35 mm thick and shall consist of 100 mm x 35 mm teakwood stiles and top rail, 200 mm x 35 mm bottom rail and 150 mm x 35 mm lock rail and 12 mm thick particle board infill panels. The infill panels shall be fixed with adhesive and moulded Teakwood beadings (minimum 12.5 mm x 12.5 mm size).

The shutter shall be painted with 2 coats of approved shade synthetic enamel paint or polyurethane paint as specified over approved coat of primer.

4.3. Glazed Wooden Door Shutter

Glazed wooden door shutter shall be 38 mm thick and shall consist of 100 mm x 38 mm Teakwood stiles and top rail, 200 mm x 38 mm bottom rail and 150 mm x 38 mm thick lock rail. 4 mm thick plain glass or 5.5 mm thick toughened glass panels shall be fixed in the stiles and rails with neoprene adhesive and 12.5 mm x 12.5 mm moulded Teakwood beading. All the wood work shall be painted with 2 coats of approved shade synthetic enamel paint or polyurethane paint as specified over a coat of primer.

4.4. Flymesh Door Shutter

Flymesh door shutter shall be 38 mm thick and shall consist of 100 mm x 38 mm Teakwood stiles and top rail, 200 mm x 38 mm bottom rail and 150 mm x 38 mm thick lock rail and net of galvanised MS wire gauge of IS gauge designation 856 and dia 0.56 mm fixed with 12.5 mm x 12.5 mm moulded Teakwood beading. The shutter including wiremesh shall be painted with 2 coats of approved shade synthetic enamel paint or polyurethane paint as specified over a coat of primer.

5. MEASUREMENT AND RATE

For item rate tenders wood work in door/window frames shall be measured in Cu.M. Door/window shutters shall be measured in Sq.M. Hardwares and fittings like locks, tower bolts, door closer etc. shall be counted in numbers provided. Length and width shall be measured to the nearest 0.01 M. Area and volume shall be worked out to the nearest 0.01 Sq.M and 0.001 Cu.M.

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Rate for item rate tenders shall include all materials, labour, erection, protective measures, transport, conveyance, storage and other incidental expenditures as required for completion of the items.

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HYDERABAD

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- Stranded Aluminum Conductor from 16 mm2 and above
- XLPE insulation- Type A
- Inner and outer Sheath will be extruded
- Inner sheath will be ST2
- Steel strip/wire armoured
- Outer sheath of cable will be FRLS XLPE, ST2 Type
- Voltage grade- 1100 V
- IS 1554/7098 Part 1

b. Control Cable

- Stranded Copper Conductor 2.5 sq. mm
- XLPE insulation type A.
- Inner and outer Sheath will be extruded
- Inner sheath and outer sheath will be ST2
- Steel strip/wire armoured
- Outer sheath of cable will be FRLS XLPE, ST2 type
- Voltage grade - 1100 V
- IS-1554/7098 Part I

c. Lighting Cable/Wire in conduit

- 2.5 mm2 stranded Copper XLPE/PVC insulated wire in concealed PVC conduit will be used in Lighting fixtures/ flameproof fixtures.
- 4 core 6 mm2 stranded Copper will be used from indoor lighting DB to junction box on the lighting poles.
- 3 core 2.5 sq. mm stranded copper cable (YWY} will be used from junction box on the lighting pole to lighting fixture.

Cable Sizing

Cables shall be heat and oil resistant and suitable for service in the maximum environmental conditions described for the Platforms/Terminal and can be expected at the respective locations. All nominal power cable ratings shall be based on maximum ambient temperatures (design temperature) as specified under site conditions. De-rating factors shall be applied as necessary to take account of Installation configuration and variation in ambient temperature. Conductor current ratings for distribution board feeders shall be established on the basis of 125 % of the rated actual load current at the ambient temperature and de-rated for grouping and method of installation. Cables for emergency duty equipment shall have fire performance characteristics to lEC 332-3 Category A. Safety critical circuit cables, such as certain Fire and Gas and communication signals required to maintain integrity during a fire, shall be fire resistant type to the requirements of IEC 331. Control & Instrument multicore cables shall have 20% spare conductors (cores).

Cable Glands, Cable Accessories and Transit Frames

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Each cable shall be provided with a number, which shall be tagged on the cable at regular intervals for easy identification. The numbering scheme to be adopted for the cables, shall match with the existing cable numbering philosophy.

All cables shall be fitted with FLP double compression type cable glands. All cable glands and adopters shall be made of non-ferrous/non-corrosive material and shall be fitted with soft sealing nylon washers. Fiber washers shall not be used. Flameproof double compression cable glands and flameproof plugs shall be certifi ed by CIMFR. Such transit frames shall include at least 20% spare capacity for future use.

17.0 LIGHTING SYSTEM

Plant lighting system shall comprise:

a) Normal Lighting

b) Emergency lighting

c) Normal lighting: - Normal lighting shall be fed by AC supply 240 V, 1 phase system(specifically required by DGMS). Normal lighting system shall provide enough illumination so as to enable plant operators to move safely within the accessible areas of plant to perform routine operation include reading of field instruments, operation of all valves etc. and to carry out all the necessary maintenance and adjustment to equipment.

d) Emergency lighting: - Lighting requirements provided during the failure of power supply for normal lighting are broadly indicated here below:

1. To facilitate carrying out of specified operations, for safe shutdown of the plant.
2. To gain access and permit ready identification of firefighting facilities such as firewater pumps, fire alarm stations etc.

Adequate number of self-contained portable hand lamps and battery-operated emergency lighting units shall be provided for immediate use for buildings where no DC supply is available.

LED Lamps shall generally be used for Indoor/outdoor plant lighting, non-process buildings and control room. All ballasts shall be with copper winding and capacitor for power factor improvement (to 0.95) shall be provided with fixtures as applicable.

All outdoor lighting shall be automatically controlled by means of photo switch or timers with manual control.

The Lighting panels shall be provided with MCB as incomer and miniature Circuits Breakers (MCBs + ELCB) for outgoing feeders control and protection of lighting circuits. MCBs shall not be loaded beyond 80% of rated capacity. A minimum of 25% of miniature circuit breakers of each board shall be left as spares.

17.1. Lux level in the plant area for calculation of lighting fixtures are as follows:

Control room	-	300 lux
Electrical room	-	150 lux
Office room	-	300 lux
Battery room	-	100 lux
Guard room	-	100 lux
Outdoor Area	-	20 Lux
Street/ Road	-	10 Lux
Utilisation Factor	-	As per manufacturer's catalogues.

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Maintenance Factor - 0.6 for Outdoor / 0.7 for Indoor

Note: Illumination level of other areas not mentioned here shall be as per IS: 6665. Lighting design shall confirm to relevant International Codes and Standards, IES Hand Book and shall take into consideration the requirements from point of view of safety and ease in operation and maintenance. Bidder shall submit illumination calculation to Owner/Owner's Engineer for approval during detail engineering.

Wiring for lighting and convenience outlets in outdoor areas shall be carried out with PVC/XLPE armored cables run along the column / platforms and structures. The armored cable shall enter lighting fixture / JB through double compression gland for safe area, Ex(e) or Ex(d) equipment and through flameproof glands for Ex(d) equipment. Where required suitable mechanical protection shall be provided for lighting fixtures (e.g. wire guard).

Two pole MCB shall be used for controlling fixtures in hazardous areas to isolate phase as well as neutral.

17.2. Outdoor street lighting system: Supply, installation, testing and commissioning of lighting pole of 9m/4.5m height, 100 mm nominal Diameter B class MS pipe, having base Plate 200mmx200mmx5mm along with Flameproof and Weatherproof 80/110W LED well glass light fitting complete with lamp and built in control gear and choke of approved make (Cat.No.WG/A/1234 of Sudhir Switchgears or equivalent approved make), including supply and installation of earthing conductor of 8 SWG GI wire, nuts, bolts, Neck portion of lighting pole shall made up be of 50mm diameter GI pipe(radius of neck shall be 250mm). The pole shall be painted with 01 coat of primer and 02 coats of aluminium paint. The job shall also include supply and installation of 4 way Flameproof/weather proof junction box(with 4 cable entries) having 8 Nos., 6A, 440V shrouded terminal, with double compression FLP glands/lugs with looping arrangement and supply and termination of 3C X 2.5 sq. mm. armoured copper PVC/XLPE insulated cable from JB to light fitting The job complete in all respects as per specifications, drawings and instructions of EIC / Site engineer.

17.3. WP Endura LED: Supply and fixing of surface mounted weather proof Endura LED WT 550 light fitting of PHILLIPS or equivalent approved make complete with all accessories such as LED module, driver, optics, thermal sink, connector blocks etc, including installation.

17.4. Type of Indoor Lighting Fixtures

Battery Room	LED Ceiling Point: Industrial Flame proof Supply and fixing of surface mounted LED ceiling light fitting type Mainstream spot Aura 15W of PHILLIPS or equivalent approved make complete with all accessories such as LED module, driver, optics, thermal sink, connector blocks etc including installation complete in all respects.
Control Room and other rooms	LED Ceiling Point: Supply and fixing of surface mounted LED ceiling light fitting type Mainstream spot Aura 15W of PHILLIPS or equivalent approved make complete with all accessories such as LED module, driver, optics, thermal sink, connector blocks etc including installation complete in all respects
Wall mounted fixture	Supply and fixing of LED wall light cat. no. 35022 9W fitting of PHILLIPS or equivalent approved make complete with all accessories such as LED module, driver, optics, thermal sink, connector blocks etc including installation

17.5. Ceiling Fan

Electrical room & Guard room - 1200 mm Sweep Fan with Electronic regulator.

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17.6. Exhaust Fan

Battery room	-	300/450 mm FLP Exhaust Fan with Louver.
Electrical room/Toilet	-	300/450 mm Exhaust Fan with Louver.

18.0 SILENT GEG SET

Rating	-	40 KVA (Minimum)
Voltage	-	415 V
Phase	-	3P, N
Frequency	-	50 Hz
Cooling	-	Air Cooled / Radiator cooled
Starting	-	Auto - Manual

Noise, Emission & Smoke limits-As per latest Amendment of Environment (Protection) Act 1986

Noise level	-	Less than 75 db (A) at a distance of 1M from Acoustic enclosure
Enclosure	-	Acoustic enclosure with Residential Silencer
Location	-	Outdoor
Battery Charger	-	To charge GEG.SET Battery

Note: GEG size mentioned here is minimum. Actual rating of GEG shall be decided by the bidder based on actual base load plus actual load one largest motor during starting, during detail engineering.

19.0 DISTRIBUTION BOARD

- Main Electrical Distribution Board (EDB)/ LT Panel/ Emergency Panel with changeover switch. Refer SLD.
  - Shall be Floor mounted, Stand-Alone type with cable alley and bus chamber
  - Shall have one incomers with suitably rated MCCB for EDB
  - Shall have one incomers with suitably rated MCCB for LT panel.
  - Shall have two incoming power sources (one from LT panel and other from DG with changeover switch) with suitably rated MCCB for Emergency Panel.
  - Shall have Outgoing feeders with suitably rated MCCB as per feeder requirement.
  - Motor Feeder if any shall be selected as per Type 2 coordination chart
  - Shall have spare feeders min 10% of each rating or one of each type, whichever is greater
  - Single Phase Load (If any) shall be equally distributed on each phase

- Normal LDB for Indoor and Outdoor lighting
  - Shall be wall mounted, recessed type
  - Shall have one incomer with suitably rated MCCB with RCCB (Residual Current Circuit Breaker), fed from LT Panel

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- Shall have Outgoing feeders with suitably rated MCB as per feeder requirement for Indoor and Outdoor lightings.
- Single Phase Load shall be equally distributed on each phase
- Shall have spare feeders min 10% of each rating or one of each type, whichever is greater.

♣ Switchgear used for LV feeders shall incorporate the following protective devices:

a) Short Circuit
b) Earth fault

20.0 ELECTRICAL EQUIPMENTS FOR HAZARDOUS AREA

ELECTRICAL EQUIPMENT'S

The Electrical equipment's for hazardous areas shall be selected as per IS: 5571 and petroleum rules. The minimum requirements are summarized below

Equipments	Zone-1		Zone-2	
LV Ind.Motors	Ex-d	Ex-d	Ex-d	Ex-e
Push Button Stations	Ex-d	Ex-d	Ex-d	Ex-d
Motor Starter	Ex-d	Ex-d	Ex-d	Ex-d
Plug Sockets	Ex-d	Ex-d	Ex-d	Ex-d
Welding Receptacles	Ex-d	Ex-d	Ex-d	Ex-d
Lighting Fixtures,Lighting Fitting,Control gear	Ex-d	Ex-d	Ex-d	Ex-d
Hand Lamps i) Light Fitting ii) Transformer Unit iii) Plug & socket	Ex-d	Ex-d	Ex-d	Ex-d
Lighting Panels / Power Panels	Ex-d	Ex-d	Ex-d	Ex-d
Break Glass Units (Fire Alarm System)	Ex-d	Ex-d	Ex-d	Ex-d

21.0 SPLIT A.C. SYSTEM

♣ All A.C.s shall be 230V, 50 Hz, 1Ph & N, 2/1.5 TR, 5 star rating.

♣ One (1) no. of split AC shall be provided for office room and Control room each.

22.0 SWITCH SOCKET (IF APPLICABLE)

22.1. 16/6A or 15/5A, 3 pin, Switch Socket (PNE) – ROMA ANCHOR for each stations (If applicable).

- ♣ Control Room - 2 Nos.
- ♣ Office Room - 2 Nos
- ♣ Electrical Room - 1 Nos.
- ♣ Guard Room - 1 No.
- ♣ Chromatograph Room - 2 Nos

22.2. 25 amps, 230 volts, SPN, industrial type switch socket outlet, with 2 poles and earth metal enclosed plug top along with 16 amps.rotary switch in sheet steel enclosure, on surface or in recess, with chained metal cover for the socket outlet in Control/Scada and office room.

22.3. 32 amps, 230 volts, SPN, industrial type switch socket outlet, with 2 poles and earth metal enclosed plug top

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along with 32 amps. "C" series, SP MCB in sheet steel enclosure, on surface or in recess, with chained metal cover for the socket outlet in Control/Scada and office room.

22.4. 63A, 415V AC (3Ph) Flame proof and weatherproof– Industrial Switch Socket unit fully interlocked with plug for each stations- one number

Note: All Equipment Rating mentioned in this specification are minimum. However, Bidder shall furnish actual rating to owner/consultant during detail engineering for approval.

23.0 ELECTRICAL INSTALLATION

Electrical installation design shall be in accordance with IS 732.

23.1. Cable Laying:

Cable shall be laid in the cable trays / ladders as specified in codes & Standard and Segregation / Separation of cables. Emergency and Instrumentation systems cables shall as far as practical be routed away from normal services systems. Special consideration shall be given to the routing and segregation of cables, to minimize the effects of fire on emergency and essential supplies and production operation. Wherever practicable the cables for duplicate feeds and equipment shall run via separate routes to increase security of supply. In addition, the minimum distances between power / control wiring and electronic / signal wiring on prolonged cable routes shall be as per code and standard

23.2. Lighting and Small Power

a) Lighting:

All external lighting and general area lighting shall be provided according to good engineering practice. LED fixtures shall be used for outdoor & Indoor lighting. Perimeter / fence lighting shall be provided using LED lighting fixtures with suitable spaced at an interval. The lighting fixtures and other equipment shall be suitable for the area of classification in which they are located. The illumination levels shall be as covered in the specifications & IS 6665.

b) Emergency/Critical Lighting:

Emergency/critical lighting fixtures shall be provided with 12 hours backup battery banks through Solar power System. Emergency/ Critical lighting fixtures shall be automatically activated on loss of mains.

c) Small Power:

3-Phase and single-phase socket outlet systems shall be provided in the facilities for:

• 240V, 50 Hz, 1 phase, neutral and earth, 16A, 5 pin, domestic type outlets for the office building and for general purpose use in the, Switchgear rooms, local equipment rooms, offices and workshops. • Socket outlets shall be provided in all switch rooms for special test equipment.

All single-phase socket outlets shall be protected by 30 mA earth leakage circuit breakers. All other earth leakage protection requirements shall be identified on the basis of minimising earth leakage protection where not required by statutory requirements, standards, or regulations to minimize nuisance tripping, and where reduction of such protection does not degrade safety.

• Nameplates shall be installed at each receptacle clearly indicating source of supply, voltage and amperage.

24.0 ATTACHMENT

- GTS for GEG Set - E/02/2501
- PTS for GEG Set -
- GEG Set Datasheet -
- GEG Set QAP -

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♣	GTP for UPS	-	E/02-2502
♣	PTS for UPS	-	
♣	UPS Datasheet	-	
♣	UPS QAP	-	
♣	PTS for Solar		
♣	Solar datasheet		
♣	Solar QAP		
♣	GTP for Battery	-	E/02-2519
♣	Battery Datasheet	-	
♣	Battery QAP	-	
♣	GTP for Power and Control Cable	-	E/02-2510
♣	PTS for Power and Control Cable	-	
♣	Power and Control Cable Datasheet	-	
♣	Power and Control Cable QAP	-	
♣	GTP for Sheet Steel Distribution Board	-	E/02-2503
♣	PTS for Electrical Distribution Board	-	
♣	Electrical DB Datasheet	-	
♣	Electrical DB QAP	-	
♣	GTS – FLAMEPROOF & WEATHERPROOF EQUIPMENT	-	E/02-2512

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BHAGYANAGAR GAS LIMITED (BGL)

TENDER DOCUMENT FOR CONSTRUCTION OF MOTHER STATIONS IN HYDERABAD GA

PTS – CABLE AND ACCESSORIES
P.019141 G11077 E102

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For technical specification for Cable and Accessories, please refer GTS-Cables and Accessories Doc. No. E/02/2510.

Below table in this PTS – Cable and Accessories contains the amendment to the GTS _ Cables and Accessories.

Wherever there is conflict between the requirements mentioned in GTS & PTS, the requirement laid down in the PTS shall prevail.

Sr. No.	Description	Reference Page No.	Clause/ Para/ Section	Amendment/Addition/Modification/Deletion	
General Technical Specification					
1	Cables and Accessories	Page 1 of 5	1.0	Modification	This specification covers requirement for the design, manufacture, inspection, testing and supply of the XLPE insulated cables (upto 1.1 kV). All power and control cable up to 1.1 KV shall be XLPE, Category C2, ST2, Armored FR-LS Type.
2	Cables and Accessories	Page 1 of 5	2.0	Modification	"The cables shall comply with the latest edition of the following standard" shall be read as **"The cables and its associated materials/parts shall be designed, manufactured & tested conforming to latest editions of the applicable Indian Standards, including the below mentioned standards"**
3	Cables and Accessories	Page 1 of 5	2.0	Addition	Vendor requirements: All cables shall be supplied as per approved vendor list in tender document.
4	Cables and Accessories	Page 1 of 5	3.0	Addition	All the cables shall be Improved fire performance cables suitable for Category C2 (Appendix A of IS 7098 Part-I Reaffirmed 2005). Outer PVC sheath of cables shall be flame retardant type conforming to category AF as per IS:10810.
5	Cables and Accessories	Page 1 of 5	3.0	Addition	1. The improved fire performance cables shall be designed to have minimum Oxygen index of 29 at 27 + 2 degree Celsius. 2. The improved fire performance cables shall be designed to have minimum temperature index of 21 at a temperature of 250 degree Celsius & maximum smoke density of 60% as per ASTM D2863. 3. The cables shall have a low smoke property and the minimum average value of light transmittance shall be 60% as per ASTM D2843

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Sr. No.	Description	Reference Page No.	Clause/ Para/ Section	Amendment/Addition/Modification/Deletion	
6	Cables and Accessories	Page 1 of 5	3.0	Addition	**Temperature Rise** Cables shall be suitable for use with conductor temperature rise up to 90 degree Celsius under normal operation and 250 degree Celsius under short circuit condition.
7	Cables and Accessories	Page 1 of 5	3.1	Deletion	PVC Cables
8	Cables and Accessories	Page 2 of 5	3.1.1	Modification	"All power/control cables for use on medium voltage systems shall be heavy duty type, 1100 V grade with aluminum/copper conductor, PVC insulated, inner sheathed, armored and overall PVC sheathed." shall be read as, "**All power/control cables for use on medium voltage systems shall be heavy duty type, 1100 V grade with copper conductor, XLPE insulated, inner sheathed, armored and overall PVC sheathed. "**
9	Cables and Accessories	Page 2 of 5	3.2.1	Modification	Power cables for 3.3 kV system shall be with Aluminium conductor, XLPE insulated (unearthed grade), screened, sheathed, armoured and overall PVC sheathed. Shall be read as **"Power cables for 1.1 kV grade shall be with Aluminum/Cu conductor, XLPE insulated (unearthed grade), screened, sheathed, armored and overall PVC sheathed. "**
10	Cables and Accessories	Page 4 of 5	4.1.5	Addition	h) Insulation Resistance (Volume Resistivity) Test i) Dimensional Check j) Meggar Test on each cable drum
11	Cables and Accessories	Page 5 of 5	5.1.2	Addition	Permissible Drum Tolerance shall be +/-5% of standard drum length.

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Sr. No.	Description	Reference Page No.	Clause/ Para/ Section	Amendment/Addition/Modification/Deletion	
12	Cables and Accessories			Addition	List of drawing document to be submitted during during detailed engineering ,despatch clearance and delivery of cable. 1. Data Sheet - To be submitted during bidding stage 2. Typical arrangement drawings in approved AutoCAD format.-To be submitted during bidding stage 3. Delivery schedule - To be submitted during bidding stage 4. Catalogues / References - To be submitted during bidding stage 5. Technical leaflets - To be submitted during bidding stage 6. List of Mandatory spares - To be submitted during detail engineering stage 7. Type tests reports and list of FAT and SAT- To be submitted during detail engineering stage 8. QA/QC program.- To be submitted during detail engineering stage 9. Inspection and test procedures.- To be submitted during detail engineering stage 10. Inspection & Test reports.- To be submitted during detail engineering stage 11. Structure drawing- To be submitted during detail engineering stage 12. Operator's instruction and maintenance manual,- To be submitted during detail engineering stage 13. Manual on method of installation, checkups and tests to be carried out before commissioning of equipment- To be submitted during detail engineering stage 14. QAP.- To be submitted during detail engineering stage 15. Transportation procedure to site & erection procedure of cables at site.- To be submitted during detail engineering stage 16. Maintenance and operating manuals.- To be submitted during detail engineering stage 17. Packing/shipping list with weights and dimensions.- To be submitted during detail engineering stage 18. FAT & SAT procedure- To be submitted during detail engineering stage 19. Final technical file- To be submitted during detail engineering stage
13	Cables and Accessories			Addition	The Owner/Consultant’s approval of the QAP / drawings shall not relieve the Vendor of his responsibility for supplying conforming with the relevant specifications

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BHAGYANAGAR GAS LIMITED (BGL)

TENDER DOCUMENT FOR CONSTRUCTION OF MOTHER STATIONS IN HYDERABAD GA

PTS – ELECTRICAL DISTRIBUTION BOARDS
P.019141 G11077 E103

Rev.	Date	Description	Prepared By	Checked By	Approved By
0	23.09.2024	Issued for Tender			

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1.0 SCOPE

Scope of work includes Design, Manufacturing, Supply, Installation, Testing & Commissioning of Electrical Distribution Board (EDB).

2.0 REFERENCE STANDARDS

• IEC 61869	:	Instrument transformers
• IEC 60005	:	Direct acting indicating analogue electrical measuring instruments and their accessories.
• IEC 60186	:	Voltage transformers
• IEC 60255	:	Electrical relays.
• IEC 60288	:	PVC-insulated cables for switchgear and control gear wiring.
• IEC 60417	:	Graphical symbols for use on equipment.
• IEC 60439	:	Low-voltage switchgear and control gear assemblies.
• IEC 60529	:	Degrees of protection provided by enclosures. (IP Code)
• IEC 60688	:	Electrical measuring transducers for converting a.c. electrical quantities to analogue or digital signals.
• IEC 60715	:	Dimensions of low-voltage switchgear and control gear. Standardized mounting on rails for mechanical support of electrical devices in switchgear and control gear installations
• IEC 60947	:	Low-voltage switchgear and control gear.
• IEC 61000-4	:	Electromagnetic Compatibility (EMC).
• IEC 61346-1	:	Industrial systems, installations and products – Structuring principles and reference designations.
• IS 8623 (Part 1)	:	Low Voltage switchgear and control gear assemblies: Part 1 Requirements for type tested and partially type tested assemblies
• IS 13947 (Part 1)	:	Low Voltage switchgear and control gear assemblies: (Part 1) General rules (Superseding IS 2147 and IS 4237).
• IS 13947 (Part 1)	:	Specification for Low Voltage switchgear and control gear : (Part 4) Contactors and motor starters, sec 1 Electromechanical contactors and motor starters (Superseding

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IS 2959 and IS 8544 (all parts))

- Indian Electricity Rule as amended up to date, any other relevant local law codes & regulations (Latest edition) applicable, shall meet requirement for switchboard & associated material.

3.0 AMBIENT CONDITIONS

Max/Min. Region Temperature	-	45 C / 5 C
Max/Min. Design Temperature	-	50 C / 0 C
Max/Min Region Relative Humidity	-	100% / 5%
Altitude above MSL-	:	Less than 1000 MTS
Atmosphere-	:	Tropicalized to withstand the site condition, dust & Vapour
Location-	:	Indoor

4.0 POWER SYSTEM DETAILS

Voltage with ±%	415 V ± 20%
Frequency with ±%	50 Hz ± 5%
No. of phase & wire	3P + 1N
Fault level	35kA for 1 sec – for EDB
Earthing mode	Solidly Earthed
Control supply & Auxiliary supply	230 volt for EDB , If any other Voltage required, same shall be derived internally, by manufacturer EPC shall take care during detail engineering

5.0 EXECUTION

Compartmental / Non compartmental	Compartmental – EDB
Single front/ Double front	Single front
Draw out/Non draw out	Non-Draw out
Floor mounted	EDB
Installation	Ventilated Room

6.0 BUS BARS

Copper / Aluminum	Aluminum – EDB.
Bare/ insulated	Insulated
Type of insulation	PVC
Rating- as per SLD	Yes

7.0 EARTH BUS BAR COPPER / ALUMINIUM

: Aluminium (Sized for Full rating of the EDB).

8.0 METERING CURRENT TRANSFORMER

VA	:	As per SLD
Accuracy class	:	As per SLD (Class 1.0)

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9.0 PROTECTION CURRENT TRANSFORMER

VA	:	As per SLD
Protection class	:	As per SLD (Class 5P10)

10.0 PROTECTION POTENTIAL TRANSFORMER

VA	:	As per SLD (50VA)
Protection class	:	As per SLD (Class 3P)
Voltage ratio	:	As per SLD (415V/√3 / 110V/√3)

11.0 METERING AND PROTECTION

A. Indicating Instrument

EDB: Digital Multifunction Meters Flush mounted (Having serial Link Communication ie., RS-485 for transfer of Signals, i.e. Voltage, Current, Frequency, Power Factor, kWH etc. to SCADA).

B. Protection

Incomer : EDB

EDB: Microprocessor based MCCB having Overcurrent, Short Circuit and Earth Fault release protection.

Outgoing: EDB: Overcurrent, Short Circuit and Earth Fault release protection

Note - Refer SLD for further details and scheme.

12.0 CABLE ENTRY (TOP/ BOTTOM) : BOTTOM

13.0 SPACE HEATER

	:	EDB: Thermostatically Controlled Anti-Condensation Heaters with MCB
Switch Socket & CFL Lamps	:	9 W CFL with Toggle switch in marshalling Panel

14.0 CABLE GLANDS : YES

15.0 CABLE LUGS : YES

16.0 PAINTING – TYPE & SHADE : **RAL -7032**

17.0

Description	Per Station
EDB	1 No. at each Stn
OLDB, EOLDB	1 No. at each Stn
ILDB, EILDB	1 No. at each Stn

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** The requirement of panels may be change or vary as per actual site condition.

18.0 SPECIFIC FEATURES

a) Ingress Protection for EDB IP 52 (min).

b) Necessary Potential free contacts (On off Trip) for RYB on grid

c) GTS-Sheet steel Distribution Board (E/02/2503) mention the general requirement, while PTS-Specification for Electrical Distribution Boards mention the project specific requirement and wherever there is conflict between the requirement mentioned in GTS & PTS, the requirement laid down in PTS shall prevail.

d) EDB shall be provided with surge arrestors in incomer.

e) Single phase feeders shall be derived and provided with two pole MCB. In this regard, Supplier shall used current limiting MCCB as incomer to these MCBs, to limit the fault current 10 kA and subsequently MCB shall be 10kA rating.

f) Single phase used for outdoor lighting shall be timer controlled.

g) Gland plate shall be of Aluminum and 3mm thick for EDB.

19.0 MANDATORY SPARES

MCCB of Each Rating	Nos.	1
Power Contactor of Each Rating	Nos.	1
Indicating lamp of each type	Nos.	1
Push button & switches (Set) of each type	Nos.	1
MCB of each rating	Nos.	1
RCCB of each rating	Nos.	1
Timer Switch of each type	Nos.	1
Switches of each rating	Nos.	1
HRC Fuses of each rating and each type	Nos.	10
Multi-function Meter	Nos.	1
Megger – 500V	Nos.	1

Spares for Electrical Distribution Board (EDB) (One Set for Each EDB as supplied
(Note- Quantities mentioned against each item are for one set only)

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BHAGYANAGAR GAS LIMITED (BGL)

TENDER DOCUMENT FOR CONSTRUCTION OF MOTHER STATIONS

PTS - UPS SYSTEM
P.019141 G11077 E104

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1.0 SCOPE OF WORK

Scope of work includes Supply, Installation, Testing and Commissioning, establishes the minimum requirements for the detailed design of UPS, UPS DB (with VRLA batteries & Rack) that meets the Instrumentation load requirement of control room building.

DESIGN AND OPERATIONAL REQUIREMENTS:

The UPS system shall be based on latest generation of IGBT based type.

Redundant scheme with by-pass:

In UPS system having this configuration two sets of rectifiers and inverters shall be provided. Under normal condition, when AC mains power is available, both the rectifiers shall operate in parallel and supply DC power on float/rapid charging the 2x50% batteries 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. These parallel redundant rectifiers shall be single phase. 415V, 3 -phase power shall be made available to these rectifiers from DB/grid supply. The rectifier/charger of the UPS system shall accept single phase input using automatic healthy phase selection logic for selection of any single available healthy phase (±10% of 415V, TPN supply) for supply to the inverter as well as to charge the battery bank. These rectifiers shall charge the battery at 0.2C rate.

- In case of incoming supply failure of both rectifiers the 2x50% batteries shall feed the inverters without any interruption. Each rectifier shall be designed for simultaneously feeding complete inverter load and float/rapid charging of the 2x50% batteries to its rated capacity. Each rectifier shall be equipped with 'On Line' automatic as well as manual charging facility.
- Normally both inverters will be synchronized with each other and with stabilized power supply. Both inverters shall operate in parallel and share the load equally.
- The load sharing controls shall not be subject to common mode failure and any failure of the load sharing controls shall not result in the loss of vital power.
- Manual by pass switch shall be provided.
- 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.
- Phase selection in auto/healthy phase scheme shall be such that in case all the three phases are healthy at 'auto/healthy phase selectors' of Rectifier-1 and Rectifier-2, different phases shall be selected in both the auto/healthy phase selectors to feed power to respective Rectifiers.
- The ventilation fans shall be supplemented by 100% redundant fan in normal operation.

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The power supply for fan shall be tapped from the inverter output. It should be possible to operate inverter even after the failure of the fan without temperature rise inside the inverter cubicle exceeding the safe operating temperature limits.

- UPS shall be designed for overload of 125% for 10 min. and 150% for 1 min.
- Battery shall be VRLA. The battery capacity shall be decided considering load power factor as 0.8, de rating factor for ageing 0.8 and de rating for minimum ambient temperature as applicable.
- Battery shall provide 4 hrs backup.
- Noise level at a distance or 1 m. from UPS panels shall be as per IEC standard.
- Enclosure shall be fabricated with cold rolled sheet annealed steel of minimum thickness 2.0 mm.
- The door hinges shall be concealed type. The doors and the removable covers shall be provided with non-deteriorating neoprene gaskets without any discontinuities. Gaskets shall be held in position in groove in shaped sheet steel work or these shall be of U type.
- All external hardware shall be cadmium/zinc plated steel.
- Terminal blocks shall be grouped according to circuit functions and suitably numbered. 20% extra terminals shall be provided in the terminal block.
- Removable bolted aluminium gland plate, heavy duty compression type rolled aluminium cable glands, crimping type aluminium cable lugs for Al. Cables and copper cable lugs for Cu. Cables, pressure clamp / bolted type terminals etc. shall be provided for each incoming and outgoing cable.

Valve Regulated Lead Acid cell/ battery

Valve Regulated Lead Acid(VRLA) shall be as per IS- 15549 -Specification for Stationary Valve Regulated Lead Acid Batteries Specification and IEC 60896-21 and IEC-60896-22.

VRLA cell/ battery shall be suitable for float duty operation at 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 supply load in the event of normal power supply failure. Battery shall be sealed maintenance free Type. The type of plate construction for batteries shall be fibrous in nature.

Battery shall be supplied in two parallel banks of 50% capacity each. The battery shall be suitable for being boost charged to fully charged condition from fully discharged condition within 10 hours unless otherwise specified.

COMPONENT DETAILS

All components shall conform to relevant IS/IEC standards and shall be of reputed make. Makes of all components shall be subject to purchaser's / consultant's approval.

Thyristors , Diodes and Transistors

The thyristors, diodes and transistors shall have adequate safety margins to withstand specified operating conditions. A factor of safety of minimum 4 shall be taken against voltage surges.

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STATIC SWITCH

Static switches shall be naturally commutated type with parallel inverse connected thyristors. These shall be rated for continuous duty for 100% load.

STABILIZER

Voltage stabilizer shall be static type and shall satisfy the following requirements:

i. Maximum output voltage variation under steady state condition shall be ± 2%.

ii. Maximum harmonic distortion shall be less than 5%.

iii. The output voltage shall be restored within ± 2% of nominal value in less than 2 secs.

TRANSFORMERS AND CHOKES

All transformers and chokes shall be of dry type and air cooled. This shall be class 'H' insulated, vacuum impregnated. Class F / Class B insulated cast resin transformers and chokes are also acceptable.

UPS DB -

UPS DB shall have min. IP-42 protection and suitable for wall mounting application and paint shall be RAL7032 and have ON OFF indication along with digital voltmeter and ammeter provision.

2.0 GENERAL

- Ref. Standard : IEC 62040 (LATEST)

3.0 AMBIENT CONDITIONS

- Max/Min. Region Temperature - 45°C / 5°C
- Max/Min. Design Temperature - 50°C / 5°C
- Max/Min Region Relative Humidity - 100% / 5%
- Altitude above MSL : Less than 1000 mts
- Atmosphere : Tropicalized
- Location : Indoor

4.0 VENDOR SHOP TESTS

Shall be as per Approved QAP by Owner/ Consultant

5.0 SUPPLY

- Parallel redundant Online UPS with static switch.
- Rectifier/Inverter
- VRLA maintenance free Batteries with Batteries rack and Flame proof Junction box.
- Isolation transformer and Static switch voltage stabilizer in Bypass supply
- Interconnecting cable

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6.0 ERECTION, TESTING & COMMISSIONING

EPC Contractor shall arrange site tests like overload, Load transfer, change over, Mains fail, all functions /alarm/indication and Battery charge discharge test. However, if any conflict for site tests, job procedure or method statement of testing commissioning of UPS SYSTEM and Battery approved by Owner / Consultant. EPC Contractor shall fulfill all requirement of UPS & BATTERY erection, testing and commissioning.

7.0 QUANTITY

S.NO	STATION	RATING	QUANTITY
1.	Hyderabad station, Hyderabad	**6 kVA	**1 No. at each**

Note: **During Detailed Engineering UPS Sizing shall be finalized by contractor based on actual load.

8.0 UPS- INPUT

- Rated Voltage : 415V ± 20%
- Rated frequency : 50 Hz ± 5%
- No. of Phase & wire : 3P + 4W
- Earthing mode : Solidly earthed
- Power factor : 0.8 – 0.9 lagging

9.0 UPS - OUT PUT

- Rated Power : During Detailed Engineering UPS Sizing shall be finalized by Contractor
- Voltage : 230V ± 1%
- Wave form : Sinusoidal
- Frequency : 50 Hz ± 1%
- No. of phases and wire : 1 Ph. + 2W
- Load Power factor range : 0.8 lag to 1.0
- Total Harmonic distortion : <3%LL< 5%NLL
- Current crest factor : Upto 3
- Unbalanced load : Upto 100%
- Overload capacity : 150% for 1 minute, 125% for 10 minutes
- UPS system overall efficiency : > 90%

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10.0 MONITORING

i) Output voltage of UPS (Common)

ii) Output current of UPS (Common)

iii) Battery DC Voltage

iv) Input voltage of each rectifier (ph to ph)

v) Input current of each rectifier

vi) Output current of each inverter

vii) Output voltage of each inverter

viii) Bypass frequency

ix) Output frequency of each inverter

11.0 BATTERY

TYPE : VRLA maintenance free

Back up time: 4 Hours

12.0 BATTERY RACK

It shall be Mild steel stand pre-treated and epoxy painted alkali resistance. It shall be Double row double tier type.

All the Nuts/Bolts/ washer shall be **SS** only.

Each set of battery shall be supplied with all accessories including but not limited to the following:

a. Inter cell, inter row and interbank connectors and end take offs. These shall be of Nickel-plated copper.

c. Cell number plates and fixing pings, Lugs for cable termination as required.

d. One number Cell testing voltmeter (3V –0-3V) complete with leads

e. Four pairs of Rubber gloves

f. One number Spanner

g. Any other accessories.

13.0 CABLE SIZE :

Refer Single Line Diagram

Final Cable sizing shall be considered according actual load during detail engineering.

All the UPS internal cables / serial link (UPS to Battery Junction box /Battery) shall be of FRLS.

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14.0 PAINTING TYPE & SHADE

: RAL-7032

15.0 SPECIFIC REQUIREMENTS

The Parallel Redundant UPS system shall be designed as follows:

- Each system includes one rectifier and one inverter.
- The battery and static and manual by pass power supply shall be provided for UPS system.
- Enclosure Degrees of Protection shall be min IP-42.
- Isolating transformer shall be provided at input & output.
- An isolating transformer shall be needed in the bypass power supply to comply with the required UPS neutral system.
- MCCB shall be provided for the battery, UPS inputs & outputs.
- Each UPS system is sized for 100% full load continuously.
- VRLA battery should have two banks. Each bank shall have facility to isolate each bank separately. This isolator shall be suitable to battery room.
- Each battery bank shall take care of 4hrs. backup time.
- RS485 communication capabilities (Modbus Protocol) of UPS shall transmit the health monitoring signal to RTU/SCADA.
- 03 Nos. Auxiliary contactors with potential free contacts (1NO + 1NC) wired upto terminal strip shall be provided in each UPS for any contact multiplication by owner at a later date.
- Refer below for mandatory spares for UPS system.

16.0 DRAWINGS AND DOCUMENTS

Contractor shall provide the following drawing/documents of UPS system during detail engineering for Owner/PMC review and approval. Nos of copy for drawings and documents shall be as per TENDER specification for this project.

- Specification sheet
- Technical Particulars
- Block Diagram
- General Arrangement drawings and foundation plan
- Calculation for battery sizing
- Feeder Details for UPSDB
- Descriptive literature and catalogues
- Bill of materials
- Schematic & Wiring Diagram

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- Installation, operation & maintenance manual
- Spare parts list with identification
- Test Certificates
- Guarantee Certificates

17.0 MANDATORY SPARES

For each set

System Control Card of each type	Nos.	1
SMPS Card of each type	Nos.	1
1-phase Charger Card of each type	Nos.	1
Gate Drive Card of each type	Nos.	1
Thyrsitor (Charger) of each rating and each type	Nos.	1
Thyristor (Static Switch) of each type	Nos.	1
DC capacitor of each rating and each type	Nos.	1
AC capacitor of each rating and each type	Nos.	1
Free Wheeling Diode (Charger) of each rating and each type	Nos.	1
IGBT of each rating and type	Nos.	1
Rectifier Input Fuses (Fast acting) of each rating and each type	Nos.	1
DC Fuses of each rating and each type	Nos.	1
By pass fuses of each rating and each type	Nos.	1
Choke of each rating and each type	Nos.	1
Cooling Fan	Nos.	1
Indication LED Lamp of each type	Nos.	10

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	PTS- GAS ENGINE GENERATOR SET	P.019141 G 11077 E001

BHAGYANAGAR GAS LIMITED (BGL)

TENDER DOCUMENT FOR CONSTRUCTION OF MOTHER STATIONS IN HYEDERABAD GA

PTS -GAS ENGINE GENERATOR SET

P.019141 G11077 E001

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SILENT GAS ENGINE GENERATOR SET

1.0 SCOPE OF WORK

Scope of work includes Supply, Installation, Testing and Commissioning, establishes the minimum requirements for the detailed design of complete GEG system with suitable pressure reduction system.

Scope also includes supply, laying, termination of all power, control/signal cables, glands and lugs from GEG/AMF Panel to EDB, RTU and GEG's own auxiliary interconnecting cables. All cables shall be XLPE insulated, FRLS PVC outer sheath, armoured.

2.0 GENERAL

2.1	Silent GEG Control Panel	-	REQUIRED
2.2	Max/Min. Region Temperature	-	45°C / 5°C
2.3	Max/Min. Design Temperature	-	50°C / 5°C
2.4	Max/Min Region Relative Humidity	-	100% / 5%
2.5	Altitude Above Sea Level	-	Less than 1000m
2.6	Atmospheric Pollution	-	Tropicalised to withstand site condition, Dust and vapour
2.7	Acoustic Enclosure	-	Required
2.8	Location	-	outdoor
2.9	Rating	-	Continuous

3.0 MAIN POWER SYSTEM DETAILS

Voltage ± %	-	415 V± 10%
Frequency ± %	-	50 HZ ±5%
Fault Level	-	25 KA for 1 Sec.
Earthing mode	-	Solidly earthed.

4.0 AUXILIARY POWER

- 230 V, 50 HZ, 1P, N

5.0 GENERATOR

Rated output power	-	40 KVA (min.)
Rated Voltage	-	415 V ± 5%
Rated Frequency	-	50 HZ ± 3%
Power factor	-	0.8 (lagging)
Insulation class of Generator	-	Insulation class H with Temperature rise limited to class F or class F with temperature rise limited to class B
Type of Excitation	-	Self excited and self regulator.
Voltage regulation	-	Less than 2%
Harmonic Content	-	Less Than 3%
Over load capacity	-	10% for one hour in every 12 hours
Over Speed	-	120% for 2 minute
Degree of Protection (w/o enclosure)	-	IP 23 for Generator IP 52 for Control Panel

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Acoustic and engine emission norms of CPCB shall followed.

6.0 GAS ENGINE

6.1	Lower Heat value of the Gas	-	8200 – 9100 Kcal/Sm^3
6.2	Gas Pressure regulator	-	In case any pressure reducing valve/ regulator is required to meet the engine requirement, same to be supplied by the engine supplier
6.3	Safety Control High water temperature Low Lube Oil Pressure Over speed		
6.4	Type of cooling	-	Radiator cooled

7.0 SPECIFIC FEATURES OF SILENT GEG SET

7.1	Governor	-	GEG set with hydraulic/ Electronic Governor.
7.2	Battery Charger	-	To charge the Battery of Silent GEG Set from 230 V AC Grid Supply.
7.3	A.V.R.	-	YES
7.4	Automatic/Manual Starting	-	Automatic / Manual starting for Silent GEG set through AMF panel placed in Electrical room at main control room building.
7.5	Gas Generator Control Panel	-	1 No. 4 pole, MCCB, Over current, short circuit & Earth Leakage Protective release. - 1 No. 4 pole, Power contactor, AC-3 duty with Aux. contact as required for AMF operation & interlock with down stream contactor at main electrical distribution Board. - Multifunctional digital meter comprising P.F., KWH, Frequency, Voltmeter, Ammeter. - 3 Nos. CT's for metering - Indication lamps for load on & set running - MCB's as required for control supply

8.0 ACOUSTIC ENCLOSURE

- Modular construction

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- All the four walls & roof to be covered with Insulating material conforming to IS:8183 for sound proofing
- Minimum thickness of insulating material 75-100 mm
- Minimum Density of Insulating Material 64 Kg / m^3
- Insulating material compressed between Fibre glass cloth/ vinyl sheet and nonferrous perforated sheet for anti droning effect
- Special Residential silencer to control exhaust noise
- Specially designed attenuators to control sound at air entry to the enclosure and exit from the enclosure
- Gas Generator Set mounted on specially designed anti vibration pads.
- Lift arrangement of Gas Generator set in the base frame
- High quality EDPN gaskets on all the doors. Lockable type door Handles
- Adequate ventilation to meet air requirement for combustion and heat removal
- Gas detection system shall be provided with alarm and trip contact

9.0 NOISE LEVEL

- 75 dB(A) at a distance of 1meter from Acoustic Enclosure.

10.0 STATION INLET GAS PRESSURE

Rating	Station Inlet Gas pressure at site
40 kVA	Bidder to confirm

11.0 MODES OF OPERATION

11.1 GEG Set shall function as per the following scheme.

- Auto start on mains failure scheme (AMF).
- Manual start - in service / test mode.
- Manual stop upon supply restoration.

11.2 Auto start on mains failure scheme (AMF)

This shall be effective in auto position of Auto/ manual selector switch located in control panel. The generator shall be normally at rest. Upon failure of normal supply, a start impulse from voltage monitoring relay shall be provided by GEG suppliers. Using this impulse, generator shall start automatically and rated speed & Voltage shall be built up. An impulse shall be given for closing of generator contactor. All accessories required for

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starting and completion of various sequence of operation for the above purpose shall be provided as part of generator supply.

11.3 Manual start - in service mode

This shall be effective in manual position of Auto/ manual selector switch and service position of service/ test selector switch located in control panel. The scheme of operation shall be same as of auto mode above, except the starting command shall be extended manually using push button from the control panel.

11.4 Manual start - in Test mode

This shall be effective in service position of service / test selector switch. The scheme of operation shall be same as that of manual start in service mode above except the closing command for generator contactor shall not be extended.

11.5 Stop upon restoration of grid mains supply

On restoration of normal supply, changeover to normal supply from the generator supply at main electrical distribution board shall be done automatically. Switching off the Generator set and generator contactor shall be done manually from local, after running the set for around one minute on idle condition.

12.0 SPECIFIC REQUIREMENTS

1. Separate Potential free contacts for Silent GEG ON & OFF & FAULT status shall be provided for owner's use in LCP Panel in addition to the RS 232/RS 485 port for signalling to the RTU system.
2. Contractor shall arrange the civil foundation for GEG sets based on approved Foundation calculation. Contactor shall furnish other related civil drawing for the same.
3. Contactor shall supply all materials required for erection, testing & commissioning of GEG sets. Transportation to site location, Erection, Testing & commissioning shall be in bidder's/Contactor's scope.
4. All routine tests as per relevant standards shall be carried out in the presence of purchaser's representative.
5. The Gas Engine Generator set shall be tested for output, general performance, overloads and other tests sufficient to prove the correctness of the design both at works and at site.
6. These inspections shall, however, not absolve the vendor free from his responsibility for making good any defect which may be noticed subsequently.
7. Proper shed shall be provided by Contractor for GEG Set & AMF Panel/Control panel.
8. Contractor shall responsible to provide latest technology based AMF change over system for GEG Set.
9. Contractor shall responsible for any steel structure/ fabrication work for installation of Control panel/AMF Panel of GEG set.

13.0 MANDATORY SPARES

Mandatory spares shall be as per Manufacturer.

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1.0 SCOPE OF WORK

This specification covers, engineering, manufacture, assembly, stage testing, and inspection and testing before supply and delivery at site of mineral oil- immersed, natural air-cooled, outdoor type, double-wound 3 phase 11/0.433 KV Distribution Transformers for outdoor use in power distribution systems.
The specification is applicable Transformer capacity up to 500 KVA.

2.0 REFERENCE STANDARD

ISS–1180/Part-I/ 2014&Amendmentno.1 2016 to IS :1180-Part-1/2014	Outdoor/Indoor type Oil immersed distribution Transformer upto and including 2500 kVA, 33KV Specifications Mineral Oil Immersed
IS 5484	Specifications for Aluminum wire rods
IS 649	Testing of Steel sheet and strips for magnetic circuits
IS 191: 2007	Copper
IS 335 : 1993	New insulating oils
IS 554 : 1999	Pipe threads where pressure-tight joints are Made on the threads —Dimensions, tolerances and designation
IS 1576 : 1992	Solid pressboard for electrical purpose
IS 1608 : 2005	Mechanical testing of metals — Tensile testing
IS 1747: 1972	Nitrogen
IS 1885 (Part 38) :1993	Electro technical vocabulary: Part 38 Power transformers and reactors
IS 1897: 2008	Copper strip for electrical purpose
IS 2099: 1986	Bushings for alternative voltages above 1000volts
IS 13730	Specification for winding wires

IS 3024 : 2006	Grain oriented electrical steel sheets and strips
IS 3347	Dimensions for porcelain transformer bushings for use in lightly polluted atmospheres
IS 8603:2008	Dimensions for porcelain transformer bushings for use in heavily polluted atmospheres,12/17.5 KV
ISS 5/1961	Specification for colors for ready mixed paints.
ISS- 6600/1972 / IEC 76	Guide for loading of oil Immersed Transformers

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ISS-10028	Installation, Maintenance of Transformers
ISS-4257	Dimension for clamping arrangement for bushings (for porcelain and metal parts)
ISS- 3401	Silica gel
ISS-1866	Code of practice for maintenance & supervision of Mineral insulating oil in equipment
IS 3639: 1966	Fittings and accessories for power transformers
IS 6162	Paper-covered aluminum conductors
IS 7404 (Part1): 1991	Paper covered copper conductors: Part 1 Round conductors
IS 7421: 1988	Porcelain bushings for alternating voltages up to and including 1000 V

3.0 SYSTEM DETAIL

The distribution transformers shall be installed outdoor locations along 11 kV distribution networks, which consist of underground/ overhead networks. The HV winding shall be connected with HT SFU/OCB/VCB/SF6 CB of the ring main unit/ DO Fuse through 11kV (E) XLPE cable. LV winding shall be connected to LV distribution box/switch fuse Unitthrough 1.1 kV XLPEAluminum conductor Cable.

The transformers shall be suitable for outdoor installation, RCC foundation based with 3 phase 50 Hz, 11 KV systems in which the neutral is effectively earthed and they should be suitable for service under fluctuations in supply voltage up to plus 12.5% to minus 12.5%.

3.1 GENERAL DETAILS

Sr. No	Parameters	Values
1.	Location	At Universal Service station in West Bengal
2.	Max ambient air temperature (Degree C)	50
3.	Min. ambient air temperature (Degree C)	-2
4.	Max average daily ambient air temperature (Degree C)	45
5.	Max. yearly weighed average ambient temperature (Degree C)	40
6.	Max. altitude above mean sea level (meter)	1000
7.	Maximum relative humidity (%age)	0 to 100%

3.2 Total Quantity

01 Nos 630 KVA at EACH Mother station

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4.0 PRINCIPAL PARAMETERS

1.	System voltage (max.)	:	12 KV
2.	Rated voltage HV	:	11 KV
3.	Rated voltage LV	:	433 V
4.	Line currentHV	:	Vendor shall furnish
5.	Line current LV	:	Vendor shall furnish
6.	Frequency	:	50 Hz +/-3%
7.	HV Connection	:	Delta
8.	LV Connection	:	Star Neutral brought out
9.	Vector group	:	Dyn-11
10.	Type of cooling	:	ONAN
11.	Tap changing arrangement	:	7.5 %to +10% in Steps of 2.5 %
12.	Noise level	:	As per IS standard
13.	Permissible temperature rises over ambient:		35 Deg.C of top oil measured 40 Deg.C of winding measured by resistance
14.	HV Phase to Phase	:	255
	HV Phase to Earth	:	205
	LV Phase to Phase	:	75
	LV Phase/ Neutral to Earth	:	55
15.	Basic Insulation Level	:	95 KV
16.	Energy Efficient Level	:	**Min. 3 star**
17.	Impedance (%)	:	4.5

18. Transformer standard losses in watts at 50% ,100% load & No-load losses shall be provided by vendor for Energy efficient 3 star Transformer as per Beuro of Energy Efficiency (Govt of India) latest Amendment. No deviation shall be accepted for losses.

5.0 TECHNICAL REQUIREMENTS

A. CORE

Transformer core shall be stacked core type, shell type or with wound core construction using new and high quality CRGO core with heat resistant insulating coating. The core shall be of new high-grade cold rolled grain oriented annealed lamination core having low loss and good grain properties, coated with hot oil proof insulation, bolted together.

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The complete design of core must ensure permanency of the core losses with continuous working of the transformers. The complete design of core must ensure permanency of the core loss with continuous working of the transformers. The value of the maximum flux density allowed in the design and grade of lamination used shall be clearly stated in the offer.

B. CORE CLAMPING:

- MS channel shall be used on top and bottom.Core Channel on LV side to be reinforced at equidistance, if holes / cutting is done for LT lead in order to avoid bending of channel.
- MS Channels shall be painted with hot oil-resistant paint.The transformers core shall be suitable for over fluxing (due to combined effect of voltage and frequency) up to 112.5% without injurious heating at full load conditions and shall not get saturated. The nominal flux density in any part of the core shall not exceed 1.69 Tesla at 100% rated voltage and frequency and the maximum flux density in any part of the core and yoke at rated voltage and frequency shall be such that the flux density with 112.5 % combined voltage and frequency variation from rated voltage and frequency shall not exceed 1.9Tesla. (REF IS 1180) Clamping and Tie-rods shall be made from HT Bright Bars steel & shall be painted with hot oil resistant paint. (IS 1180) Clamping and Tie-rods shall be made from HT Bright Bars steel & shall be painted with hot oil resistant paint. (IS 1180).

C. AMOURPHOUS

The core shall be high quality Amorphous ribbons having very low loss formed into wound cores of rectangular shape, bolted together to the frames firmly to prevent vibration or noise. The complete design of core must ensure permanency of the core loss with continuous working of the transformers.

D. WINDINGS

Double paper covered Electrolytic Copper conductor or class H super enamel cover Electrolytic Copper conductor shall be used for 11 KV class Transformers.
A mix of Electrolytic copper conductors for HV & LV winding will not be permitted.

E. CURRENT DENSITY

Electrolytic copper conductor shall not be more than 2.5 A/sq.mm.

F. INTERNAL CLEARANCE AND COILS

Minimum Radial clearance of LV Coil to Core	:	4mm (For 100 to 500 KVA)
Minimum radial clearance between LV coil to HV coil	:	11 mm
Phase to phase clearance between HV conductors	:	10 mm
Minimum electrical clearance between inside surface of the Tank and outside edge of the winding	:	30 mm
Minimum No. of HV Coils up to 500 KVA	:	4 Nos
No. of LV coils per Phase	:	1 Nos

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G. TAPS

Tapings shall be provided on the higher voltage winding for variation of HV voltage within range of (-) 7.5% to +10% (For 200 KVA & 500KVA) in steps of 2.5%.
Tap changing shall be carried out by means of an externally operated self- Position rotary switch and when the transformer is in de-energized condition. Switch position No.1 shall correspond to the maximum plus tapping.
Each tap change shall result in variation of 2.5% in voltage.
Provision shall be made for locking the taping switch handle in position.

H. OIL

The insulating oil shall comply with the requirements of IS 335.
The specific resistance of the oil shall be as per IS 6103.
Oil shall be filtered and tested for break down voltage (BDV) and moisture content before filling.

Insulating oil for the first filling of the transformers including 20% extra shall be supplied in non-returnable sealed drums suitable for outdoor storage.

I. INSULATING MATERIAL

Insulation Kraft Paper & pressboard shall be standard make.
All spacers, axial wedges / runners used in windings shall meet the requirement of IEC 641.

6.0 TANK

The transformer tank shall be of rectangular in shape. The tank shall be made of prime quality MS sheet of thickness stated below with necessary stiffener to withstand the pressure built in during the expansion of oil due to temperature rise.
Tank shall be such that, it shall facilitate easy lifting of core with coils from the tank without dismantling LV bushings.

For sides	3.15 mm
For Top & Bottom	5 mm

The exterior of the transformer tank and other ferrous fitting shall be thoroughly cleaned, scraped /sand blasted and given a priming coat and two finishing coats of durable oil and weather resistant paint conforming to colour code 632 of IS-5/1961.

4 Nos of Lifting lugs shall be provided.

4 Nos. of welded heavy-duty pulling lugs of MS plate 8 mm thick shall be provided to pull the transformer.

7.0 GENERAL ASSESORIES

BREATHER & CONZERVATOR

A conservator tank of adequate capacity shall be provided on the transformer in such a position as not to obstruct the electrical connections to the transformer and shall have a capacity between highest and

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lowest visible levels to meet the requirement of expansion of the total cold oil volume in the transformer and cooling equipment from the minimum ambient temperature to 90° C.
The conservator tank shall be supported above the transformer tank or above the cooling radiator bank by suitable brackets and shall be so designed that it can be completely drained during service by removing plug from drain point. It shall also be possible to remove the conservator for cleaning purposes as and when required.

The conservator shall be fitted with magnetic type oil level gauge with low level electrically insulated alarm contact.

A valve shall be provided on the conservator side to cut off the oil supply to the transformer after providing a straight run of pipe for at least a length of five times the internal diameter of the pipe on the tank side of the Buchholz Relay.

Each conservator tank shall be fitted with a breather in which silica gel will be the dehydrating agent. It shall be designed such that the passage of air is through a dust filter and silica gel. The external atmosphere shall be continuously in contact with the silica gel and the moisture absorbed shall be indicated by a change in colour which can be easily observed from a distance.

Buchholz Relay

A double float type relay confirming to IS 3637 shall be provided. The relay shall be provided with a test cock suitable for a flexible pipe connection for checking its operation. A copper tube shall be connected from the gas collector to a valve located about 200 mm above ground level to facilitate sampling with the transformer in service. The device shall be provided with two electrically independent ungrounded contacts one for alarm on gas accumulation and the other for tripping on sudden rise of pressure.

Pressure Relief Device

The pressure relief device shall be provided of sufficient size for rapid release of any pressure that may be generated within the tank and which might result in damage to the equipment. The device shall operate at a static pressure of less than the hydraulic test pressure of transformer tank. Means shall be provided to prevent the ingress of rainwater inside the tank due to installation of this device. The diaphragm shall be of suitable design and material and situated above maximum oil level.

BUSHINGS

For 11 KV Transformers - 12 KV class bushings shall be used and for LV side, 1.1KV terminal bushing shall be used. Bushing shall be as per IS 3347.
Bushings of following or other makes having type tested as per IS 2099.

The winding terminals of all bushings shall be such as to facilitate the removal of the bushings without necessitating any major operation.

The ends of HV windings shall be brought out through bushings suitable for connection with 11KV cable box.

The ends of LV windings shall be brought out through bushing suitable for connecting with 1.1 KV Bus Duct/Cable Box.

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COOLING ARRANGEMENT

Detachable type, cooling radiator banks of adequate capacity and in requisite number shall be provided with each transformer.

Shut-off valves of adequate size and in requisite number shall be provided between radiator and headers and between tank and cooler banks.

The cooling radiator banks may be supported from the tank.

The cooling radiator shall be so designed as to avoid pockets in which moisture may collect and shall withstand the pressure tests.

All valves of the cooler connections shall be of gun metal or cast steel or may have cast iron bodies with gun metal fittings.

The valves shall be of full wave type with internal screw and shall be opened by turning counterclockwise when facing hand wheel.

Provision for padlocking the valves in open or closed positions shall be made.

Every valve shall be provided with an position indicator

All valves shall be provided with flanges having machined faces.

HOUSING /CABLE BOX AND TERMINAL ARRANGEMENT

The housing of Cable Box shall be min. IP 56.

The voltage windings of each transformer shall terminate on weatherproof insulated bushings of specified voltage level.

The insulated bushings shall be suitable for connection with specified cables.

All bushings shall be equipped with suitable terminal connectors of approved type and size and all terminals current carrying contact surfaces shall be adequately silver-plated.

8.0 TEMPERATURE INDICATORS /PROTECTIONS

The dial type, oil and winding temperature indicators for local and remote monitoring shall be provided by supplier. The alarm contacts of winding temperature indicators shall be adjustable to close between 50C and 100C and tripping contacts to close between 60C and 120C and both shall reopen when the temperature has fallen by about 10C. Potential free contacts shall be provided for OTI & WTI for monitoring

All contacts shall be adjustable on a scale and shall be accessible on removal

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of the cover. The temperature indicators shall be so designed that it shall be possible to check the operation of the contacts and associated equipment

Suitable current transformer shall be provided for input to WTI.

Vendor shall provide NO/NC contacts in the relevant fittings / instruments for effecting the protections as mentioned below:

- Winding hot spot temperature indication with alarm and trip.
- Oil temperature indicator with alarm and trip.
- Low oil level alarms for conservator
- Buchholz relay with alarm & trip

Wiring liable to be in contact with oil shall have oil resisting insulation and the bare ends of strands shall be treated to prevent creepage of oil along wire.

There shall be no possibility of oil entering connection boxes used for cables or wiring. Panel connections shall be neatly and squarely fixed to the panel. All instruments and panel wiring shall be run in PVC or non-rusting metal cleats of the limited compression type. Wiring shall be terminated on suitable terminal boards placed in the marshalling box.

9.0 SURFACE TRATMENT & PAINTING

The internal and external surfaces including oil filled chamber and structural steel work shall be given proper treatment to remove all rust, scale, foreign adhering metal, grease, etc. The outside surface of the Transformer shall be primed with zinc rich two pack epoxy media followed by epoxy-based powder coating with a colour shade smoke grey colour paint corresponding of IS: 5 and shall appear smooth & elegant in finish.

All paints shall be carefully selected to withstand heat and extremes of weather. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling

GALVANIZING

Threads of nuts and bolts (cadmium plated) shall be so made that after cadmium plating; nuts will have a neat fit and can be turned through the full length of threads of the bolts.

10.0 FITTINGS

The following fittings and accessories shall be provided:

- Bushings with metal parts and gaskets to suit the specified termination arrangements
- Separate bushing for neutral
- Silica gel breather with oil seal and connecting pipe
- Pressure relief device
- Inspection windows
- Dial type winding temperature indicator fitted with maximum pointer and two sets of contacts for alarm and trip with CT
- Dial type oil temperature indicator fitted with maximum pointer and two sets of contacts for alarm and trip
- Air release plug

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- Cover lifting eyes, transformers lifting lugs, jacking pads, towing holes, core and winding lifting lugs, skids and pulling eyes on both sides
- Rating and diagram plates on transformers and auxiliary apparatus
- Two numbers earthing terminals

- Bottom & top filter valves with threaded male adopters
- Bottom sampling / drain valve
- Pocket on tank cover for thermometer
- Off Load Tap changing equipment along with all accessories
- Under carriage with 4 Nos. flanged bi-directional wheels with locking and bolting device
- Marshalling box (IP55)
- Requisite No. of radiators with shut off valves
- Complete wiring upto marshalling box with PVC insulated copper conductor cables of 1100 Volts grade
- Insulating oil in non-returnable steel barrels
- Buchholz Relay, double, float type with one set of alarm contacts, one set of trip contacts, one testing petcock and one shut-off valve on conservator side .

- Conservator with oil filling hole and cap isolation valve, drain valve, & magnetic type oil level gauge
- Low oil level switch

11.0 SPARES

Following spares shall be supplied free of cost along with the transformer

i. One complete set of gaskets
ii. 20% extra oil supplied in non-returnable sealed drums suitable for outdoor storage

12.0 BOUGHT OUT ITEMS

The documentations including product leaflets and test certificates shall be submitted for following brought out items:

a) Buchholz Relay
b) Winding temperature indicators
c) Oil temperature indicators
d) Bushings
e) Marshalling box
f) Tap changing equipment

13.0 INSPECTION & TESTING

Transformer shall be subjected to inspection by Owner/ Consultant or by an agency authorized by the owner at the manufacturer's works .

Acceptance test shall be carried out included but not necessarily limited to the followings:

- A general visual check shall be carried out along with checking of general arrangement, tap changing equipment, fittings & accessories, cable termination / bus duct arrangement etc.
- Dimensional & Electrical clearance test

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- Breakdown value (BDV) test shall be carried out on transformer oil samples before and after testing of the transformer. Bought out test certificate of the oil from the supplier is to be provided.
- Ratios at each tap and vector group
- Measurement of winding resistance
- Measurement of insulation resistance
- Measurement of no-load loss and current
- Load losses measurement
- Measurement of impedance at principal tap and load loss
- Induced over voltage withstand test
- Pressure relief device test
- Operational test for Buchholz relay
- Measurement of IR before and after HV test
- Di-electric test of oil
- Noise level check
- Magnetic balance test

Additional tests:

- Oil leakage test : All tanks and oil filled compartments shall be tested for oil tightness by being completely filled with air/oil of a viscosity not greater than that of insulating oil to IS: 335 at an ambient temperature and subjected to a pressure equal to the normal pressure plus 35 kN/m2 measured at the base of the tank. This pressure shall be maintained for a period of not less than 12 hours for oil and 1 hour for air, during which time no leakage shall occur.

- Vacuum test: One transformer tank of each size (applicable for system voltage upto 72kV) shall be subjected to a vacuum of 34.7kN/m2 gauge pressure (250 mm Hg) for one hour. The permanent deflection of flat plates after the vacuum has been released shall not exceed the value specified below without affecting the performance of the transformer.

Pressure test:
One transformer tank of each size shall be subjected to a pressure corresponding to twice the normal head of oil or to the normal pressure plus 35kN/m2 whichever is lower as measured at the base of the tank and will be maintained for one hour. The permanent deflection of the flat plates after the excess pressure is released shall not exceed the figures specified above

The following type test reports shall be submitted during inspection for review:
a. Impulse withstand voltage test on one leg (Primary and Secondary) of transformer (Only test report of prototype is to be submitted for this test)
b. Measurement of zero phase sequence impedance (type test report of prototype).
c. Measurement of noise level (type test report of prototype)

Apart from the above, Quality Assurance Plan shall be carried out.

For components/equipment bought from other sub-suppliers, copies of certified test reports (of test carried out at the respective manufacturer's works) shall be submitted.

14.0 DRAWINGS/DATA/MANUALS

Documents to be submitted during detailed engineering

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- Typical General arrangement drawing of the transformer including dimensions and showing fittings and accessories of transformers
- Data sheet duly filled up
- Outline dimensional drawing of transformer and accessories.
- Connection diagram.
- GA & Schematic diagram of tap changing mechanism
- Shipping drawing showing dimensions and weights of heaviest package.
- Nameplate diagram.
- Interconnecting / control cable schedule
- Bushing drawings and specification.
- Schematic diagram showing of flow of oil in cooling system as well as each limb and winding
- Foundation plan of the Transformer
- Cross sectional drawing of HV Cable box & LV Bus Duct flange / cable box
- Quality assurance plan
- Any other document / drawing requested by the Owner/ Consultant at the time of drawing approval

15.0 APPROVED MAKE

AS PER BGL APPROVED VENDOR LIST

16.0 TECHNICAL DATASHEET

(FULFILLED BY VENDOR)

Sl. No.	Description		
1.	Make		
2.	Name of Manufacturer		
3.	Place of Manufacture		
4.	Voltage Ratio		
5.	Rating in kVA	--	250 KVA
6.	Core Material used and Grade: a) Flux density b) Over fluxing without saturation (Curve to be furnished by the Manufacturer in support of his claim)		
7.	Maximum temperature rise of: a) windings by resistance method b) Oil by thermometer		
8.	Magnetizing (no-load) current at: a) 90% Voltage b) 100% Voltage c) 110% Voltage		
9.	Core loss in watts : a) Normal voltage b) Maximum voltage		
10.	Resistance of windings at 20 0C (with 5% tolerance) : a. HV Winding (ohms)		

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b. LV Winding (ohms)

11. Full load losses (watts) at 75 0C

12. Total Losses at 100% load at 75 0C

13. Total Losses at 50% load at 75 0C

14. Current density used for : (Ampere/sq. mm)
    a) HV Winding
    b) LV Winding

15. Clearances: (mm)
    a) Core and LV
    b) LV and HV
    c) HV Phase to Phase
    d) End insulation clearance to earth e) Any point of winding to tank

16. Efficiency at 75 0C :
    a) Unity P.F. and
    b) 0.8 P.F.

    1) 125% load
    2) 100% load
    3) 75% load
    4) 50% load
    5) 25% load

17. Regulation at:
    a) Unity P.F.
    b) 0.8 P.F. at 75 0C

18. % Impedance at 75 0C

19. Flash Test:

    (i) HV 28 kV / 50 HZ for 1 minute
    (ii) LV 3 kV/50 Hz for 1 minute

20. Over potential Test (Double Voltage and Double frequency for 1 minute)

21. Impulse test

22. Mass of: (kg)

    a) Core lamination (minimum)
    b) Windings (minimum)
    c) Tank and fittings
    d) Oil
    e) Oil quantity (minimum) (liter)
    f) Total weight

23. Oil Data:
    1. Quantity for first filling (minimum) (liter)
    2. Grade of oil used
    3. Maker's name
    4. BDV at the time of filling (kV)

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24. Transformer:
1) Overall length x breadth x height (mm x mm x mm)
2) Tank length x breadth x height
3) Thickness of plates for
a) Side plate (min)
b) Top and bottom plate (min)
4) Conservator Dimensions

25. Radiation:
1) Heat dissipation by tank walls excluding top and bottom
2) Heat dissipation by cooling tube
3) Diameter and thickness of cooling tube
4) Whether calculation sheet for selecting cooling area to ensure that the transformer is capable of giving continuous rated output without exceeding temperature rise is enclosed.

26. Inter layer insulation provided in design for:

1) Top and bottom layer
2) In between all layer
3) Details of end insulation
4) Whether wedges are provided at 50% turns of the HV coil

27. Insulation materials provided
a) For Conductors
(1) HV
(2) LV
b) For Core

28. Material and Size of the wire used
1) HV Dia (mm) (SWG)
2) LV

b) No. of Conductors in parallel
c) Total area of cross section (sq mm)

29. Whether the name plate gives all particulars as required in Tender

30. Particulars of bushings HV/LV
1) Maker's name
2) Type IS-3347/IS-2099/IS7421
3) Rating as per IS
4) Dry power frequency voltage withstand test
5) Wet power frequency voltage withstand test

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SOLAR PANEL SYSTEM

P.019141 G11077 E005

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	PTS - SOLAR PANEL SYSTEM	**P.019141 G11077 E005**

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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
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 ABBREVIATION

1.0 SCOPE

1.1 This Specification provides the minimum requirements for the design, manufacture, testing and supply of the Solar Electric Power System to be installed. The Solar Electric Power System shall independently meet the power requirement of continuous loads as defined in Data Sheet.

1.2 The exact number of solar electric power systems along with loads connected to each system and the load rating of each system shall be as indicated in the equipment Data Sheet.

1.3 Each solar electric power system when installed in accordance with Vendor's instructions shall form self-sufficient power system to meet the power requirements of continuous loads.

1.4 Scope also includes supply, laying, termination of all cables, lugs, glands from Solar Charger to EDB, Solar Panel to charger, Battery etc all interconnecting cables. All cables shall be XLPE insulated, FRLS PVC outer sheath, armoured.

2.0 REFERENCE DOCUMENTS

The equipment supplied shall comply with the requirements of the latest revision of the relevant standards of

NEC	National Electrical Code
NEMA	National Electrical Manufacturers' Association
NFPA	National Fire Protection Association
API	American Petroleum Institute
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
BIS	Bureau of Indian Standards
IEC	International Electro-technical Commission

Any other recognized international codes or standards may be used in lieu of the above, subject to the approval of the Company.

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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 POWER SYSTEM

Power system shall include the following equipment. Photovoltaic solar cell array (solar panels). Battery bank, solar power controller the solar power system shall be self-sustained type. The photovoltaic solar cell array (solar panels) and the solar controller shall be sized to meet through battery back-up, the load cycle requirements of the connected loads with the solar energy availability at site under worst weather conditions the load requirement per day shall be determined on the basis of load data specified in the Data Sheet.

4.2 SOLAR PANELS

4.2.1 The photovoltaic solar panel array shall consist of required number of individual solar panels. The individual photovoltaic elements shall be connected in suitable series-parallel combinations too obtain the required voltage and current rating of a solar module. Individual solar modules shall be connected in suitable series parallel combinations to obtain the required voltage and current rating of a solar panel. Solar panel array shall consist of required number of panels in series parallel combination to meet the System requirements.

4.2.2 The Solar panels will be mounted on steel support structure of suitable height on the control room roof top.

4.2.3 The solar panel array shall be designed based upon isolation data (to be gathered by contractor from metrological department) and following design conditions:

a) Output current to be considered at operating point based on following operating conditions:

i) Cell temperature while delivering current corresponding to P max point on the I-V curve at specified ambient temperature.

ii) Operating voltage considering:

- Charging voltage of the battery.
- Voltage drops in cables between solar array and solar, controller and solar controller and battery.
- Voltage losses in solar controller.
- Negative tolerance, if any, on the output voltage at solar controller.

4.2.4 After working out the output current at operating point, the following derating factors shall be applied:

a) Deterioration factors over life span or 15% whichever is higher.
b) Losses due to dust deposit or 1% whichever is higher.
c) Losses due to module/branch mismatch or 2% whichever is higher.
d) Losses due to line resistance cables (panel to controller).
e) Losses in field wiring and array wiring. Losses in solar controller.
f) Battery charge/discharge efficiency or 93% whichever is lower.
g) Any other de-rating factor considered essential for satisfactory and guaranteed performance of Solar Power System (e.g. negative tolerance on nominal rating of solar panels)
h) Derating factor of 2% or as applicable (whichever is higher) to account for panel orientation other than the specified one as per insulation data.

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i) The solar panels shall be able to fully charge the battery bank after "3 NO SUN DAYS" cycle from the surplus power available from the solar panel in next 14 days with 70% Depth of Discharge of battery.

4.3 BATTERYBANK

4.3.1 BATTERYCELLS

a) The battery bank shall be charged from the surplus power available from the solar panel when the sunlight is available and will supply/supplement the solar electric power from the solar panel when the sunlight is inadequate under cloudy condition and during nights. The battery cells shall be low self-discharge up to 3% at 27°C per month) Sealed maintenance free (Valve regulated lead acid VRLA) suitable for photovoltaic application. The battery cells shall be provided with flame arresting type catalytic caps or ceramic plugs. The type of battery cells shall be as specified in equipment Data Sheet.

b) The battery shall incorporate the following features:

i) High charging efficiency.
ii) Good cycle life even for deep discharge.
iii) Extended life expectancy.
iv) Long maintenance interval Maintenance free for VRLA battery cell.
v) large electrolyte reservoir.

c) The type, AH capacity and no. of cells in the battery bank shall be decided on the following basis:

i) Geographical and climatic conditions prevalent at site.
ii) Back-up during low insulation periods considering the de-rated solar panel output and insulation data.
iii) Unless specified otherwise, the system voltage shall be 12 V (Nominal).
iv) Battery suitable for 4000 or more charge-discharge cycle for 10% depth of discharge and for 1600 or more charge discharge cycle for 70% depth of discharge.
v) Battery backup shall be considered as per Data sheet.
vi) Design ambient temperature minimum and maximum site temperatures as given in Specification- “Site Conditions and Climate".
vii) Deterioration-factor over the life span (Actual or 20% whichever is higher).
viii) Weight of individual cell shall be of the order of 55 Kg
ix) Self-discharge during low insulation periods considering average ambient temperature of 30°C.

4.3.2 The battery shall be able to fully charge after”3 no sun days” cycle from surplus power available from the solar panel in next 14 days with 70% depth of discharge.

4.3.3 General requirements and performance for VRLA batteries shall be as per manufacturer data available in market.

4.4 SOLAR POWER-CONTROLLER

4.4.1 TECHNICAL REQUIREMENTS

a) The solar power controller shall regulate the charge of the battery and shall monitor the charging current from the solar array power from the battery set shall be routed through the solar controller.

b) The controller shall be provided with low loss type, high efficiency, tested and tropicalized components with overall loss of the solar controller not exceeding 10%ofthe rated load. MCCBs and MCBs shall be used for the circuit or device protection in place of fuses. However, semiconductor grade fuses shall be used for diodes, SCRs etc.

c) Unless specified otherwise, the solar controller shall be wall mounted type with hinged and gasket door in the front. The cable entry shall be from top or bottom (to be decided at the time of detailed engineering.) through glands and access to all inside equipment shall be from the front only.

d) The supply system shall be suitable for both negative earthed and unearthed system as required. The provision of negative earthing shall be through an isolating link.

e) Apart from required control elements, the following components/ features shall be provided in the controller as minimum requirements:

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i) A 2-Pole MCCB with shunt trip to isolate the solar panel from the solar controller/battery on receipt of 60% LEL signal from the gas detection panel. (The signal will be in the form of a normally open potential-free contact).

ii) The battery bank shall be automatically disconnected from the solar panels when the state of charge of the battery reaches 110% or maximum permissible charge level (as indicated by the battery manufacturer) and from the load when the depth of discharge reaches 70%. The battery bank shall be automatically reconnected to the Solar Panel when the state of charge of the battery drops to 100%.

iii) Ammeters to measure load current and solar array current.

iv) An array fault indicator to indicate solar array failure.

v) Voltmeter to indicate system output voltage and Battery voltage.

vi) Charge-discharge Ammeter.

vii) Battery deep discharge alarm and indication.

viii) Control circuit fail alarm and indication.

ix) Switches mounted on the front to disconnect all alarms and indications.

x) Necessary transducers for providing two wire 4-20 mA signals for the following parameters :

- ¬ Battery voltage
- ¬ Solar array current
- ¬ Battery charging current
- ¬ Load current
- ¬ Solar panel fault indicators

xi) Current limiting features with active elements.

xii) Voltage regulator shall be switching mode type.

xiii) Digital Ampere hour meter.

g) Protection features to take care of faults in DCDB bus, solar controller, solar panel, battery circuit etc.

4.5 GENERAL REQUIREMENTS

4.5.1 BUS BARS

Bus bars shall be sufficiently sized and adequately braced for the supply conditions specified in data sheet. The bus bars shall be electrolytic copper and shall be sleeved with 1100V grade flame retardant PVC. Bus joints shall be bolted type and insulated by flame-retardant insulation tape.

4.5.2 EARTHING

An earth bus bar made of electrolytic copper shall be provided, running the complete length of the solar controller. All non-current carrying parts shall be bonded with flexible copper wires with the earth bus. The earth bus shall have provisions at both ends for connecting it to earth grid conductor.

4.5.3 SEGREGATION

All electrical devices and live parts in the solar controller panel shall be segregated by means of metallic screens. All power connections in case of solar controller shall be segregated from one another and from the electronic circuits

4.5.4 CABLING

All interconnecting cables between various solar panels and main JBs, included in scope of supply, shall be Flame Retardant Low Smoke (FRLS) type. Cables of sizes, as specified, connecting JBs to solar controller, solar controller to battery shall be supplied by contractor.

Adequate space shall be provided for termination of external cables. All required Nickel Chromium plated brass double compression cable glands and tinned copper plugs shall be included in the scope of supply.

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4.5.5 MATERIALS AND FINISH

All materials shall be selected and finished to resist the site conditions and climate specified.

All electronic circuit boards shall be tropicalized to prevent corrosion and fungus growth. Painting shall be suitable for the requirements specified in Specification.

4.5.6 IDENTIFICATION

All solar panels, batteries, solar controller and related devices and materials shall have permanent tags in contrasting colours affixed on them and lettering of at least 12 mm size. The tag inscription shall be in line with the equipment number list.

5.0 FABRICATION

5.1 PANEL CONSTRUCTION

5.1.1 The Solar modules shall have suitable encapsulation and sealing arrangements to protect the Silicon elements (Cells) from the environment. The arrangement and material of encapsulation shall be compatible with the thermal expansion properties of the silicon cells and the module framing arrangement/material. The encapsulation arrangement shall ensure complete moisture proofing for the entire life of the solar modules.

5.1.2 The solar panel shall have suitable supporting arrangement complete with adjustable mounts, solar module fixing accessories, inter-module connections, cable termination arrangement, double compression, nickel/chromium plated, brass cable glands and all other necessary equipment and hardware. The supporting arrangement shall be such as to utilize minimum space on the control room roof top. Unless specified otherwise width of the walkway is 1600mm. The panel dimension and its supporting structure shall be so sized as to leave a clear walking space of minimum 750mm. Materials used in the construction of panel frame to support the solar modules, supporting structure and all other accessories shall be suitable for location in extremely corrosive, dusty environment to be encountered. The solar module framing shall be copper free aluminum alloy. Arrangement, such as, vertical stainless steel rods or flexible rods shall be provided to prevent bird landing on the panels. Each panel shall be provided with a weatherproof Junction box with minimum IP 55 enclosure with removable gasket front cover for termination of external cables. The electrical terminals in the junction box shall be corrosion proof and anti-loosening type. Suitable bypass diodes shall be provided for partial shadowing of modules, if recommended by manufacturer.

6.0 INSPECTION AND TESTING

6.1 All tests shall be carried out as per relevant Standards at Vendor's works.

6.2 The Consultant/Owner reserves the right to have a representative to witness the final testing and inspection. Prior intimation of at least 20 days shall be given to enable the Consultant/Owner depute its representative to witness the tests.

6.3 Testing and inspection shall include but not necessarily limited to the following:

6.3.1 GENERAL (FOR ALL ITEMS)

a) A quantitative check to ensure that all items in specified quantity are present.
b) A visual inspection to check workmanship and compliance with submitted drawings.
c) Dimensional checks.

6.3.2 SOLAR PANELS

a) Following environmental tests shall be carried out on photovoltaic modules on sampling basis. Minimum 2% of ordered modules or 1 no. Module, whichever is higher, shall be subjected to following tests and performance of module before and after each test shall be tabulated and furnished. The tests shall be carried out sequentially on each module selected for testing and the tested module shall be discarded after tests.

b) In case on account of testing:

i) The overall deterioration in the performance of the tested modules after test exceed 5% of rated performance, or
ii) The tested module exhibits any open circuits and or ground faults, or
iii) The tested module develops cracks or mechanical damage, or

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iv) The tested module fails to pass the electrical isolation tests

c) The entire ordered lot of modules shall be tested.

S.No	Test Details	Test Details
1	Cold	Temp. : (-) 40°C Duration : 16 Hrs.
2	Rapid Change of Temperature	Low Temp.: (-)40°C High Temp:+ 85°C No. of cycles :10 Duration of Exposure:30 Min.
3	Dry heat	Temp. : 85°C Duration : 16 Hrs.
4	Salt mist	Temp. : + 35°C Duration : 48 hrs.
5	Wind	Pressure equivalent to an air velocity of
6	Rain	Test as required in the mentioned Standards
7	Dust	Test as required in the mentioned Standards
8	Composite /Humidity Test	Test as required in the mentioned Standards.
9	Mould Growth	84 days
10	Hail Storm test	Test as required in the mentioned Standard
11	Shock Test	Peak Acceleration : 490m/sec 2 Duration : 11

* Vendor shall submit the test procedure for Owner's review. Vendor shall indicate test conditions like temperature limits and duration etc. and also mention the name of the applicable standards.

d) The following design qualification tests shall also be conducted:

i) Earth continuity test.
ii) Electrical isolation test.
iii) * Hot spot endurance test.

NOTE: Type test certificate can be accepted for the tests marked with asterisks (*).

6.3.3 SOLAR CONTROLLER

a) Tests in the following order shall be conducted for the panel:
b) General
c) Earth Continuity Test
d) Functional Tests
e) Insulation Resistance Measurement
f) Heat Run Test
g) Insulation Resistance Measurement
h) Functional Test

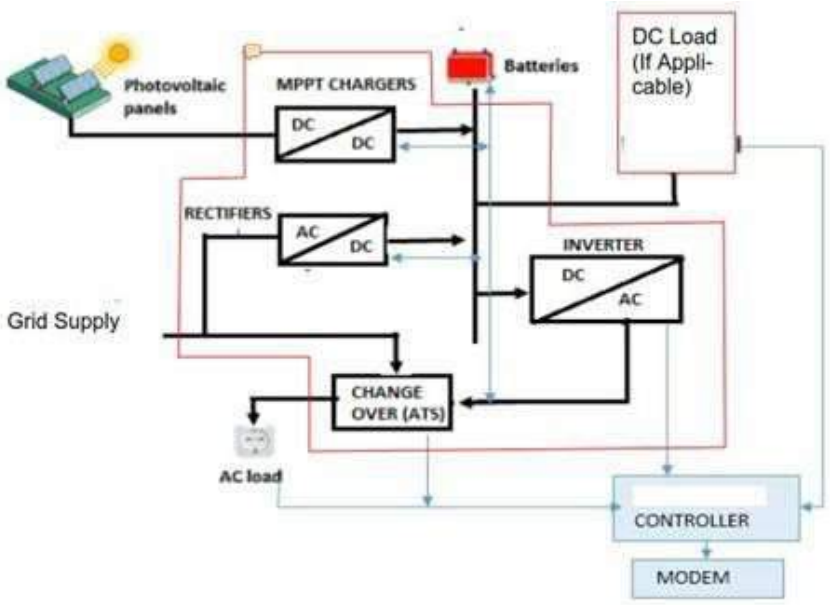
6.3.4 Burn out tests for 120 hrs. On the complete system in one assembly.

7.0 MARKING, PACKING AND SHIPMENT

The offered equipments along with accessories shall be shipped to site packed in wooden crates. They shall be wrapped with polythene sheets, before being placed in the crates to prevent damage to finish. Crates shall have skid bottom for handling.

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8.0 BLOCK DIAGRAM OF SOLAR SYSTEM



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FIELD INSPECTION, TESTING AND COMMISSIONINGH OF ELECTRICAL INSTALLATION

P.019141 G11074 E101

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	FIELD INSPECTION, TESTING AND COMMISSIONING OF ELECTRICAL INSTALLATION	**P.019141** **G11074** **E101**

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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
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 ABBREVIATION

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)	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 (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.

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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 FIELD INSPECTION, TESTING AND COMMISSIONING

4.1 Contractor shall carry out complete field inspection, testing and commissioning of el ectrical 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) k. Earth resistance measurement for each earth electrode, and the earthing
l) system as a whole.
m) 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.

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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

4.12.2 LV 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
415 V	1000	100
240 V	500	10
110 V	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 Volts	Minimum Insulation resistance in Mega ohm 40 Degree
415 V	1000	15
240 V	500	12
110 V	500	10

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.

4.12.4 HIGH-VOLTAGE TESTING

D.C. high voltage test shall be conducted asper 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*(phase/line voltage)	Any Conductor and Metallic	Conductor to Conductor	
0.65/1.1	3	3	5

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.

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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.

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).

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	GTS – AC UPS SYSTEM	**E/02/2502**

UNINTERRUPTED POWER SUPPLY SYSTEM

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	GTS – AC UPS SYSTEM	E/02/2502

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1. SCOPE

1.1. The specification covers the design, engineering, manufacturing, testing at works and dispatch in well packed condition of Uninterrupted Power Supply System required to supply AC power for nonlinear loads.

1.2. This standard shall be read in conjunction with relevant Specification Sheet, single line diagram & UPS distribution diagram.

1.3. The scope shall include the followings:

i) Full wave-controlled rectifier

ii) Inverter

iii) Static switches

iv) Ni-Cd battery

v) Static voltage stabilizer for bypass supply

vi) Manual bypass switches

vii) Isolation input and output transformers to achieve desired output voltage & isolation

viii) UPS Distribution Board

ix) Interconnecting cabling between various units of UPS

x) All other items required, but not specified for safe and reliable operation of UPS system.

2. STANDARDS TO BE FOLLOWED

2.1. The equipment shall conform to the latest issue of the following and relevant Indian Standard specifications or equivalent specification of the country of origin or IEC specifications.

IS : 13314	Solid state inverters run from storage batteries.
IS : 11260	Stabilized power supplies AC output.
IEC : 60146	Solid state inverters.
IEC 62040	Uninterruptible Power Supply System

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2.2. The equipment shall also conform to the provision of Indian Electricity Rules, Indian Supply Act and any other statutory regulations in force from time to time.

3. AMBIENT CONDITIONS & ELECTRICAL SYSTEM CHARACTERISTICS

3.1. Included in Particular specification sheet (PTS).

4. DESIGN AND OPERATIONAL REQUIREMENTS.

4.1. The UPS unit and its associated equipment shall be suitable for operating at the specified rating continuously with the specified voltage and frequency variations under the ambient conditions indicated in specification sheet without exceeding the temperature rise limits specified in relevant standards and without any detrimental effect on any part.

4.2. The UPS system shall be based on latest generation of IGBT based, pulse width modulated (PWM) design with proven performance.

4.3. Redundant scheme with by-pass

Under normal operating conditions, both inverter units should run in parallel sharing 50% load in synchronism with by-pass power and supply uninterrupted a.c. power to load. on failure of one of these inverters, the faulty inverter should get automatically disconnected from the load and healthy inverter should supply 100% load in synchronism with by pass supply. in the event of second inverter also developing a fault, a no-break load transfer to standby power supply should take place through static switch.

4.4. Output frequency of the inverters must remain synchronised to one another, which in turn shall be synchronised to the standby power supply frequency provided the latter does not vary by more than ± 6%. It should be possible to change the setting of frequency range of synchronism between above limits in steps of ± 1%. Outside these limits, inverter should desynchronise with the bypass and run at its own frequency. When running at its own frequency, frequency variation shall be maintained less than ± 0.1%. Resynchronisation with bypass power supply must take place automatically with some time delay when frequency comes back to ± 6% range. Change-over from inverter to bypass or bypass to inverter shall also be possible in desynchronised mode of operation. Change-over time in both synchronised and desynchronised mode operation shall be indicated.

4.5. The UPS unit shall be suitable for 0.7 lagging to unity power factor loads. The overall load power factor may be taken as 0.8 lagging.

4.6. The maximum wave form distortion of the output voltage shall not exceed 5% r.m.s for linear load and 10% r.m.s. for non-linear loads. The UPS unit shall be suitable for operation for non-linear loads having crest factor of 3.

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4.7. The inverter steady state output voltage and frequency (free running) variation shall not exceed ±1% for specified input power supply condition and no-load to full load condition.

4.8. Voltage dip/rise on sudden application / throw of 100% load or on changeover from inverter to bypass or vice versa shall not exceed 15% and shall be recovered within 100 m.sec. to rated voltage.

4.9. UPS shall be designed for overload of 125% for 10 min. and 150% for 10 sec. After which drooping characteristic shall come into operation.

4.10. On failure of the main supply, inverter unit shall continue to supply rated load from the battery bank for 12 hours duration unless specified otherwise in the specification sheet.

4.11. Charger shall simultaneously supply entire power necessary for inverter and to keep the battery of required capacity in fully charged condition. Provision for automatic charging in both float and boost shall be made.

4.12. Battery shall be Ni-Cd pocket plate type. The battery capacity shall be decided considering load power factor as 0.8, derating factor for ageing 0.8 and derating for minimum ambient temperature as applicable. Above all, a 20% design margin shall be considered on the final capacity.

4.13. The ventilation fans, if provided shall be supplemented by 100% redundant fan in normal operation. Normal and redundant fan shall run together. The power supply for fan shall be tapped from the inverter output. It should be possible to operate inverter even after the failure of the fan without temperature rise inside the inverter cubicle exceeding the safe operating temperature limits.

4.14. In case of inverter failure due to any reason or overload, affected unit should be isolated and changeover to other inverter or to bypass should take place automatically.

4.15. Noise level at a distance or 1 m. from UPS panels shall not exceed 60 dB.

4.16. UPS system shall be provided with necessary control, protection, metering, indication, alarm & annunciation for reliable and safe operation of the system.

4.17. All semi-conducting devices shall be protected by fast acting semi-conducting fuses.

4.18. The battery may be taken out of service for maintenance during which period it shall be possible for the inverter to continue operation taking power from the rectifier. The input filter of the inverter shall be suitably designed to take care of this operational requirement.

4.19. It shall be possible to vary the output voltage steplessly within ± 5% of the specified output voltage. This adjustment shall be possible to be made when UPS is in operation.

4.20. UPS system shall be suitable for both floating output or earthing of one leg in case of single phase system / star-point in case of three phase system.

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4.21. The UPS system shall have very high system of reliability having minimum MTBF of 50,000 hrs. Vendor shall furnish the value of MTBF, MTTR and availability factor.

5. CONSTRUCTIONAL DETAILS

5.1. The equipment shall preferably be supplied in enclosed, dust & vermin proof, floor mounted, sheet steel enclosure. Minimum degree of protection for enclosure shall be IP-52 as per IS-13997.

5.2. Enclosure shall be fabricated with cold rolled sheet annealed steel of minimum thickness 2.0 mm.

5.3. The door hinges shall be concealed type. The doors and the removable covers shall be provided with non- deteriorating neoprene gaskets without any discontinuities. Gaskets shall be held in position in groove in shaped sheet steel work or these shall be of U type.

5.4. All external hardware shall be cadmium/zinc plated steel. Hardware for fixing the removable parts shall be provided with retaining devices.

5.5. Panels shall be liberally designed. All components shall be so mounted that they are easily accessible for inspection and maintenance.

5.6. UPS unit shall preferably have separate panels for each rectifier inverter units, bypass supply, distribution boards, etc. Various panels of UPS except distribution boards shall be mounted side-by-side & bolted together to form compact assembly.

5.7. Distribution boards shall be of fixed type single front execution in fully compartmentalised design and divided into distinct panels each comprising of bus-bar chambers, individual feeder modules and vertical cable alley.

5.8. Mounting height of components requiring operation and observations shall not be lower than 300 mm and higher than 1800 mm.

5.9. All the live parts which are accessible after opening the front cover / back cover shall be properly insulated or provided with insulating barrier to prevent accidental contact. Bus bars of distribution boards shall be PVC sleeved.

5.10. Nameplate consisting of black perpex with white engraving shall be provided for each panel and for each equipment mounted on the front of the panel. Suitable label identification for each component mounted inside the panel shall also be provided.

5.11. All the wirings shall be properly laid and ferruled at both ends. PVC channels may be used for wiring. For control wiring, minimum 0.5 sq.mm. copper conductor shall be used.

5.12. The power connections may be made by PVC insulated flexible copper cables or taped copper / aluminium strip.

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5.13. All power & control cables shall enter from the bottom unless otherwise specified in the specification sheet.

5.14. Removable bolted aluminium gland plate, heavy duty compression type rolled aluminium cable glands, crimping type aluminium cable lugs for Al. Cables and copper cable lugs for Cu. Cables, pressure clamp / bolted type terminals etc. shall be provided for each incoming and outgoing cable.

5.15. Terminal blocks shall be grouped according to circuit functions and suitably numbered. 20% extra terminals shall be provided in the terminal block.

5.16. A suitably sized earth bus shall be provided at the bottom of panel with provision for earth connection at both ends to purchaser's earth grid.

5.17. All panels shall be of same height so as to form a bank, which shall give good aesthetic appearance.

6. COMPONENT DETAILS

6.1. All components shall conform to relevant IS/IEC standards and shall be of reputed make. Makes of all components shall be subject to purchaser's / consultant's approval.

6.2. THYRISTORS, DIODES AND TRANSISTORS.

The thyristors, diodes and transistors shall have adequate safety margins to withstand specified operating conditions. A factor of safety of minimum 4 shall be taken against voltage surges.

6.3. PCBs

All electronic control & monitoring printed circuit cards shall be fixed type on ceramic insulators to avoid loose contacts due to vibration/long usage. Failure of each PCB shall be indicated by visual alarm and indication. The visual fault diagnostic shall preferably indicate fault into various sections of the cards. All printed circuit board shall be mounted on fixed ceramic insulator.

6.4. ELECTROLYTIC CAPACITORS

These may be polarised aluminium type I, suitable for long life and category I, as per IS:4317 or equivalent IEC. The capacitor shall preferably be self healing type. These shall be so located in inverter panels that the operating temperature does not exceed 65°C maximum.

6.5. TRANSFORMERS AND CHOKES

All transformers and chokes shall be of dry type and air cooled. This shall be class 'H' insulated, vacuum impregnated. Class F / Class B insulated cast resin transformers and chokes are also acceptable.

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6.6. INSTRUMENTS

Ammeters & voltmeters shall be moving coil type of class 1.0 accuracy as per IS:1248. These shall be flush mounting type of minimum size of 96 mm x 96 mm. Frequency meter shall be of reed type having range of 45 Hz to 55 Hz. Alpha-numeric Liquid Crystal Display for metering various parameters is also acceptable.

6.7. STATIC SWITCHES

Static switches shall be naturally commutated type with parallel inverse connected thyristors. These shall be rated for continuous duty for 100% load. Short time rated static switches are not acceptable.

6.8. VOLTAGE STABILIZER

Voltage stabilizer shall be static type and shall satisfy the following requirements:

i) Maximum output voltage variation under steady state condition shall be less than1%.

ii) Maximum harmonic distortion shall be less than 5%.

iii) The output voltage shall be restored within $\pm$1% of nominal value in less than 2 secs.

6.9. INDICATION LAMPS / LCD DISPLAY

All indication lamps shall be of LED type suitable for the specified control voltage, having minimum illumination of 40 millicandella. The colour of the LEDs shall be as follows :

ON : Red

OFF : Green

FAULT : Yellow

- LCD display is acceptable for Audio and visual alaram.

6.10. MCB

For isolating devices of various equipment, MCB shall be used. These shall be provided with overload and short circuit protective devices and shall conform to IS:2516.

Battery Circuit Breaker shall have under voltage trip and reverse polarity protection device.

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7. MONITORING SYSTEM

7.1. Microprocessor based monitoring system for UPS to supervise the UPS operation on PC shall be provided to indicate following data:

i) Output voltage of UPS (Common)

ii) Output current of UPS (Common)

iii) Battery DC Voltage

iv) Input voltage of each rectifier (ph to ph)

v) Input current of each rectifier

vi) Output current of each inverter

vii) Output voltage of each inverter

viii) Bypass frequency

ix) Output frequency of each inverter

7.2. Print out facility shall be available for all the Alarms and Faults conditions.

8. PAINTING

8.1. The enclosure after pre-treatment, shall be painted with two coats of anti-rust paint followed by two coats of anticorrosive paint.

8.2. All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.

8.3. Unless otherwise specified, the finishing shade shall be light grey Shade No. 631 as per IS:5.

8.4. Electrostatic powder paint shall be preferred.

9. TESTS AND INSPECTION

9.1. The UPS units shall be subjected to test as per relevant standards. The test shall include, but not limited to the following:

i) Rectifier & inverter soft starting

ii) Regulation test

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iii) Heat run test for 8 hours

iv) Overload test

v) Test for changeover time in synchronised and desynchronised mode.

vi) Test for dynamic response and transient performance

vii) Sequence & transfer test

viii) Noise level measurement

ix) Test to check the selectivity of protective devices

x) Alarm test (simulation of various fault conditions)

xi) Measurement of harmonic distortion

xii) Ventilation test (operation without redundant fan)

xiii) Insulation test

xiv) Current division in parallel UPS

9.2. All the above tests shall be carried out in presence of purchaser's representative. In addition, the equipment shall be subjected to stage inspection during process of manufacture at works and site inspection.

9.3. These inspection, shall, however, not absolve the vendor from his responsibility for making good any defects, which may be noticed subsequently.

10. DRAWINGS AND DOCUMENT

10.1. Drawings and documents as per Annexure-I shall be supplied.

10.2. All drawings and documents shall have the following description written boldly:

-- Name of client
-- Name of Consultant
-- Order Number Code No. and Description

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11. SPARES

11.1. Item wise unit prices for spare parts as listed in Annexure-III shall be offered along with main equipment with recommended quantity for the period as stipulated in Specification Sheet.

11.2. Any other spare parts required, but not specified, shall also be offered.

12. PACKING

12.1. The board shall be properly packed before despatch to avoid damage during transport, storage and handling.

12.2. The packing box shall contain a copy of the installation, operation and maintenance manual.

12.3. A sign to indicate the upright position of the panels to be placed during transport and storage shall be clearly marked. Also proper arrangement shall be provided to handle the equipment.

13. DEVIATIONS

13.1. Deviations, if any, from this standard shall be clearly indicated in the offer with reasons thereof. Deviations from the data indicated in specification sheet shall be shown clearly by encircling it and indicating the revised data in specification sheet.

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ANNEXURE I
DRAWINGS & DOCUMENTS

FOLLOWING DRAWINGS AND DOCUMENTS FOR ALL EQUIPMENT OF UPS SYSTEM SHALL BE PROVIDED:

SI. No.	Description	With BID	After Order		
			For ApprovaI		FinaI
		No. of copies	No. of copies	No. of weeks	No. of copies
1.	Technical Particulars	1	6	2	8
2.	Block Diagram	1	6	2	8 + 1R
3.	General Arrangement drawings and foundation plan	1	6	2	8 + 1R
4.	Calculation for battery sizing	1	6	2	-
5.	Feeder Details for Distribution Boards	1	6	2	8 + 1R
6.	Bill of materials	-	6	2	8 + 1R
7.	Schematic & Wiring Diagram	-	6	2	8 + 1R
8.	Installation, operation & maintenance manual	-	-	-	8
9.	Spare parts list with identification	1	-	-	8
10.	Test Certificates	-	-	-	8
11.	Guarantee Certificates	-	-	-	8

Note :

1. R-Reproducible.
2. Period of submission of drawings for approval shall be counted from the date of LOI.
3. All final documents shall be submitted prior to despatch of equipment. These shall be made in bound sets.

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ANNEXURE II

METERING INDICATIONS AND ALARM SCHEDULE

A. METERING

1. Incoming Voltmeter with selector switches for each incomer
2. Ammeter with selector switches for each incomer
3. Ammeter & Voltmeter at each inverter output and bypass output
4. Frequency meter & power factor meter at one common point of output
5. Ammeter & Voltmeter at incoming of each UPS distribution boards
6. Battery charge / discharge Ammeter

B. LED INDICATION

1. A.C. Mains 'ON'
2. Load on inverter
3. Battery on float
4. Battery on boost
5. Fault (one lamp for all types of fault)
6. Fan failure indication

C. AUDIO-VISUAL ALARM (with Accept & Reset facilities)

1. Mains failure
2. Inverter output overvoltage
3. Inverter output undervoltage
4. Inverter temperature high
5. Static switch failure

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ANNEXURE III

LIST OF SPARES - MANDATORY

The following spare parts shall be quoted along with the offer:

a) Control Card
b) SMPS Card
c) Charger Card
d) Gate Drive Card
e) One of each type of thyristors, diodes & IGBT
f) One of each type of capacitors, resistors and chokes
g) Semi-conductor fuses of each rating
h) Signal lamps.

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BATTERY

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1.0 SCOPE

The intent of this specification is to define the design, manufacture and testing of batteries for the DC Power system.

2.0 CODES AND STANDARDS

The equipment shall comply with the requirements of latest revision of following standards of BIS (Bureau of Indian standards/IEC/BS/VDE/JEEE/NEMA) unless otherwise specified.

IS- 8340	General Requirements and Methods of Tests for Lead Acid Storage Batteries
IS-1651	Stationary Cells and Batteries, lead acid type with tubular positive plates
IS-1652	Stationary Cells and Batteries, lead acid type with plante positive plates

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

3.0 GENERAL REQUIREMENTS

The offered Battery shall be brand new with sate of art technology and proven field track record.

4.0 SITE CONDITIONS

Battery shall be suitable for operating satisfactorily in humid corrosive atmosphere found in gas processing plants. Service conditions shall be as specified in PTS elsewhere.

5.0 TECHNICAL REQUIREMENTS

5.1 The cell/ battery shall be suitable for float duty operation at 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 supply load in the event of normal power supply failure. Battery shall be sealed maintenance free Type. The type of plate construction for batteries shall be fibrous in nature.

5.2 The rated Ampere-Hour capacity of the cell/ battery shall be at reference temperature of 27 deg C, constant current discharge at 10 hours rate (C10) and an end cell voltage of 1.75 V/ cell.

5.3 Ampere hour of the battery shall be selected based on following:

a. Minimum site ambient temperature to suit the project requirement
b. End cell voltage
c. Ageing factor of 1.25
d. Design margin of 1.1.

5.4 Number of cells and 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 cell and end cell voltage shall be as per project datasheet unless other wise specified.

5.5 Battery shall be supplied in two parallel banks of 50% capacity each. The battery shall be suitable for be ing boost charged to fully charged condition from fully discharged condition within 10 hours unless other wise specified.

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5.6 Battery assembly shall be supplied in dry and uncharged condition. Dry electrolyte and required quantities of electrolyte liquid with 10% extra quantity shall be delivered with the battery in a suitable, non-returnable, sealed containers unless otherwise specified.

5.7 Each cell shall have a separate container. The cell container shall be of high strength alkali resistant translucent material and designed to withstand mechanical stresses, shocks and vibrations.

5.8 The components such as containers, lids/ covers and seals used in the manufacture shall meet the Fire, flame and smoke resistance rating as defined in ANSI/UL94 and have an oxygen Index of at least 28 in accordance with ASTM D-2863.

5.9 The terminal posts shall be nickel-plated steel. The terminals shall be suitable for short circuit current and specified discharge current without damage to cell as a result of terminal heating.

5.10 Cells shall be designed to withstand the mechanical stresses encountered during normal transportation and handling. The battery shall be suitable for satisfactory operation at remote unattended sites. The batteries shall need minimum maintenance, which shall not be earlier than 6 months. The battery shall be installed in battery room having restricted ventilation.

5.11 A Flame arrestor shall be mounted on the cell so that all vented gasses 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 in to the cell to cause explosion.

5.12 The following information shall be permanently marked on the cell:

- Nominal voltage
- Name of manufacturer/model reference
- Rated capacity in ampere hours (Ah) with End Cell Voltage
- Voltage for float operation of 27 deg C with tolerance of ± 1%
- Month and year of manufacture.

5.13 Each set of battery shall be supplied with all accessories including but not limited to the following:

a. Battery stand. Mild steel stand pretreated and epoxy painted / PVC coated.
b. Inter cell, inter row and inter bank connectors and end take offs. These shall be of Nickel plated copper.
c. Cell number plates and fixing pings, Lugs for cable termination as required.
d. One number Cell testing voltmeter (3V –0-3V) complete with leads
e. Four pairs of Rubber gloves
f. One number Spanner
g. Any other accessories.

6.0 PERFORMANCE

Batteries shall be type tested to meet the performance requirements for each design and AH rating of cells as per IS 8340.

7.0 INSPECTION AND TESTING

Batteries shall be subject to inspection by Consultant / Owner or by a third agency authorized by the owner, to access the progress of work. Consultant / Owner's representative shall be given free access in the works from time to time for stage wise inspection and progress reporting. Two weeks advance notice shall be given to witness the final routine test and other tests as agreed upon.

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Following routine tests shall be carried out as a minimum as part of acceptance tests for each AH rating of cells/ battery. For long duration type test, type test certificates of identical Ampere Hour ratings shall be furnished.

a. Physical examination
b. Polarity and absence of short circuit
c. Marking and packing
d. Verification of dimensions
e. Air pressure test
f. Test for voltage during discharge
g. Test for AH capacity
h. Test for charges retention if specified in the date sheet.
i. Insulation resistance.

Load test shall be carried out on the Battery at site after installation as part of commissioning.

8.0 PACKING AND DESPATCH

All the equipment shall be divided into several sections for protection and case 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 bottoms for handling. Special notations such as “Fragile’, “This sideup” “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. 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 specified.

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CABLES AND ACCESSORIES

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1. SCOPE

This specification covers requirements for the supply of PVC cables for Medium Voltage, XLPE cables for High Voltage Systems and cable accessories for high voltage systems.

2. STANDARDS

The cables shall comply with the latest edition of the following standards:

IS: 1554 (Part-I)	-	PVC insulated (heavy duty) electric cables – Part I for working voltages up to and including 1100V.
IS: 1753	-	Aluminium conductors for insulated cables.
IS: 3961 (Part II)	-	Recommended current ratings for cables: Part II PVC insulated and PVC sheathed heavy duty cables.
IS: 5831	-	PVC insulation and sheath of electric cables.
IS: 7098 (Part II)	-	Cross-linked Polyethylene insulated PVC sheathed cables: Part-II for Working Voltage from 3.3 kV upto and including 33 kV.
IS: 8130	-	Conductors for insulated electric cables and flexible cords
IEC: 183	-	Guide for Selection of HV Cables.
IEC: 227	-	PVC Insulated Electrical Cables.
IEC: 502		Extruded solid dielectric insulated power cables for rated voltages from 1 kV up to 30 kV.
IEC: 885	-	Electric Test methods for Electrical Cables.

3. GENERAL CONSTRUCTION

These shall be suitable for laying in trays, trenches, ducts, conduits and underground buried installation with uncontrolled backfill and possibility of flooding by water. Extra PVC/Rubber end caps for each XLPE Cable size shall be supplied. The terminating and straight through joint kits for the cables shall be suitable for the type of cables offered and for storage without deterioration upto 50 Deg. C ambient temperature.

3.1. PVC CABLES

All the power cables of 16 sq. mm. And above shall be of aluminium and all the control cables and power cables upto 6 sq. mm. shall be of copper. The control cables shall have conductors of minimum 2.5 sq. mm. Copper.

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3.1.1. All power/control cables for use on medium voltage systems shall be heavy duty type, 1100 V grade with aluminium/copper conductor, PVC insulated, inner sheathed, armoured and overall PVC sheathed.

3.1.2. The construction of the conductors shall be 'stranded' for all cables. Conductors of nominal area less than 25 sq. mm. shall be circular only. Conductors of nominal area 25 sq. mm. And above may be circular or shaped.

3.1.3. The core insulation shall be with PVC compound applied over the conductor by extrusion and shall confirm to the requirements of Type 'A' compound of IS:5831. Control cables having 6 core and above shall be identified with prominent and indelible Arabic numerals on the outer surface of the insulation. Colour of the numbers shall be white with a spacing of maximum 500 mm between two consecutive numbers.

3.1.4. The inner sheath shall be applied over the laid-up cores by extrusion and shall be of PVC confirming to the requirements of Type ST2 PVC compound of IS:5831. The extruded inner sheath shall be of uniform thickness of size not less than those stipulated in IS: 1554.

3.1.5. For multicore cables, the armouring shall be by single round galvanized steel wires where the calculated diameter below armouring does not exceed 13 mm and galvanized steel strips where this dimension is greater than 13 mm.

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

3.2. XLPE CABLES

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

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

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

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

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

3.2.6. 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 coloured strips or by printed numerals.

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

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

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

3.3. CABLE ACCESSORIES

The termination and straight through joint kits for use on high voltage system shall be suitable for the type of cables offered as per this specification. The termination and joints shall be supplied in kit form. The kit shall include all insulating and sealing materials apart from conductor fitting and consumable items. An installation instruction shall also be included in each kit.

3.3.1. Terminating Kits

The terminating kits shall be suitable for termination of the cable to an indoor switchgear / alternator / motor.

4. TESTING AND INSPECTION

The cables shall be tested and examined at the manufacturer's works. All the materials employed in the manufacture of the cable shall be subjected, both before and after manufacture of the cable, to examination, testing and approval by OWNER/CONSULTANT. Manufacturer shall furnish all necessary information concerning the supply to Owner's Representative. The Owner's Representative 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 wire or other material which appears to him to be of unsuitable description or of unsatisfactory quality.

4.1. Cables

4.1.1. After completion of manufacture of cables and prior to despatch, cables shall be su *b*jected to type, routine, acceptance and special tests as detailed below. OWNER / CONSULTANT reserves the right to witness all tests with sufficient advance notice from Bidder. The test reports for all cables shall be got approved from the Owner's Representative before despatch of the cables.

4.1.2. All routine tests, acceptances tests, type tests as well shall be carried out on PVC cables as listed in IS:1554, Part-I.

4.1.3. The inner and outer sheath of XLPE cables shall be subjected to all the tests applicable for PVC cables. The test requirements for insulation and sheath of PVC cables shall be as per latest revisi on of IS:5831.

The following tests shall be carried out on XLPE cables as per IS:7098, Part-II.

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4.1.4. Type Tests

The following shall constitute type tests:

a) Tensile test

b) Wrapping test

c) Conductor resistance test

d) Test for armour wires

e) Test for thickness of insulation and sheath

f) Physical tests for insulation

g) Physical tests for PVC sheath:

   a) Fire Resistance

   b) Cold Impact

   c) Bleeding & Blooming

h) Partial discharge test

i) Bending tests

j) Heating cycle test

k) High voltage tests

4.1.5. Acceptance Tests

a) Tensile test (for aluminium)

b) Wrapping test (for aluminium)

c) Conductor resistance test

d) Test for thickness of insulation and sheath

e) Partial discharge test

f) High voltage test

g) FRLS test

4.1.6. Routine Tests

a) Conductor resistance test

b) Partial discharge test

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c) High voltage test

4.2. Cable Accessories

Type tests shall have to be carried out to prove the general qualities and design of a given type of termination/jointing system. The type test shall be conforming to the latest IEC:502-2, 466 specifications.

5. PACKING AND MARKING

5.1.1. Cables shall be despatched in wooden drum 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.

5.1.2. On the flange of the drum necessary information such as manufacturer's name, type size voltage grade of cable, length of cable in meters, drum no. cable code, ISI Certification mark, gross weight etc. shall be printed. An arrow shall be printed on the drum with suitable instruction to show the direction of rotation of the drum.

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GTS – FLAMEPROOF & WEATHERPROOF EQUIPMENT

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GTS – FLAMEPROOF & WEATHERPROOF EQUIPMENT

1.0 SCOPE

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This specification covers the requirements of design, manufacture, testing, packing and supply of flameproof & weatherproof Power Distribution Boards, Lighting Fixtures, Junction Box, Control Stations, plugs, sockets, transformers, hand lamps and accessories suitable for installation in locations handling flammable liquids and gases.

2.0 CODES AND STANDARDS

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

Standards		Description
IS-5	-	Colours for ready mixed paints and enamels
IS-1248	-	Direct acting indicating analogue measuring instruments and accessories
IS-2148	-	Flameproof enclosures for electrical apparatus
IS-6381	-	Electrical apparatus for explosive gas atmosphere – increased safety's'
IS/IEC -60079-0	-	Electrical apparatus for explosive atmosphere (General Requirements)
IS / [EC 60079-1	-	Electrical apparatus for explosive gas atmospheres (Equipment Protection by Flameproof Enclosures "d").
IS / IEC 60079-7	-	Electrical apparatus for explosive gas atmospheres (Equipment Protection by Increased Safety "e").
IS / IEC 60529	-	Degrees of protection provided by enclosures (IP Code).
IS / IEC 60947	-	LV switchgear and control gear.

2.2. 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.

2.3. The equipment shall also conform to the provisions of CEA Regulations 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 conflict between requirements specified in various applicable documents for the project, the most stringent one shall prevail. However, Owner's decision in this regard will be final and binding.

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3.0 GENERAL REQUIREMENT

3.1. The offered equipment shall be brand new with state of art technology and proven field track record. No prototype equipment shall be offered.

3.2. Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least 10 years from the date of supply.

4.0 SITE CONDITION

R1

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 and fertilizer plants. The lighting and power panels shall be designed to operate under site condition. If not specifically mentioned, ambient temperature of 50° C & design temperature of 55° C and an altitude not exceeding 1000 m above mean sea level shall be considered.

5.0 CERTIFICATION

R1

The equipment shall have test certificates issued by recognized independent test house (CIMFR/ CPRI/ERTL/Baseefa/LCIE/UL/FM or equivalent) and accepted to PESO and must also be approved by PESO and/ or any other statutory authority such as UL/ FM/ BASEEFA/ PTB/LCIE/ RIIS in its country of origin as required. 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 marking as required by statutory authorities.

6.0 TECHNICAL REQUIREMENTS

6.1. Construction

R1

6.1.1. The enclosures of the plugs, sockets, transformers and hand lamps 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.

6.1.2. The equipment shall be suitable for use in outdoor open locations and shall have IP-55 degree of protection. The sockets for fixed installation, i.e. 415 V three phase sockets and 240 V single phase sockets, 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) galvanized sheet steel or FRP. The canopy shall be suitable for providing protection against rain from top and two sides.

6.1.3. The enclosures shall be provided with gaskets made of non inflammable and self extinguishing material.

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6.1.4. Indicating lamp(s) wherever provided shall be clustered LED type (with minimum 3 numbers LEDs, preferably connected in parallel), mounted inside an enclosures of minimum diameter of 15mm.

6.1.5. All internal wiring shall employ 2.5 mm2, 660V grade, PVC insulated copper conductor wires.

R1

6.1.6. Bus bars in the lighting and power panels shall be made of high conductivity copper, and shall be supported by non-hygroscopic insulators. Bus bars shall be colour coded for identification of phases and neutral.

6.1.7. The outgoing feeders shall be provided with double pole MCBs having overload and short-circuit releases.

6.1.8. All MCBs (except isolators) and ELCBs shall be with 10kA breaking capacity.

6.1.9. Wherever the size of incoming cable to lighting panels is more than 35 sq.mm. a suitable cable adapter box shall be provided and attached to the panel.

6.1.10. All metal surfaces shall undergo manufacturer's standard cleaning painting cycle. After preparation of under surface, the equipment shall be painted with two coats of epoxy based final paint with colour shade as below:

-Flame proof (Gas group IIAI IIB)	: Dark admiralty grey shade 632 of IS-5/RAL 7035
-Flame proof (Gas group IIC)	: Light yellow shade 355 ofIS-5

R1

Flameproof enclosure shall be suitable for zone 1 & 2, gas group IIA / IIB or IIC(wherever specified) & temperature class T3.

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

6.1.11. 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 plate shall be of nickel plated brass or stainless steel.

6.1.12. All accessories like nuts, bolts, washers etc. shall be made of stainless steel SS-3 04.

6.1.13. All the non current carrying metallic parts of the equipment shall be inherently bonded together. The TPN sockets shall be provided with two earthing studs, with lugs on the exterior of the enclosure, suitable for termination of 10 mm dia. GI wire rope. Internal earth terminals shall be provided in each enclosure for all single phase plugs and sockets for connecting the earth core of the cables.

6.1.14. 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 & Up to 70mm^2**

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Gland to Terminal Distance	40mm	60mm	100mm	150mm

6.1.15. The sockets shall be provided with 2 nos. suitably sized cable entries at the bottom for specified cable sizes and complete with 2 nos. flameproof double compression type nickel plated brass flameproof cable glands. The plugs shall be supplied with l no. suitably sized cable entry for specified cable size and complete with l no. double compression type nickel plated brass flameproof cable gland. Each socket shall be supplied with 1 no. flameproof nickel plated brass sealing plug, for plugging the unused cable entry.

6.1.16. The sockets shall have external fixing lugs for mounting on wall or column. The holes provided on these lugs shall be of oblong type.

6.1.17. A nameplate indicating Tag Number shall be provided on each socket. 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. The nameplates shall be engraved type and permanently fixed on the equipment. In case the standard details given above are embossed on the enclosures, the same need not be repeated on the nameplate.

R1

6.2. **Socket Outlets & Plugs and Welding Receptacles**

6.2.1. The sockets shall be provided with a switch and a mechanical interlock so as to break the electrical circuit before the plug is completely withdrawn and make the circuit after the plug is fully inserted.

6.2.2. In order to prevent accidental removal of plug from socket, the engagement and disengagement shall be by two separate and distinct movement and positions.

6.2.3. 415V, 63A three phase flameproof plugs and socket meant for welding receptacle/ any other three phase auxiliary load, shall be provided with 4 pins (3P+E).

6.2.4. 4 pin sockets shall be provided with 63A, three pole heavy duty switch; whereas, 5 pin sockets shall be provided with four pole (TPN) heavy duty switch.

6.2.5. 24V and 240V, I5A single phase flameproof plug and socket shall be provided with 3 pins (2P+E).

6.2.6. Provision shall be made so that it shall not be possible to insert 24V plug on to a 240V socket.

6.2.7. The sockets shall be provided with either a spring loaded hinged cover, or with a cap connected through metallic chain, to close the same when not in service.

6.2.8. Scraping earth connection shall be provided between the plug and socket. Earth pin of plug shall first engage with earth pin of switch socket.

6.2.9. The plug assembly shall be mechanically rugged, light and shall not unduly stress the socket or its own pins when fitted on to the socket. The diameter of the earth pin of the plug and socket shall be at least 1.1 times the diameter of the phase pins.

6.3. **240V/ 24V Portable Transformer Units**

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6.3.1. The 240V/ 24V portable transformer unit shall be supplied complete with 240V/ 24V transformer having a 24V socket on the secondary side and 5 meter length of 3 x l.5 mm^2 copper conductor, PVC insulated, metal braided flexible cable, duly terminated in the transformer primary at one end and having 240V plug on the other end. The socket outlets and plugs shall meet the requirements of clause 6.2 above.

6.3.2. The 240V/ 24V transformer shall be designed for 100VA rating on continuous basis. HRC fuses shall be provided on primary and secondary side of the transformer. The transformer shall have an earthed screen between primary and secondary winding.

6.3.3. Suitable handle for carrying the transformer unit shall be provided.

6.4. **24V Hand Lamp Units**

6.4.1. Each hand lamp unit shall be supplied complete with l5 meter length of 3 x l.5 mm^2 copper conductors, PVC insulated, metal braided flexible cable, duly terminated in the hand lamp at one end and having 24V plug on the other end. The plug shall meet the requirements of clause 6.2 above.

6.4.2. The well glass provided shall be clear and toughened type.

6.4.3. Hand lamp shall be provided with either galvanised steel or epoxy powder coated mild steel protective wire cage using minimum 5mm welded steel construction and having mesh dimension not exceeding 50mm x 70mm.

6.4.4. The lamp holder of the hand lamp shall be suitable for 60W, 24V, 50Hz lamp with ES cap.

6.4.5. Suitable handle for carrying the hand lamp unit and a stand type guard suspension hook shall be provided.

R1

6.5. **Flame Proof and weather Proof Junction Box and Control Stations**

6.5.1. Push buttons for START and STOP shall be of GREEN and RED colour respectively. Unless otherwise specified, each push button shall have one normally open and one normally closed contact. The STOP push button shall be mushroom type with stay put feature and lockable in pressed position.

6.5.2. All control switches shall be provided with a pistol grip handle. Unless otherwise specified, all selector switches shall have minimum two poles for each position. Each position of switch shall be indelibly marked on the control station.

6.5.3. All ammeters shall be of moving iron type having an accuracy class of 3 and suitable for 1Ampere CT secondary. Unless otherwise specified, min. size of ammeter shall either be 72mm x 72mm or min. 65mm dia. 80% of the scale length shall cover 100% of the CT current uniformly and the balance 20% of the scale cover 100-600% of the CT primary. A red mark corresponding to the full load current of the motor shall be provided on the ammeter dial. The ammeter front glass shall be toughened (Type 'A' glass).

6.5.4. All push button and control switch contacts shall be rated for min. 5Amps at 240V AC-15.

6.5.5. For increased safety junction boxes, the terminals shall be provided with positive locking device against loosening.

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6.5.6. The enclosure shall be in addition, of increased safety execution, Exe, as per relevant standard and shall be suitable for installation specified in specification sheet.

6.5.7. The junction boxes shall be liberally dimensioned in order to avoid temperature rise inside the enclosure which may damage the insulating materials or gaskets employed therein.

6.5.8. Cables shall enter the terminal box through increased safety compression type cable glands. From the terminal chamber to the main enclosure, the connections shall be made through proper bushings.

6.5.9. An additional earthing terminal inside the terminal chamber shall be provided.

6.5.10. The junction boxes shall be provided with Brass-Nickel plated shorted links. The terminal block shall be made of non-hygroscopic compound. Bakelite / Hylam shall not acceptable.

6.5.11. All screws / bolts and nuts shall be of stainless steel.

6.5.12. Junction boxes and cable glands must be certified by Statutory Authorities for use in the specified hazardous area. Equipments certified by overseas authorities shall obtain certificate of compliance / letter of opinion from respective statutory authorities.

6.5.13. Duly wired prototype samples for junction boxes shall be submitted for scrutiny as and when called for.

6.5.14. Type Test certificates for increased safety type junction boxes and cable glands along with blanking plugs shall be supplied.

R1

6.6. **Flameproof and weatherproof lighting fixture**

6.6.1. The construction of lighting fixtures shall be such that replacement of lamp or any normal maintenance of fixture shall not affect their suitability for use in classified area.

6.6.2. Glass used for lighting fixture shall be clear suitable for use under conditions involving exceptional risk of mechanical damage.

6.6.3. Well glass lighting fixture for Zone 2 classified area shall meet requirement IS 6381.

6.6.4. Mechanical strength of well glass shall satisfy requirement of IS 2206 (for type A glass) for flameproof 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 50 mm.

6.6.5. Glass used for aviation and navigational lighting fixture shall be coloured in itself.

6.6.6. 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”.

6.6.7. All lighting fixtures which are not certified as flameproof construction but approved for use in Zone-2 are shall have approved enclosed break lamp holder and complete enclosure certified as having restricted breathing type construction. Lamp holder shall be screw type.

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6.6.8. All lighting fixtures suitable for discharge lamps shall be provided with one ¾" ET threaded entry and supplied with approved type double compression nickel-plated brass cable gland.

6.6.9. All lighting fixtures suitable for incandescent lamps shall be provided with two ¾" 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.

6.6.10. The top of all well glass lighting fixtures shall be identically drilled/ threaded to facilitate the installation on pole / column or ceiling.

6.6.11. All flood lighting fixtures shall be supplied with adjustable mounting arrangement both in horizontal and vertical plane.

6.6.12. Lighting fixtures suitable for discharge lamps shall be provided with power factor correction capacitor, choke starter, etc. housed in separate control gearbox. 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.

6.6.13. Control gearbox shall be provided with three ¾" ET threaded entry (incoming, supply to lighting fixture and for looping to other fixture/ control gear box). The control gearbox shall be supplied with approved type three double compression nickel-plated brass cable glands and one threaded plug for sealing used entry.

6.7. **Terminals & Wiring**

6.7.1. 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. The terminals shall be suitable for termination of solid conductors up to 6 mm^2 and stranded conductors above 6 mm^2. Tinned copper lugs shall be provided for cable termination.

6.7.2. All internal wiring shall employ adequately sized, 660V grade, PVC insulated Copper conductor wires, colour coded for phase, neutral and earth, with minimum conductor sizes as below:

TPN Plugs and sockets:	16 mm^2
SPN Plugs and sockets:	2.5 mm^2

6.7.3. For flameproof equipments, terminal box can be provided in 'Exe' execution.

7.0 INSPECTION, TESTING AND ACCEPTANCE

7.1. During fabrication, the equipment shall be subjected to inspection by 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 Owner/ Owner's inspector. All routine acceptance tests shall be carried out at manufacturer's works, under his care and expense.

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7.2. Type test certificates from CIMFR or equivalent test house, applicable PESO / CCE / DGFASLI / 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:

7.4.1. General visual inspection

7.4.2. Dimensional inspection

7.4.3. Verification of mechanical and electrical operations

7.4.4. Dielectric tests

7.4.5. Over pressure test (for flameproof plugs and sockets)

7.4.6. Static hydraulic test for flameproof lighting fixtures

7.4.7. Thermal shock test for flameproof lighting fixtures

7.4.8. Durability test for flameproof lighting fixtures

7.4.9. Any other routine and acceptance test as per applicable standards.

8.0 PACKING AND DESPATCH

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. 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.

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SHEET STEEL DISTRIBUTION BOARDS

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1. SCOPE

1.1. This standard covers the technical requirements of design, manufacture, testing at works and delivery in well-packed condition of Sheet Steel Distribution Boards.

1.2. This standard shall be read in conjunction with relevant Specification Sheets and Feeder details.

2. STANDARDS TO BE FOLLOWED

2.1. The Design, manufacture and testing of the equipment shall comply with the latest issue of the following Indian Standards, unless otherwise specified.

IS : 8623	--	Specification for low voltage switchgear and control gear assemblies.
IS : 13947	--	General requirement for switchgear and control gear for voltages not exceeding 1000 V AC and 1200 V DC.
IS : 5578	--	Guide for marking of insulated conductors.
IS : 11353	--	Guide for uniform system of marking and identification of conductors and apparatus terminals.
IS : 10118	--	Code of practice for selection, installation and maintenance of switchgear and control gear.

Various components housed in the distribution board shall conform to the Indian Standard Specification as mentioned against the component details.

2.2. The design and operational features of the equipment offered shall also comply with the provisions of the latest issue of the Indian Electricity Rules and other Statutory Acts and Regulations. the supplier shall, wherever necessary, make suitable modifications in the equipment to comply with the above.

2.3. Wherever any requirement, laid down in this standard, differs from that in Indian Standard Specification the requirement specified herein shall prevail.

3. SERVICE CONDITIONS

3.1. AMBIENT CONDITIONS

These shall be as indicated in Specifications Sheet.

3.2. SYSTEM DETAILS

These shall be as indicated in Specification Sheet.

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4. OPERATING REQUIREMENTS

The distribution board shall be suitable for operating at the specified rating continuously with the specified voltage and frequency variations under the ambient conditions indicated in Specification Sheet, without exceeding the permissible temperature rise and without any detrimental effect on any part.

5. DESIGN AND CONSTRUCTIONAL FEATURES

5.1. GENERAL

5.1.1. The distribution board shall consist of an assembly of a series of floor mounting, identical, metal clad, dead front type panels of unitised design. The panels shall be placed side by side to form a compact assembly and shall be extensible on either side.

5.1.2. The complete assembly shall be dust, damp and vermin proof having minimum degree of protection equivalent to IP-52 as per IS:13947.

5.1.3. The frame work of the cubicles shall be of bolted/welded construction. The minimum thickness of steel shall be 2 mm for load bearing members, 1.6 mm for non-load bearing members and 3 mm for base channel. The doors and covers shall be fabricated from cold rolled sheet steel. Suitable reinforcement, wherever necessary, shall be provided.

5.1.4. The door hinges shall be concealed type.

5.1.5. All external hardware shall be cadmium plated/zinc passivated. The hardware for fixing the removable parts shall be provided with retaining devices.

5.1.6. The doors and the removable covers shall be provided with non-deteriorating neoprene gaskets. Gaskets without any discontinuity shall be preferred. Gaskets shall be held in position in groove of shaped sheet steel work or these shall be of U type. Adhesive cement, if used, shall be of good quality so that the gasket do not come off during service.

5.1.7. All the components shall be accessible for inspection and maintenance without the necessity for removal of the adjacent ones. In case of single front design all components shall be accessible from the front for maintenance and back opening doors/openable covers for maintenance shall not be acceptable.

5.1.8. The layout of the components inside a module shall be liberal to facilitate maintenance and the interconnection of wiring between the components shall not be subjected to any undue stress at the bends.

5.1.9. Mounting height of components requiring operation and observation shall not be lower than 300 mm and higher than 1800 mm.

5.1.10. Inter panel barriers shall be provided.

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5.1.11. Adequate arrangement for earthing shall be provided to safeguard the operator or other personnel from electric hazards under all conditions of operation.

5.2. PANEL ARRANGEMENT

5.2.1. The distribution board shall be drawout/non-drawout type in single front/double front configuration as specified in Specification Sheet.

5.2.2. Each Panel shall have its horizontal bus-bar chamber running on the top with multi-tier module units in the centre and having vertical bus-bar chamber and cable alley on either side.

5.2.3. The modules shall be enclosed on all sides and shall be so arranged that larger ones are placed at the bottom portion of the panel. Fixed type modules shall be at least 300 mm from the base channel.

5.2.4. The number of modules in the panel shall not exceed six for motor starter feeders and eight for switch fuse/MCB/MCCB feeders. The minimum size of module shall be 300 mm and 200 mm for starter and switch fuse feeders. The incomer and bus coupler module sizes for ratings upto 400 A shall be half the panel size. For higher ratings they shall be housed in single panel.

5.2.5. The module door shall be so interlocked that it shall not be possible to open the door with switch/MCCB in closed position. Defeat interlock facility shall be provided.

5.2.6. The relay, meters, switches/MCCB and lamps shall be flush mounted. All components of one module shall be mounted on the same module on a rigid sheet steel chassis. A 20 mm dia rotating knob on the door shall be provided for closing and opening.

5.3. BUS BARS AND CONNECTIONS

5.3.1. The bus-bar shall be suitable for the supply system specified in the Specification Sheet. The bus-bar and connections shall be made of electrolytic copper or high conductivity aluminium alloy conforming to Grade E91E of IS:5082.

5.3.2. The bus-bar shall be amply sized to carry the rated continuous current under the specified ambient temperature without exceeding the temperature of 90°C. The bus-bars shall also be designed to withstand the system fault current for 1 second without exceeding the temperature of 200°C for bare aluminium and 250°C for bare copper. The minimum acceptable size of bus-bars shall be 250 Sq.mm (Al). Calculation for the bus-bar sizing shall be furnished for review.

5.3.3. In case of double front arrangement of distribution boards different sets of vertical bus-bars shall be provided. The vertical bus-bars shall be PVC sleeved or shrouded by insulating barriers which shall have cutouts to permit entry of power wires. It shall be possible to remove the shroud for inspection and maintenance. Neutral-bars shall be provided in this chamber.

5.3.4. Horizontal bus-bars shall be of same cross-section through out. Stepped bus-bars shall not be acceptable.

5.3.5. All bus-bars shall be arranged and colours coded according to IS:5578/11353.

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5.3.6. The horizontal bus-bar shall run in a separate bus chamber located at the top shall have separate screwed cover for inspection purpose.

5.3.7. The bus-bars shall be rigidly supported at equal intervals to withstand maximum short circuit stresses. The supports shall be of moulded construction with built-in anti tracking barriers. The support material shall be of fibre glass reinforced thermosetting plastic.

5.3.8. All joints shall be suitably treated to avoid oxidation of contact surfaces and bimetallic corrosion. A minimum of two bolts with spring washers shall be used for horizontal bus-bar joints.

5.3.9. Horizontal bus bars shall be insulated with heat shrinkable PVC sleeves of reputed makes. Insulating shrouds shall be provided for all joints of insulated bus-bars.

5.4. CLEARANCE AND CREEPAGE DISTANCES

5.4.1. The clearance and creepage distances shall not be lower than the values specified below:

i)	Minimum clearance between two live conductors	--	20 mm
ii)	Minimum clearance between live part and accidentally dangerous part	--	20 mm
iii)	Minimum creepage distance	--	28 mm

5.4.2. The clearances and the creepage, as specified above, shall definitely be maintained in the bus-bar system. Provision of bus-bar insulations, separator or barriers shall not be considered to reduce the clearance from the values specified above.

5.4.3. At the termination points in the equipment, e.g. MCCB, switches, contactors, thermal relays, etc. it is realised that above clearance may not always be possible to be maintained. All such points where above clearance are not possible to be maintained should, therefore, be insulated or taped.

5.5. INSULATION

5.5.1. The insulation used shall be non-hygroscopic and may be of porcelain, Epoxy-resins or fibre glass moulded with plastic. It shall be of adequate electrical and mechanical strength to give trouble free service during normal operation and short circuit conditions.

5.5.2. The insulation shall be treated suitably to withstand the tropical conditions and atmospheric pollution as specified in Specification Sheet.

5.6. POWER WIRING

5.6.1. The connections from bus-bar including neutral to individual units on the modules shall consist of PVC insulated flexible copper cable or tapped copper strip.

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5.6.2. The power wiring size shall be decided based on the rating of the switch, MCCB after using a rating factor of not more than 50% over the current rating in free air. In any case the minimum size of power wiring shall not be less than 4 Sq.mm copper.

5.6.3. the size of connection from incomer to horizontal bus-bar and from horizontal bus-bar to bus coupler shall not be less than the size adopted for horizontal bus-bar.

5.7. CONTROL WIRING

5.7.1. The switch board shall be completely factory wired and ready for external connections.

5.7.2. The wiring shall be carried out with flexible stranded PVC insulated copper conductor cables of 1100 Volt grade. The size of wires shall be as follows:

C.T. Circuit	--	2.5 Sq.mm
V.T. and Control Circuits	--	1.5 Sq.mm

5.7.3. All wiring shall be provided with dependent both end marking as per IS:5578. Numbered ferrules, reading from the terminals outwards, shall be provided at both ends of all wiring for easy identification. These shall be interlocking type plastic ferrules.

5.7.4. Control wiring circuits, fed from a supply common to a number of feeders, shall be so protected that failure of a circuit in one feeder does not affect the operation of the other feeders.

5.7.5. The wiring to the equipment mounted on the doors shall be carried out with flexible multi strand copper conductor cable and supported so that opening of the door, there is no undue strain on wire leads.

5.7.6. The control cables shall be neatly arranged and properly supported.

5.8. EXTERNAL CABLE TERMINATION

5.8.1. All power and control cables shall enter the distribution board from the bottom unless otherwise specified in Specification sheet. Sufficient space shall be provided for ease of connection and termination of cables.

5.8.2. All cables shall be of 1.1 KV grade PVC insulated armoured and PVC sheathed except for single core cable which may be unarmoured. The number and sizes of cable shall be as indicated in Feeder details.

5.8.3. Compression type cable glands alongwith the cable lugs as required and shall be provided for termination of cables.

5.8.4. The cable glands shall be of rolled Aluminium or Nickel/Cadmium plated brass heavy duty double compression type and shall be mounted on a removable gland plate, provided at a minimum height of 75 mm from the bottom of the distribution board. Two numbers spare knockouts of size 20 mm shall also be provided on the gland plates for future use.

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5.8.5. For all power cables crimped type aluminium lugs for aluminium cables and tinned copper lugs for copper cables shall be provided.

5.8.6. Terminal Block for control cable are pressure clip type and Terminal Block for power cables are bolted type. These shall be protected type and rated for 1100 Volts service. The minimum current rating of terminal block shall be 16 Amp. The construction shall be such that after the connection of cables by means of lugs, necessary clearance and creepage distance are available.

5.8.7. Where more than two cables in parallel are required to be terminated, a system of bus links shall be provided with adequate clearance and spacing.

5.8.8. Suitable clamps to support the vertical run of cables shall be provided.

5.8.9. The terminal block shall be grouped according to circuit functions and suitably numbered. 20%extra terminals shall be provided in the terminal block.

5.8.10. For power connections, suitable marking on the terminals shall be provided to identify the phases.

5.9. FEEDER DETAILS

5.9.1. The requirements of incomer, bus coupler and outgoing feeders shall be as indicated in the single line diagram, feeder details and corresponding schematic diagram.

5.9.2. The bus coupler shall be so located that it is possible to maintain half of the bus-bars while the other half is still alive. Complete segregation of bus-bar connections to bus coupler shall be provided.

5.9.3. Castle key type mechanical interlocks shall be provided between incomers and bus section modules to avoid paralleling of incomers. In addition padlocking facilities shall be provided in OFF position.

5.9.4. Single phase loads shall be distributed as far as possible on all the three phases.

6. COMPONENT DETAILS

6.1. The make of the components shall be as specified in Specification Sheet and shall conform to type of co-ordination C as per IS:13947.

6.2. MOULDED CASE CIRCUIT BREAKERS

6.2.1. The MCCB shall conform to IS:13947 (Part 2) and shall having rupturing capacity as specified in Specification Sheet.

6.2.2. The MCCB shall be provided with quick make, quick break type manually operated trip free mechani sm, thermal tripping devices of inverse characteristics, instantaneous short circuit tripping devices and necessary auxiliary and alarm switches.

6.2.3. The thermal and short circuit tripping device shall be adjustable type.

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6.2.4. In addition, under voltage trip shall be provided, if specified.

6.3. SWITCHES

6.3.1. The switches shall be Motor duty type AC23 category and shall comply with the requirements laid down in IS:13947 (Part 3). Switches upto 63 Amps shall be rotary type and those of 100 Amp and above shall be link type.

6.3.2. 'ON' and 'OFF' positions of the switches shall be indicated on the panel. Provision shall be made to lock the switch in the 'OFF' position.

6.3.3. The fixed contacts shall be shrouded and the contacts shall be silver plated.

6.3.4. Two Pole switches shall also isolate the neutral circuit alongwith phase circuit. 4 Pole / 2 Pole switches shall be used for 3 Phase/1 Phase circuits respectively.

6.4. FUSES

The fuses shall be of non-deteriorating HRC cartridge link type and conform to IS:9224. They shall be suitable for the load and the service required in the circuit.

6.5. AIR BREAK CONTACTORS

6.5.1. The Air Break Contactor shall be of AC3 category unless otherwise specified, conforming to IS:13947 (Part-4).

6.5.2. The dropout voltage shall not exceed 65% of rated voltage.

6.5.3. Each contactor shall be provided with auxiliary contacts as required. The rating of the auxiliary contacts shall be 5 Amps. AC or 1 Amp. DC at the specified control voltages. The spare auxiliary contacts shall also be wired terminal block.

6.6. BIMETAL THERMAL OVERLOAD RELAYS

6.6.1. The contactor shall be provided with three pole bimetal thermal overload relays unless otherwise specified. The bimetal relays shall be of suitable range, ambient temperature compensated and shall be separate mounting type. They shall be adjustable through graduated scale and shall be provided with changeover contact.

6.6.2. Bimetal relays shall conform to IS:3231 and shall have built in single phasing preventor.

6.6.3. The bimetal relays shall be provided with a manual reset device resettable after opening the cubicle door. Auto reset thermal relays are not acceptable.

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6.7. CURRENT TRANSFORMERS

6.7.1. The current transformers shall conform to IS:2705.

6.7.2. Current Transformers shall be cast resin. The Current Transformers shall be rigidly mounted and shall be easily accessible for maintenance and testing.

6.7.3. The Current Transformers shall be of 5 VA output or as specified in SLD/Data Sheet. The output shall be adequate for the instrument and metering duties involved with sufficient margin. The Current Transformers shall have the accuracy Class-1 for the metering duty.

6.7.4. All the Current Transformers shall be provided with terminals and shorting links. One of the terminals of C.T. shall be earthed. The polarity of the C.T. shall be clearly marked.

6.7.5. The C.T.s shall be capable of withstanding momentary open-circuit on the secondary side without injurious effects.

6.8. INSTRUMENTS AND METERS

6.8.1. All instruments shall be flush mounting type with square face and shall be tropicalized and dust tight.

6.8.2. The size of the instruments shall be 96 mm x 96 mm for full and half size modules and 72 mm x 72 mm for lower size modules.

6.8.3. Dials shall be parallax free with scale marked in black on white background and shall be suitable for direct reading.

6.8.4. Zero adjusters shall be provided for operation from the front of the cases.

6.8.5. All ammeters and voltmeters shall have $0 - 90^{o}$ scale moving iron spring controlled type and of Class 1.5 accuracy as per IS:1248. The scale range of the ammeter and voltmeter shall be as indicated in the feeder details.

6.8.6. In case of motor feeders, the ammeter shall be graduated uniformly upto C.T. primary current and with a compressed end scale upto 6 times the C.T. primary current. Red pointer shall be provided, which can be adjusted at site for indicating full load current.

6.8.7. KWH meter shall be 3 phase 4 wire type. These shall conform to the requirements of IS:722 and shall be C.T. operated. The current coil shall be rated for 5 Amp.

6.8.8. All kWh meters shall be provided with test blocks for current and voltage coils for testing them at site without interrupting their recording while in service.

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6.9. PUSH BUTTON AND CONTROL SWITCHES

6.9.1. The switches and push buttons shall conform to utilization category AC 11 / DC 11 as per IS:13947 (Part-5). The contact shall be rated to make, break and carry inductive current of 5 Amp. At 415 V AC and 1 Amp at 220 V DC.

6.9.2. The control switches shall be spring return rotary type unless otherwise specified and provided with pistol grip type handle. The control switches for circuit breakers shall be additionally fitted with lost motion devices and sequencing devices.

6.9.3. The selector switches shall be stay-put rotary type and provided with oval shape handles.

6.9.4. The push buttons shall be of momentary contact spring loaded type with a set of normally close and open contacts. The push button for 'Start' shall be shrouded type and coloured green, stop push button shall be enshrouded type and coloured red and other push buttons shall be enshrouded type coloured black. The fixing ring shall be metallic white.

6.9.5. Emergency stop push buttons, if specified, shall be lockable in pushed position.

6.10. MINIATURE CIRCUIT BREAKERS

6.10.1. The miniature circuit breakers shall conform to IS:13032 and shall be of duty category M-9.

6.10.2. It shall be provided with overload and short circuit protective devices in a heat resistant housing.

6.10.3. A certificate of short circuit rating and current time tripping curve shall be furnished alongwith the offer.

6.11. SIGNAL LAMPS

6.11.1. Signal lamps shall be provided to indicate the various circuit conditions as shown in scheme drawings. The colour of the lamps for various functions shall be as follows:

Red -- Switch/Contactor closed.

Green -- Switch/Contactor open.

6.11.2. The lamps shall be LED type having lumen output 200 millicandella in axial direction.

6.11.3. It shall be possible to remove the globe from outside for replacement of lamps.

6.12. CIRCUIT BREAKER

6.12.1. The circuit breakers shall be of air break and of horizontal drawout construction, with 3 poles and isolable bolted neutral link.

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6.12.2. Circuit breakers may be hand operated or power operated as called for in the data sheets.

The closing mechanism of the circuit breakers shall be of one of the following types :-

1. Hand operated, spring charged, independent manual type.

2. Motor wound, spring charged with a provision of manual charging

6.12.3. The operating mechanism shall be mechanically and electrically trip-free and non-pumping. Anti-pumping feature may be built in for a separate anti-pumping relay may be provided. A mechanical closing device may be provided, if feasible.

6.12.4. A mechanical trip device suitable for front of board operation and a mechanical 'ON-OFF' indicator shall be provided. Trip device should be shrouded to prevent inadvertent mal operation.

6.12.5. A series or shunt trip coil, as called for in the Data Sheets shall be provided for tripping the circuit breakers. Wattage of shunt trip coils will be sufficiently high to prevent it from picking up or holding on with specified number of indicating lights wired in series with the same.

6.12.6. Provision shall be made for remote closing and tripping of the circuit breakers, with electrically operated mechanism. A 'local/remote' selector switch shall also be provided wherever called for in the Data Sheets.

6.12.7. A maintenance closing device for slow closing and slow opening of circuit breakers shall also be provided, if feasible.

6.12.8. In case of spring charged mechanism, 'Spring Charged' indication (mechanical) shall be provided.

6.12.9. Interlock shall be provided to prevent plugging in or withdrawal of circuit breaker trolley unless it is open. Any attempt to do so shall trips the circuit breaker.

6.12.10. Interlock to prevent closing of circuit breaker, unless it is in 'SERVICE' or ' TEST' position, shall be provided.

6.12.11. Main contacts shall have ample area and adequate contact pressure to carry the rated and short time current without excessive temperature rise. The contacts shall be adjustable for wear and easily replaceable. Main contacts shall open before and close after the arcing contacts, when these are provided. Arcing contacts shall be easily accessible for inspection and replacement.

6.12.12. The tips of main and arcing contacts shall be silver plated or shall be of suitable material, to minimise erosion of contacts due to arcing.

6.12.13. Auxiliary switches directly operated by the breaker mechanism shall be provided for control and interlocks. A minimum of six normally open and six normally closed contacts shall be provided. The contacts shall be preferably convertible from NO to NC and vice versa. The contacts shall also be capable of adjustments to enable early closing or delayed opening with reference to breaker main contacts. The contacts shall be rated for 10 Amp. at 240V A.C. / D.C. All spare contacts shall be wired upto terminal block. Auxiliary contacts in the "trip" circuit shall close before the breaker main contacts close and shall open after the main contacts have opened. All other contacts shall operate simultaneously with the main contacts.

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7. ACCESSORIES

7.1. The supplier shall include the following accessories.

-- Fuse Puller.

-- Test plug for kWh meters.

7.2. SPACE HEATER

Each vertical section shall be provided with a thermostatically controlled space heater, rated for 240 V, 50 Hz and controlled through double pole miniature circuit breaker.

7.3. NAME PLATES

7.3.1. The distribution board shall have large name plate. Each single front panel shall have name plate both in front and back.

7.3.2. Each feeder shall be provided with name plate. Each single front panel shall have name plate both in front and back.

7.3.3. All control switches, push buttons, lamps, etc. shall have functional identification labels.

7.3.4. Name plate shall be of black perspex with white engraving and of minimum 3 mm thick.

7.3.5. Any other accessories required, but not specified shall also be supplied to make the distribution board complete in all respects to ensure safe and proper operation.

7.3.6. Load Manager

- Load Manager will display KWH, Real Time, Date, Voltage, Current, Power Factor, Frequency, Instantaneous Load (KW), MD-KW, KV Arh, KVAH, KVA.
- Load Manager shall have RS 232/RS 485/MODBUS protocol for communication to SCADA.
- Load Manager shall communicate KWH, MDKW, Voltage, Current, Power Factor, Frequency, etc. to Supervisory Control and Data Acquisition (SCADA).

8. PAINTING

8.1. The enclosure after degreasing, pickling in acid, cold rinsing phosphatising, passivating etc. shall be painted with two coats of anti-rust paint followed by two coats of anticorrosive paint.

8.2. Epoxy based paint shall be used, if indicated in Specification Sheet.

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8.3. All paints shall be carefully selected to withstand tropical heat and extremes of weather. The paint shall not scale off, crinkle or be removed by abrasion due to normal handling.

8.4. Unless otherwise specified, the finishing shade shall be light grey Shade No. 631 as per IS:5.

8.5. One litre of paint shall be supplied alongwith each board for touch up at site.

9. TESTS AND INSPECTION

9.1. THE DISTRIBUTION BOARDS SHALL BE SUBJECTED TO ROUTINE TEST AS PER IS:8623.

9.2. Additional tests, wherever specified, shall be carried out.

9.3. All the above tests shall be carried out in presence of purchaser's representative. In addition, the equipment shall be subjected to stage inspection during process of manufacture at works and site inspection.

9.4. These inspection shall however, not absolve the vendor from his responsibility for making good any defect which may be noticed subsequently.

10. DRAWINGS AND DOCUMENT

10.1. DRAWINGS AND DOCUMENTS AS PER ANNEXURE-I SHALL BE SUPPLIED.

10.2. ALL DRAWINGS AND DOCUMENTS SHALL HAVE THE FOLLOWING DESCRIPTION WRITTEN BOLDLY:

-- Name of client

-- Name of Consultant .

-- Enquiry / Order Number with Plant/Project Name.

-- Code No. and Description.

11. SPARES

11.1. Itemwise unit prices for spare parts as listed in Annexure-II shall be offered along with main equipment with recommended quantity for the period as stipulated in Specification Sheet.

11.2. Any other spare parts required, but not specified, shall also be offered.

12. PACKING

12.1. The distribution board shall be properly packed before despatch to avoid damage during transport, storage and handling.

12.2. The packing box shall contain a copy of the installation, operation and maintenance manual.

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12.3. A sign to indicate the upright position of the panels to be placed during transport and storage shall be clearly marked. Also proper arrangement shall be provided to handle the equipment.

13. DEVIATIONS

Deviations, if any, from this standard shall be clearly indicated in the offer with reasons thereof. Deviations from the data indicated in Specification Sheet shall be shown clearly by encircling it and indicating the revised data in Specification Sheet.

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ANNEXURE - I

DOCUMENTATION FOR SHEET STEEL DISTRIBUTION BOARDS

Sl. No.	Description	With BID	After Order			
			For Approval		Final	
		No. of copies	No. of copies	No. of weeks	No. of copies	No. of weeks
1.	Specification sheet	1	6	2	8	2
2.	Technical Particulars	1	6	2	8	2
3.	Feeder Details	1	6	2	8 + 1R	2
4.	General Arrangement and Foundation Drawings	1	6	2	8 + 1R	2
5.	Schematic Diagrams with Terminal arrangement drawings	-	6	2	8 + 1R	2
6.	Calculation for Bus-bar sizing	1	6	2	-	
7.	Illustrative and Descriptive literature	1	-	-	8	2 weeks after Inspec-tion
8.	Catalogues for bought out accessories	1	-	-	8	
9.	Installation, operation & maintenance manual	-	-	-	8	
10.	Test Certificates					
	-- Type (for MCCB / MCB / ACB)	1	-	-	-	
	-- Routine	-	-	-	8	
11.	Guarantee Certificates	-	-	-	8	
12.	Spare Parts List	1	-	-	8	

Note :

1. R-Reproducible.
2. Period of submission of drawings for approval shall be counted from the date of LOI.
3. All final documents shall be submitted prior to despatch of equipment. These shall be made in sets and shall be supplied in fine plastic coated folder.

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ANNEXURE III

THE FOLLOWING SPARE PARTS SHALL BE QUOTED ALONG WITH THE OFFER

1. LIST OF SPARES - MANDATORY

a) MOULDED CASE CIRCUIT BREAKER (OF EACH RATING)

b) INDICATING LAMPS

2. LIST OF SPARES - FOR 2 YEARS OPERATION

A. MOULDED CASE CIRCUIT BREAKER (OF EACH RATING)

i) Complete Breaker Assembly

B. SWITCHES (OF EACH RATING)

i) Assembled switch in open execution

i) FUSES Single pole moving blade assembly

ii) Single pole base assembly

C. FUSES (OF EACH RATING)

i) Fuse links

ii) Fuse fittings

D. CONTROL SWITCHES

i) Trip-Neutral-Close Control Switch

ii) Local-Remote Selector Switch

iii) Heater Switch

iv) Thermostat

v) Ammeter Selector Switch

vi) Voltmeter Selector Switch

vii) Push Button

viii) Push Button element

ix) Push Button Actuator of each type.

E. CONTRACTOR (OF EACH RATING)

i) Contractor with Auxiliary Contacts

ii) Operating Coil

iii) Auxiliary Contact Block

F. INDICATING LAMPS

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i) Indicating lamps globes of each colour

ii) Indicating lamp fittings

iii) Indicating lamp bulbs

G. METERS

i) Ammeter

ii) Voltmeter

H. PROTECTIVE RELAYS

i) Relays

ii) Thermal overload relay of each type

NOTE: All spare parts shall be identical to the parts used in the distribution boards.

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GAS ENGINE GENERATOR SET

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1.0 SCOPE

1.1 This specification covers the technical requirements of design, manufacture, assembly, testing at works and delivery in well packed condition of Gas engine generator Set with Control Panel complete with all required accessories and control equipment to supply continuous electrical power. The Gas engine generator set shall comply with noise, emission and smoke limit norms as per latest amendment of Environment (Protection) Act, 1986.

1.2 This specification shall be read in conjunction with Particular Technical Specification

1.3 The scope of supply shall include, but not limited to the following:

1.3.1 Gas engine, complete with all the required accessories and components.

1.3.2 Generator set, for operation with the above Gas engine, complete with all the required accessories and components.

1.3.3 Lubrication oil system comprising of lube oil pump, filter, cooler, piping, valves, fittings etc.

1.3.4 Radiator cooled/heat exchanger cooled with cooling tower and necessary piping.

1.3.5 Starting system complete with battery, battery charger, battery leads, control system etc.

1.3.6 All inter connecting piping, valves, and fittings up to the battery limit.

1.3.7 First fill of lubricants.

1.3.8 Common base frame suitable for assembly of engine and generator with accessories. Anti-vibration mounting pads shall also be supplied

1.3.9 Acoustic enclosure to reduce the noise level to 75 dB at 1 meter from the enclosure.

1.3.10 Exhaust manifold complete with residential silencer with lagging, metallic expansion bellow and piping as per requirement.

1.3.11 All necessary instrument interlocks, controls with necessary annunciation and indication for monitoring and safe starting, and stopping of the Gas Engine Generator set, their auxiliaries complete with tubing and cabling.

1.3.12 180 KVA Silent Gas Engine Generator control panel shall be mounted in acoustic enclosure. 125 KVA Silent gas engine generator AMF Control Panel shall be mounted in Electrical room.

1.3.13 Power and Control cable between control panel and all equipment within the battery limit including cable racks, earthing terminating materials etc.

1.3.14 All safety and protective devices.

1.3.15 All other items, not specified here but, necessary for safe, satisfactory operation of Gas Engine generator Set.

1.3.16 Set of special tools and tackles required for operation & maintenance.

1.3.17 Spare parts.

1.3.18 Erection, site testing and commissioning of the Gas Engine Generator at site.

1.3.19 25%, 50%, 100% & 110 % load test shall be carried out 4 hours at works & 8 hours at site.

1.3.20 Noise Level shall be measured at works and site at a distance of 1 meter.

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2.0 STANDARDS TO BE FOLLOWED

2.1 The design, manufacture and testing of the equipment covered by this standard shall comply with the latest issue of the following codes and other relevant Indian standard specifications unless otherwise specified in the Particular Technical Specification.

i) IS 4722 – Rotating Electrical Machines.

ii) IS 13364 (Part 2) – A C Generators driven by reciprocating internal combustion engines.

2.2 Equipment designed and manufactured to other national standards shall be acceptable provided they are in no way inferior to the above mentioned standards.

2.3 The design and operation features of the equipment offered shall also comply with the provisions of latest issue of the Indian Electricity Rules and other statutory regulations. The supplier shall, wherever necessary, make suitable modification in the equipment to comply with the above.

2.4 Wherever any requirement, laid down in this specification, differs from that in Indian standard/IEC, the requirement specified here in shall prevail.

3.0 SERVICE CONDITIONS

3.1 Ambient Conditions

These shall be as indicated in Particular Technical Specification.

3.2 System Details

These shall be as indicated in Particular Technical Specification.

4.0 OPERATING REQUIREMENTS

4.1 The Gas Engine Generator Set shall be suitable for "black start" operation. The equipment offered shall be suitable for operating at their rated capacity continuously under the ambient conditions and voltage and frequency variations indicated in Particular Technical Specification, without exceeding the temperature rise limits specified in relevant standards and without any detrimental effect on any part.

4.2 The Gas engine generator set shall be designed for continuous operation at full load or partial load and have the capability to run at 110% of the MCR for one hour in every 12 hours.

4.3 The Gas engine generator Set should start manually after prolonged idle period. Under such conditions, the auxiliary power shall not be available. The starting and lubrication system shall be suitably designed to take care of these conditions and allow easy, safe and quick starting.

4.4 The Gas engine generator Set loading sequence is not automatic and hence need not be defined by Owner/client.

4.5 The Gas engine generator Set shall be manually controlled and can be started manually both from local panel and Gas engine generator Set control panel in Electrical room.

5.0 ENGINE

5.1 General Design Feature

5.1.1 The Gas engine shall be of multistroke, multicylinder with mechanical fuel injection arrangement and complete with all the required accessories.

5.1.2 The engine output shall be suitable to meet rated load at the generator terminal.

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5.1.3 The engine shall be suitable for trouble free operation.

5.1.4 The unbalance force transmission to the foundation shall be minimum. Critical speed of the assembly shall be sufficiently higher than the rated speed of the engine.

5.1.5 The engine shall be provided with residential silencer at the exhaust.

5.2 Cooling System

5.2.1 The engine upto 125 KVA GEG set shall be radiator cooled and the engine 180 KVA and above GEG set shall be heat exchanger cooled with cooling tower & necessary piping. Supplier shall supply 2 Nos. of secondary water pump (1R +1S)

5.3 Lube Oil System

5.3.1 Proper lube oil system shall be provided for all lubricating points of the engine.

5.4 Starting System

5.4.1 The Electrical starting system shall be provided.

5.4.2 Manual starting scheme from local panel and Gas Engine Generator Set control panel in Electrical room shall be provided.

5.4.3 The starting system shall be such that the Gas Engine Generator Set shall start come up to rated speed and be ready to accept full load within the period as indicated in PTS.

5.4.4 The electric starting system shall comprise of starter motor, battery, battery charger, necessary cabling, required instruments and accessories.

5.4.5 The sealed lead acid battery shall be heavy duty type and suitable for 4 successive starting attempts of the engine without draining. The charger shall have both float / boost charging facilities. The battery shall be complete with suitable stand and other required accessories. A static battery charger of suitable capacity shall be provided to charge the battery during the time when generator is not running.

5.5 Exhaust System

- Exhaust gas turbo generator
- Exhaust manifold
- Silencer : Residential silencer
- Flexibile pipe for silencer
- Exhaust temperature monitoring

5.6 Fuel System

- Carburator
- Ist stage pressure regulator
- IInd stage Indegenous pressure regulator
- Hydraulic/Electronic Governor
- 24 volts DC solenoid gas shut off valve
- Mechanical gas shut off valve

5.7 Intake Air System

- Air intake manifold
- Dry type Air cleaner with precleaner
- Vacuum indicator

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5.8 Non shielded Ignition system

- Ignition generator(Low Tension)
- Transformer
- Spark Plugs
- Wiring harness

5.9 Coupling Arrangement

- Flexible coupling
- Flywheel to suit flexible coupling
- Flywheel Housing

5.10 Safety Control (trip Indications)

- High water temperature
- Low lube oil pressure
- Overspeed

5.11 Engine Instrument Panel (Engine Mounted)

- Starting switch with Key (outgoing)
- Water Temperature gauge
- Lube oil pressure gauge
- Lube oil temperature gauge
- Tachometer with hour meter
- Ammeter
- Push button

5.12 Speed Governing System

5.12.1 The speed governing system of the gas engine shall satisfy the following requirements:

- Steady state speed regulation shall be adjustable between 0 to 5% manually.
- Steady state speed regulation once fixed, shall not vary beyond +0.5%.
- Transient speed regulation shall not exceed 4.5% of rated speed. Momentary under speed and over speed shall not exceed 2% and 8% respectively.
- Recovery time shall be within 3 seconds.

5.12.2 The governor system shall be hydraulic/ electronic.

5.12.3 A mechanical over speed trip device shall be provided to operate at 110% of rated speed.

5.12.4 An engine mounted emergency push button shall be provided to trip the engine in case of emergency.

6.0 GENERATOR

6.1 General Design Features

6.1.1 The generator shall be directly coupled to the engine by SAE flange.

6.1.2 The ingress protection class of the enclosure shall be IP23 as per IS:4691.

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6.1.3 The generator and its accessories shall be capable of withstanding electrical, mechanical and thermal stresses while meeting the performance requirements.

6.1.4 The generator shall be synchronous A.C. generator, star connected and shall have C.M.R. of specified output at 0.8 lag p.f. at rated voltage and frequency.

6.2 Winding And Insulation

6.2.1 The stator and rotor coils shall be made out of electrolytic grade copper conductors. Successive coils shall be connected by accessible and well brazed joints.

6.2.2 The coils shall be class F or H insulated and treated with tropical and fungicidal treatments.

6.2.3 The windings shall be dried, properly impregnated with suitable varnish to withstand the site conditions and properly baked. At least two additional impregnations and baking shall be applied to the assembled coil making a total of three impregnations and bakings. Finally the windings shall be painted with special anti acid and anti alkali paints to withstand the site condition.

6.2.4 The leading wire between the windings and the outside terminals shall be through bushings.

6.3 Performance Requirement

6.3.1 The generator and the gas engine shall match properly to deliver the rated load under the specified ambient and system conditions.

6.3.2 The specified rating of the Gas Engine Generator Set indicated are net electrical power output required for owner's use and does not include the power required by the auxiliaries of the Gas Engine Generator Set. The actual output rating of the generator to be offered by vendor shall take into account the power requirement of the auxiliaries, 15% extra margin.

6.3.3 The generator shall have an overload capacity of 10% for 1 hour in any consecutive period of 12 hours after having attained the thermal equilibrium corresponding to the rated load. The terminal voltage shall be equal to the rated value. At the time of switching 'ON' the emergency loads, restarting or re-acceleration of squirrel cage motors shall be required, in addition to switching 'ON' of the lighting loads, which will be six times the rated load at power factor of 0.35 lagging. The generator and its accessories shall be capable of supplying this load at the above mentioned low power factor. Limitations, if any, shall be clearly indicated by the vendor.

6.3.4 Largest Motor Starting Requirement

The Gas Engine Generator Set shall be designed such that it can start squirrel cage induction motor of specified rating by Star delta starting method when already loaded with specified base load. The voltage dip at the generator terminal shall not exceed 15% of its rated voltage during the entire starting period which will not exceed 5 seconds. The bidder shall mention largest motor starting requirement for which the Gas Engine Generator Set shall be designed.

6.3.5 The short circuit ratio, of the generator at rated KVA and rated voltage shall not be less than 0.5.

6.3.6 The generator shall withstand 20% over speed for 2 minutes without any damage to any part.

6.3.7 The generator shall be capable of withstanding the three phase short circuit at its terminals while operating at its voltage without sustaining any damage.

6.4 Excitation System

6.4.1 The generator shall be provided with static brushless excitation system comprising of shaft driven rotor exciter, thyristor and other associated items.

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6.4.2 The capacity of the system shall be adequate to meet the performance and largest motor starting requirement of the generator.

6.5 **Voltage Regulator**

6.5.1 The generator shall have electronic voltage regulators to be mounted on the Alternator. The regulator system shall be suitable to meet the following requirements.

- Allow the generator to meet the performance requirements.
- Prevent automatic rise of field voltage in the event of excitation supply failure.
- Operated by the output current and voltage of the generator.
- Facility to regulate both locally and from control panel in Electrical room.

6.6 **Terminal Boxes**

6.6.1 All the terminal boxes shall have IP-54 degree of protection.

6.6.2 The power terminal box shall be spacious and have adequate clearance between the terminals and the cable gland for proper termination of required nos. of aluminium cables.

6.6.3 The power terminal boxes shall be provided with tinned copper sockets suitable for crimping.

6.6.4 The control terminal boxes shall be provided with pressure type terminal blocks.

6.6.5 All terminal boxes shall be complete with a heavy duty double compression type aluminium cable glands suitable for the cable sizes required.

7.0 CONTROL PANEL

7.1 Requirements

a) The control panel shall comprise of control & instrument section, , power & protection section and distribution section for satisfactory and trouble free operation of the set.

b) The control and instrument section shall house the following:

- All the required controlling elements for the engine, generator and exciter control for both manual and automatic operations..
- Panel mounted instrument.
- The required protective devices for the engine.
- The audiovisual annunciation system indicating abnormal operating conditions.
- Control switches and indicating lamps.
- All other items, as required.

c) The power and protection section shall house the following:

- ACB / MCCB, with in-built O/C & S/C, Earth fault release, C.T.s Ammeters, Voltmeters, KWH meters, Frequency meters, ON/OFF indicating lamps, control switches etc. for the control of generator.

7.2 General Design Features

7.2.1 The GEG control panel shall be free standing, floor mounting metal clad cubicle type in construction dust / damp and vermin proof type equivalent to IP-52 as per IS:2147.

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7.2.2 The thickness of sheet steel members shall not be less than 2/1.6 mm for cold rolled steel. Suitable reinforcement, wherever necessary, shall be provided. The base channel shall be more than 3 mm thick.

7.2.3 The door hinges shall be concealed type. All threaded screws in the removable parts shall be provided with retaining rings.

7.2.4 All the components shall be accessible for checking and taking off without the necessity of removing the adjacent ones. Their mounting shall be accessible and ensure the necessary degree of safety.

7.2.5 The meters, switches and lamps shall be flush mounted type.

7.2.6 The bus bars shall be for three phase and neutral and made of aluminium of required cross section and PVC sleeved. These shall be amply sized to carry the rated continuous current under the specified ambient temperature without exceeding the total temperature of 85 ° C.

7.2.7 The clearances and creepage distance shall not be lower the values specified below:

i) Minimum clearance between two live conductors – 20 mm.

ii) Minimum clearance between live parts and accidentally dangerous part – 20 mm.

iii) Minimum creepage distance – 28 mm.

7.3 Control Wiring

7.3.1 The GEG control panel shall be completely factory wired and ready for external connections.

7.3.2 The wiring shall be carried out with flexible stranded PVC insulated copper conductor cables for 1100 volts grade.

The size of wires shall be as follows:

C.T. Circuit	:	2.5 sq. mm. Copper
Control circuits	:	1.5 sq. mm. Copper.

7.3.3 All wiring shall be marked in accordance with IS:375. Numbered Ferrules reading from the terminals outwards shall be provided at both ends of all wiring for easy identification. These shall be interlocking type plastic ferrules.

7.4 Control Fuses

The fuses shall be of non-deteriorating HRC cartridge link type and conform to IS:2208. They shall be suitable for the load and the service required in the circuit.

7.5 Current Transformers

7.5.1 C.T.'s shall be cast resin, accuracy Class 1 as per IS: 2705, for metering.

7.5.2 All the C.T.'s shall be provided with terminals and shorting links. One of the terminals of the C.T.s shall be earthed. The polarity of the C.T.s shall be clearly marked.

7.6 Instruments And Metering

7.6.1 All instruments shall be flush mounting type with square face. They shall be tropicalised and dust tight. Make and type of instruments shall be as approved.

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7.6.2 For Analogue instrument Marking of the scale shall be black on white background and suitable for direct reading.

7.6.3 All indicating instruments shall be Digital & Accuracy Class 1 accuracy.

7.6.4 The KWH meter shall be as per IS:732 and provided with test blocks for current and voltage coils for testing them at site without interrupting their recording while in service.

7.6.5 The Multifunctional meter shall have

i) Voltmeter with selection for Phase to Phase.
ii) Ammeter with selection for all three phases.
iii) Frequency meter.
iv) Power factor meter.
v) KWH meter

7.7 Signal Lamps

LED type signal lamps shall be provided to indicate the various circuit conditions and these shall be placed at suitable height.

7.8 Name Plate

7.8.1 The panel shall have a large name plate on the top to indicate is name and designation.

7.8.2 All control switches, push buttons, lamps etc. shall have function identification labels.

7.9 Cable Termination

Necessary cable glands and lugs for power and control cables shall be provided.

7.10 4 POLE MCCB - Moulded Case Circuit Breaker

a) MCCB shall confirm to relevant ISS/International standard.
b) MCCB shall have Trip free mechanism.
c) Short Circuit and O/C, Circuit mechanism.

8.0 INSTRUMENTATION

8.1 The instrumentation requirement shall include field / panel mounted instruments, push buttons, lamps, audio-visual alarm system and other accessories as required.

8.2 The provision required in the control panel board shall include the followings:

- Audio-visual alarm & shut down system for:

  a) Low lube oil pressure
  b) High water temperature
  c) Over speed
  d) All shutdown condition
  e) Other abnormal conditions, as required
  f) Failure of engine to start after a preset time for 125 KVA.
  g) Other faults, as required

- Engine control system complete with:

  a. Remote / Manual switch

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b. Push buttons and other control equipment for manual start
c. Equipment and circuitry for repeated attempt to start.
d. Indicating lamps for fail to start
e. Audio visual alarm as specified and required
f. Instrumentation as specified and required
g. Operation hour counter
h. All other items, as required.

8.3 The field mounted instruments shall include the followings:

a) Pressure gauge for lube oil.
b) Other items, as required.

8.4 The supply shall be complete with all instrument erection materials with 10% extra provision.

8.5 All instruments shall be suitable for site maximum ambient temperature. All electrical and electronic instruments shall be tropicalised and fungus proof.

9.0 ACCESSORIES

The Gas Engine Generator set shall be complete with all required accessories, whether indicated or not, to make the installation complete in all respects and to ensure its safe and proper operation.

10.0 ACOUSTIC ENCLOSURE

The acoustic enclosure shall be made of 2 mm (Min) CRCA sheet. The salient feature of the acoustic enclosures is:

i. The enclosure shall be of modular construction with provision to assemble and dismantle easily at site.
ii. The sheet metal components shall be hot dip seven tank pretreated before powder coating.
iii. The enclosure shall be powder coated (inside as well outside) with a special pure polyester based powder. All nut & bolts / external hardware shall be made from stainless steel.
iv. External drain plugs shall be provided for draining lube oil.
v. The door shall be gasketed with high quality EDPN gaskets to prevent leakage of sound.
vi. The door handles shall be lockable type.
vii. Sound proofing of the enclosure shall be done with high quality Fibre glass /rock wool / mineral wool conforming to IS : 8183 . The insulating material for sound proofing shall be further covered with fibre glass tissue and perforated sheet.
viii. Acoustic hoods with noise splitters, if required, shall be used to block and reduce the sound leakage.
ix. A high efficiency residential silencer along with associated piping and flexible bellow shall be provided in the enclosure to reduce exhaust noise.
x. Specially designed attenuators shall be provided to control sound at air entry and exit points.
xi. Adequate ventilation shall be provided to meet total air requirement. If required, a blower shall be provided to meet total air requirement.
xii. Temperature of enclosure should not exceed beyond 5°C of ambient temperature
xiii. The enclosure shall be provided with high enclosure temperature safety trip.
xiv. There shall be provision of emergency shut down from outside the enclosure.
xv. There shall be arrangement for illuminating the enclosure from inside.
xvi. Noise level shall be 75 dBA at 1 m distance from enclosure.
xvii Earthing points on the body of the enclosure shall be isolated through DMC insulator mounted on the enclosure .
xviii Alarm system.

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11.0 COUPLING AND MOUNTING ARRANGEMENT

The engine and alternator shall be directly coupled by a SAE flange and mounted through AVM pads on a heavy duty steel base frame. The arrangement ensures that there will be no chance of misalignment of the Gas Engine generator and vibrations of the Gas Engine Generator set shall not be transmitted to the base frame and to the enclosure. The battery shall be kept in a separate tray inside the enclosure.

12.0 PAINTING

The enclosures, after suitable pre-treatment, shall be painted with two coats of anti rust paint followed by two coats of anti-corrosive epoxy based paints or Powder coated.

13.0 TESTS AND INSPECTION

13.1 All routine tests as per relevant standards shall be carried out in the presence of purchaser's representative.

13.2 The Gas Engine Generator set shall be tested for output, general performance, overloads and other tests sufficient to prove the correctness of the design both at works and at site.

13.3 In addition, the equipment shall be subjected to stage inspection during process of manufacture at works and site inspection.

13.4 These inspections shall, however, not absolve the vendor free from his responsibility for making good any defect which may be noticed subsequently.

13.5 Third party inspection shall be arranged by the contractor and charge so incurred shall be borne by the contractor.

14.0 SPARES

Item wise unit prices for spare parts with recommended quantity shall be quoted along with main equipment. The spares quoted shall include, in addition to, the items listed in Annexure-I, any other spares considered to be necessary.

15.0 DRAWING AND DOCUMENTS

Drawings and documents as per Annexure-II shall be supplied. All drawings and documents shall have the following descriptions written boldly.

- Name of client
- Name of consultant
- Project / Plant name
- Order no.
- Description of equipment.

16.0 DEVIATIONS

Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning. Deviations, if any, from the data indicated in Particular Technical specification sheet shall be shown clearly by encircling it and the revised data shall be indicated besides the same.

17.0 PACKING

17.1 The equipment shall be properly packed before despatch to avoid damage during transport, storage and handling.

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17.2 The equipment shall be wrapped in polythene to make it water proof. Bags of silica gel shall be kept inside to absorb moisture present during transport and storage. An additional wrapping with bitumen paper shall also be provided before the equipment is packed in wooden crates.

17.3 A sign indicating the position of the equipment placed during transport and storage shall be clearly marked. Also proper arrangement shall be provided to handle the equipment.

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ANNEXURE - I

1. LIST OF SPARES – MANDATORY

The spare parts as listed below shall be quoted for the Gas Engine Generator set along with the offer with item wise unit prices:

1. Kit comprising of water filter, lube oil filter, for 2 years of operation, considering 6 hours operation per day.
2. Air filter – 2 Nos.
3. Spark Plug – 6 Nos.
4. Fuses of all ratings.

2. EMERGENCY SPARES

(1) AVR – 1No.

(2) Diodes – 6 Nos (3 Nos. for forward operation & 3 Nos for backward operation).

3. LIST OF SPARES – FOR 2 YEARS OPERATION

A. FUSES (OF EACH RATING)

i) Fuse links

ii) Fuse fittings

B. CONTROL SWITCHES

i) Local-Remote Selector Switch

ii) Push Button

C. AUX. CONTACTOR

D. INDICATING LAMPS – of each colour with accessories e.g. globe, holder etc.

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ANNEXURE – II

DOCUMENTATION FOR GAS ENGINE GENERATOR SET

S.No	Description	With Bid No. of copies	After Order			
			For Review		Final	
			No of Copies	No. of weeks	No. of copies	No. of weeks
1	Technical Particulars	1	6	2	8+1R	2 W
2	General arrangement and foundation drg. For all the equipment	-	6	2	8+1R	2 W
3	GA, schematic and wiring diagram of AMF panel & control panel.	-	6	2	8	2 weeks
4	Terminal arrangement drg. And interconnection	-	6	2	8+1R	2 W
5	Sectional view of Gas Engine Generator set	-	-	-	8+1R	2 W
6	Illustrative and descriptive literature.	-	-	-	8	2 W after inspection
7	Catalogue for bought out accessories	-	-	-	8	-do
8	Installation operation & maintenance manual	-	-	-	8	-do
9	Type test certificates for engine, alternator and circuit breaker	-	6	2	8	-do-
10	Guarantee certificate	-	-	-	8	-do-
11	Spare parts list with identification	1	6	2	8	2 W
12	Bill of Material	-	6	2	8	2W
13	QAP	1	6	2	8	2W
14	Cable Schedule	-	6	2	8	2 W
15	Routine test Certificate	-	-	-	8	2W after inspection
16	As Built drawing for GEG set	-	-	-	8	

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QUALITY ASSURANCE PLAN
VRLA BATTERY

Drawing No. P.019141 G11013 E001
Date: 23.09.2024
Project:-Mother station Hyderabad , Composite works)
Client: BGL
Consultant:PMC

SR.NO	COMPONENTS	QUALITY CHARATERSTICS	CLASSIFICATION	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE / ACCEPTA NCE	FORMAT /RECORD	AGENCY			REMARKS
								M	C	TPIA	
RAW MATERIAL AND BOUGHT OUT ITEMS											
1	Cell Container (Polypropylene)	Dimensional conformance	Major	Measurement	Sampling as per IS- 2500,2000 part-1 inspection level(S-4)	Drg.Specs	Inspection Report	P	R	R	
		Material quality	Major	Impact strength	1 NO of every	As per IS 1146 TI-Section 17	Inspection Report	P	R	R	
		Colour shade,warpage at top & side walls,flash on edges & parting line etc	Major	Visual inspection	Sampling as per IS- 2500,2000 part-1 inspection level(S-4)	Drg.Spec s	Inspection Report	P	R	R	
2	Terminal Post	Dimensional confirm	Major	Measurement	Sampling as per IS- 2500,2000 part-1			P	R	R	
		Thread size	Major	Visual inspection	Sampling as per IS- 2500,2000 part-2			P	R	R	
		Free from defects	Major	Visual inspection	Sampling as per IS- 2500,2000 part-1			P	R	R	
3	Spacing ring	Dimensional confirm	Major	Measurement	per IS-2500,2000 part-1 inspection	Drg.Specs	Inspection report	P	R	R	
		Plating quality	Major	Thickness Measurement	Sampling as per IS-2500,2000 part-1 inspection level(S-4)	Drg.Specs	Plating report	P	R	R	
4	Stud &Nut	Dimensional confirm	Major	Measurement	Sampling as per IS-2500,2000 part-1 inspection level(S-4)	Drg.Specs	Inspection report	P	R	R	
		Thread size	Major	Gauging & visual inspection	Sampling as per IS-2500,2000 part-1 inspection level(S-4)	Drg.Specs	Inspection report	P	R	R	
		Free from defects	Major	Visual inspection	Sampling as per IS-2500,2000 part-1 inspection level(S-4)	Drg.Specs	Inspection report	P	R	R	
5	Inter cell connector	Material conformance	Major	Hardness&cond activity check	one sample	Drg.Specs	Test Report	P	R	R	
		Dimensional conformance	Major	Measurement	per IS-2500,2000 part-1	Drg.Specs	Inspectionreport	P	R	R	
6	Tab	Dimensional conformance	Major	Measurement	per IS-2500,2000 part-1	Drg.Specs	Inspectionreport	P	R	R	
		Plating quality	Major	Thickness	per IS-2500,2000 part-1	Drg.Specs	Plating report	P	R	R	
7	Plastic/Nylon Component	Dimensional conformance	Major	Measurement	per IS-2500,2000 part-2	Drg.Specs	Inspectionreport	P	R	R	
		Free from defects	Major	Visual inspection	Sampling as per IS-2500,2000 part-2	Drg.Specs	Inspection report	P	R	R	
8	Rubber components(Gasket & Sealing ring etc)	Material quality	critical	Shore hardness(Rubb er	Sampling as per IS-2500,2000 part-3	Drg.Specs	inspectionreport & Test	P	R	R	
		Dimensional conformance	Major	Measurement	per IS-2500,2000	Drg.Specs	inspection report	P	R	R	
		Free from defects	Major	Visual inspection	PER IS-2500,2001	Drg.Specs	inspection report	P	R	R	
IN PROCESS INSPECTION											
1	Plateblank manufacturing	Dimensional conformance	Major	Measurement	part-1 inspection level(S-4)	MPI Section:7	Process quality reports	P	R	R	
		Conformance of plate blank weights	Major	Weighting	part-1 inspection level(S-4)	MPI Section:7	Process quality reports	P	R	R	
		Absence of defects	Major	Visual inspection for empty	100%	MPI Section:7	Process quality reports	P	R	R	
2	Plate assembly	Dimensional conformance	Major	Measurement of plate thickness & width	IS:2500,2000 part-1 inspection level(S-4)	MPI Section:7	Process quality reports	P	R	R	
		quality of spot welding	Major	visual inspection	100%	MPI Section:8	Process quality reports	P	R	R	
		Absence of defects and damages	Major	visual inspection	100%	MPI Section:8	Process quality reports	P	R	R	
3	Plate block assembly	Assembly correctness of +ve &-ve groups	Major	Visual inspection and cofirmation for	100%	MPI section-13	Process quality reports & route tags	P	R	R	
		Correctness of insulation	Major	visual inspection	100%	MPI section-13	Process quality reports &	P	R	R	
		Tightness of strapping & damages	Major	Visual inspection for position and No of straps	100%	Mpi Section 14	Process quality reports & route tags	P	R	R	
		Plate block tightness	critical	Torqing of stud nuts	100%	Mpi Section 14	process auality	P	R	R	
		Correctness of plate blocks	Major	visual inspection	100%	Mpi Section:1 8,19	Process quality reports & route tags	P	R	R	
		Correctness of plate blocks	Major	visual inspection	100%	MPI:18,19	Process quality reports & route tags	P	R	R	

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QUALITY ASSURANCE PLAN
VRLA BATTERY

Drawing No. P.019141 G11013 E001
Date: 23.09.2024
Project:-Mother station Hyderabad ,jind sonipat (Composite works)
Client: BGL
Consultant:PMC

SR.NO	COMPONENTS	QUALITY CHARATERSTICS	CLASSIFICATION	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE / ACCEPTA NCE	FORMAT /RECORD	AGENCY			REMARKS
								M	C	TPIA	
		position of inner sealing parts	Major	visual inspection	100%	MPI:18,19	Process quality reports & route tags	P	R	R	
4	Cell assembly	Lock washer sealing parts	Major	visual inspection for proper locking	100%	MPI :21	Process quality reports & route tags	P	R	R	
		Polaity of terminals	Major	Checking according to polarity marking	100%	MPI :21	Process quality reports & route tags	P	R	R	
		Soundness of sealing & welding(leak test)	Major	Pnematic pressure test at 0.5 kg/sq.cm	100%	MPI :23	Process quality reports & route tags	P	R	R	
FINAL INSPECTION AND TESTING											
1	CELL Testing	Physical examination	Major	viaual inspection	sample as per IS-8320	IS:10918	Acceptance test certificate	P	W	W	
		Cell Designation	Major	visual inspection for cell type Si.No	sample as per IS-8320	IS:10918	Acceptance test certificate	P	W	W	
		Dimension,mass & layout	Major	Measurement of cell dimension,weig ht & GAD	sample as per IS-8320	Drg spec& GAD	Acceptance test certificate	P	W	W	
		Cell marking & content of type stickers	Major	Identification of cells	sample as per IS-8320	IS:10918	Acceptance test certificate	P	W	W	
2		Polarity and absence of short circuit	Major	Voltage measurement according to polarity	sample as per IS-8320	IS:10918	Acceptance test certificate	P	W	W	
		Air Pressure Test	Major	Measurement og pressure drop with in 15 seconnds	sample as per IS-8320	IS:10918	Acceptance test certificate	P	W	W	
		Insulation Resistance Test	Major	Megger test(250v dc)	sample as per IS-8320	IS:10918	Acceptance test certificate	P	W	W	
		AH capacity test	Major	Discharge performance of cells at 0.22c5 rate	sample as per IS-8320	IS:10918	Acceptance test certificate	P	W	W	
PRESERVATION & PACKING											
1	Packing and despatch	Comformance of packing spec	Major	Verification of packing method	100%	MPI:30	Packing check list	P	R	R	
		Conformance quality product to spec	Major	visual as per check sheat	100%	MPI:30	Packing check list	P	R	R	
2	IRN	Inspection Release Note						H	H	P	
LEGEND:											
R:Review		H-HOLD		M-Manufacturer							
P:Performed		C-Contractor		W:Witness							
ority : Owner/Engineer or their Authorised Inspection Agency.											

Note:	1. The Above Testing and acceptance criteria are minimum requirements, however, equipment supplier shall ensure and that the product also comply to the additional requirements as per Technical specifications and data sheets.
	2. The supplier shall submit their own detailed QAP prepared on the basis of the above for approval of Owner/Owner's representative and TPIA.
	3. Supplier shall submit Calibration certificates of all Instruments/Equipment to be used for Inspection and Testing to TPIA with relevant procedures and updated standards for TPIA review/Approval.
	4. TPIA will have Right to Inspect minimum 10% of all manufacturing activities on each day or as specified above.
	5. TPIA along with Owner/Owner representative shall review/approve all the documents related to QAP/Quality manuals/Drawings etc.submitted by supplier.
	6. TPIA shall also Review the Test certificates submitted by the manufacturer.
	7. Contractor shall in coordination with Supplier/Sub vendor shall issue detailed Production and Inspection schedule indicating the dates and the locations to facilitate Owner/Owner's representative and TPIA to organise Inspection.

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QUALITY ASSURANCE PLAN UPS SYSTEM

Drawing No. P.019141 G11013 E002
Date: 23.09.2024
Project: Hyderabad Mother Station (Composite Works)
Client: BGL
Consultant:PMC

SR.NO.	ITEM/COMPONENT	CHARACTERSTICS	TYPE OF CHECK	QUANTUM	REFERENCE DOCUMENT	ACCEPTANCE NORMS	RECORD	AGENCY			REMARKS
								M	C	TPIA	
	Raw Material Inspection										
1	Power Transformer Current Transformer	Dimension,HV,NL Voltages, Finishing, Marking/ Labeling	Visual Physical Check	100%	GRN,WI Drawing,Mfr TR	Compliance to the Applicable Document.	Test Certificate	P	R	R	
2	Enclosures	Dimension,Coating,Thickness	Visual Measurement	01/Batch	GRN,WI Drawing,Mfr TR	Compliance to the Applicable Document.		P	R	R	
3	Fabricated & Punched Items.	Dimension, Punching	Visual	01/Batch	GRN,WI Drawing,Mfr TR	Compliance to the Applicable Document.		P	R	R	
4	Heat Sink	Dimension,Surface,Finishin g,Mounting holes	Visual Measurement	100%	GRN,WI Drawing,Mfr TR	Compliance to the Applicable Document.		P	W	W	
5	Rubber items	Dimension, Finish	Visual Measurement	10%	GRN,WI Drawing,Mfr TR	Compliance to the Applicable Document.		P	W	W	
6	Bus-bars & Hardware	Dimension, Finish	Visual Measurement	100%	GRN,WI Drawing,Mfr	Compliance to the Applicable Document.		P	W	W	
7	Switch gears	Physical, NO/NC, Auxiliary contacts	Visual Inspection	100%	GRN,WI Drawing,Mfr TR	Compliance to the Applicable Document.	Test Certificate	P	R	R	
8	Fuses & Fuse Holder	Physical, continuity type	Visual	100%	GRN,WI Drawing,Mfr TR	Compliance to the Applicable Document.		P	W	W	
9	Capacitor	Physical/Rating	Visual	100%	GRN,WI Drawing,Mfr	Compliance to the Applicable Document.		P	R	R	
10	Semiconductor Device	Physical	Visual	100%	GRN,WI,Catalog	Compliance to the Applicable Document.	Test Certificate	P	W	W	
11	Wires, Cables	Physical,HV,Type	Visual Measurement	100%	GRN,WI,Catalog	Compliance to the Applicable Document.	Test Certificate	P	W	W	
12	Fans	Smooth runing,Physical	Visual Measurement	100%	GRN,WI,Catalog	Compliance to the Applicable Document.		P	W	W	
13	Indicating Devices	Physical & Test	Visual Measurement	100%	GRN,WI,Catalog	Compliance to the Applicable Document.		P	W	W	
14	Meters	Physical ,Accuracy	Visual Measurement	100%	GRN,WI,Cat along	Compliance to the Applicable Document.	Test Certificate	P	R	R	
15	PCBS	Material,Tracks,Levelling	Visual	100%	GRN,WI,Catalog	Compliance to the Applicable Document.	Test Certificate	P	R	R	
16	Rating Plate	System Details	Visual	100%	Drawing	Compliance to the Applicable Document.		P	W	W	
17	Cabling& wiring	Routing,Tying,finishing,colo r code,ferulling	Visual continuity	100%		Compliance to the Applicable Document.	Internal Test Report	P	R	RW	
	In process Inspection										
1	Enclosure	Degreasing,Derusting,Deburring,Phosphatising,P assivation , Cable gland plate				IS 6005 & No burrs & as per drawing	Test Certificate	P	R	RW	
2	Busbar	Material (Cu),. Size (Thickness/Width	Visual	100%	IS 5082	IS 5082	Test Certificate	P	R	RW	
		Finish Uniformity	Visual	100%		No Burrs	Test Certificate	P	R	RW	
3	PCB&Electronic componentsub assemblies	Burn in test for 96 hrs at 50 degree	Electrical	100%	Spec./Data sheet		Test Certificate	P	R	R	

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QUALITY ASSURANCE PLAN UPS SYSTEM

Drawing No. P.019141 G11013 E002
Date: 23.09.2024
Project: Hyderabad Mother Station (Composite Works)
Client: BGL
Consultant:PMC

SR.NO.	ITEM/COMPONENT	CHARACTERSTICS	TYPE OF CHECK	QUANTUM	REFERENCE DOCUMENT	ACCEPTANCE NORMS	RECORD	AGENCY			REMARKS
								M	C	TPIA	
FUNCTIONAL TEST											
1	Functional Test /Acceptance Test	Dimensions, setting of parameters, Load Test, HV Test,Transfer-Re transfer, Performance test ,Regulation, Efficiency, Noise Levek,Auxilary Modules,Annuciation,Alarm s Over load,THD(at Linear Load),Transient & Dynamic response test (50%,75% & 100% load),Fault diagonstc check, RTU-Modbus interface test, AC input failure & return test, Simulation of parallel retundant UPS fault,short circuit capability test,short circuit fuse clearance test,	Electrical Visual Physical	100%	IEC-6240-3 ,IS-8624/25,Specification and Test Report	Internal Test Report Format	TEST REPORT	P	W	W	
2	Heat run test	Continious full load test fopr 32 hrs at 0.8 pf with temp.rise measurement		1 sample	IEC-6240-3 ,IS-8624/25,Specification and Test Report		TEST REPORT	P	W	W	
3	UPSDB, & Cell booster	Visual ,rating details, All acceptance tests	Visual Electric	100%	Approved docs/spec.		TEST REPORT	P	W	W	
4	Paint shade& thickness	Uniform Coating, Colour	Visual	100%	IS 5 & Approved Data sheet	IS 5 & Approved Data sheet	TEST REPORT	P	W	W	
5	Degree of protection	Degree of Protection	Certificate		IS 2147	IS 2147		P	R	R	
6	Inspection Release Note			100%	IRN		Inspection Report	H	H	P	
LEGEND:											
R:Review		H-HOLD		M-Manufacturer							
P:Performed		C-Contractor		W:Witness							
TPIA: Third Party Inspection Agency; Control Authority : Owner/Engineer or their Authorized Inspection Agency.											

Note:	1. The Above Testing and acceptance criteria are minimum requirements, however, equipment supplier shall ensure and that the product also comply to the additional requirements as per Technical specifications and data sheets.
	2. The supplier shall submit their own detailed QAP prepared on the basis of the above for approval of Owner/Owner's representative and TPIA.
	3. Supplier shall submit Calibration certificates of all Instruments/Equipment to be used for Inspection and Testing to TPIA with relevant procedures and updated standards for TPIA review/Approval.
	4. TPIA will have Right to Inspect minimum 10% of all manufacturing activities on each day or as specified above.4.
	5. TPIA along with Owner/Owner representative shall review/approve all the documents related to QAP/Quality manuals/Drawings etc.submitted by supplier.

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	6. TPIA shall also Review the Test certificates submitted by the manufacturer.
	7. Contractor shall in coordination with Supplier/Sub vendor shall issue detailed Production and Inspection schedule indicating the dates and the locations to facilitate Owner/Owner's representative and TPIA to organise Inspection.

QUALITY ASSURANCE PLAN
POWER & CONTROL CABLES

Drawing No.P.019141 G11013 E003
Date: 23.09.2024
Project: Hyderabad Mother Station (Composite Works)
Client: BGL
Consultant:PMC

SL NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	AGENCY			REMARKS
								M	C	TPIA	
I	**RAW MATERIALS**										
1	CONDUCTOR: Copper/Aluminum (As Applicable)	1. Surface Finish	B	Visual	Each cable Drum	The Conductor Shall be Smooth & free from scratches & burrs	The Conductor Shall be Smooth & free from scratches & burrs	P	R	R	
		2. Diameter/ Dimensions	B	Physical	One Sample from lot of 10 Bobbins/drums or part there of	approved Datasheet	approved Datasheet & IS 8130'84	P	R	R	
		3. Conductor Resistance at 20 deg C	C	Physical	----DO.....	--DO—	----DO-----	P	R	R	
		4. Annealing Test	C	Physical	----DO.....	----DO-----	--DO—	P	R	R	
		5. Tensile Test	C	Physical	----DO.....	----DO-----	--DO—	P	R	R	
		6. Wrapping Test	C	Physical	----DO.....	----DO-----	----DO-----	P	R	R	
2	PVC Compound (Insulation & Sheath)	1. Visual Check of PVC Granules	A	Visual	Two samples per lot of 10 MT or part there of Each lot	Should be free from foreign particles	Should be free from foreign particles	P	W	W	
		2. Type of Compound	C	Visual		Specification of PVC Compound IS 10810 part 7 IS 5831	Specification for PVC Compound	P	R	R	
		3. Tensile Strength & Elongation	C	Physical	One samples per lot of 10 MT or part there of Each lot		----DO-----	P	R	R	
		4. Thermal Stability	C	Physical		IS 10810 Part 60	----DO-----	P	R	R	
		5. Insulation Resistance at 27^0 C & 70^0 C	C	Electrical		IS 1554 Part I 1988	Min.required $1x10^{13}$ OHM-CM at 27^0 C & Min.required $1x10^{10}$ OHM-CM at 70^0	P	R	R	
3	ARMOUR	1. Surface Condition	A	Visual	Three samples per lot of 10 MT or part there of Each lot	Should be free from white spots , oxidation	Should be free from white spots , oxidation	P	R	R	
		2. Uniformity of Zinc Coating	C	Chemical	—DO.....	IS 2633	IS 2633	P	R	R	
		3. Mass of Zinc Coating	B	Chemical	—DO.....	----DO-----	----DO-----	P	R	R	
		4. T.S. & Elongation	B	Physical	—DO.....	IS 3957	IS 3957	P	R	R	
		5.Torsion/ Winding	B	Physical	—DO.....	----DO-----	----DO-----	P	R	R	
II	**PROCESS INSPECTION**										
4	Insulation	1. type of Insulation Compound	B	Visual	Each setting & once in shift each setting & the end of each drum length	Approved Datasheet	Approved Datasheet & Costumer's Spec.	P	R	R	
		2. Dia. Over Conductor	B	Physical		Approved Datasheet	Approved Datasheet	P	R	R	
		3. Dia over Core	B	Physical	Each Setting & twice in a shift	Approved Datasheet	Approved Datasheet	P	R	R	
		4. Thickness of Insulation (Avg. Min)	C	Physical	—DO.....	Approved Datasheet & IS 1554-Part I	Approved Datasheet & IS 1554-Part I	P	R	R	
		5. Spark Testing	C	Electrical	100% each setting & twice in a shift , Each setting & twice in a Shift 100%	Approved Datasheet	Approved Datasheet	P	R	R	
		6. Surface Finish	B	Visual		Should be smooth & free from porosity	Should be smooth & free from porosity	P	R	R	
		7. Colour	B	Visual		Approved Datasheet & Customer's Specs.	Approved Datasheet & Costumer's Spec.	P	R	R	
		8. Core Printing	B	Visual				P	R	R	
		9. Continuity of Conductor as applicable	C	Electrical			Conductor of core should show continuity	P	W	W	
5	Core rewinding as required	1. Spark Test	C	Electrical	On each std. length & in multiple of it as required	No spark test failures during mfg/rewinding at specified voltage	No Failure allowed	P	R	R	
6	LAYING -UP	1. Sequence of Cores	C	Visual	Each Setting & twice in a shift	Approved Datasheet & IS 1554-I	Should be free from foreign particles	P	R	RW	
		2. Directing of Lay	C	Visual	—DO.....	----DO-----	Specification for PVC Compound	P	R	RW	
		3. Diameter of Over Laid up	B	Physical	----DO-----	Approved Datasheet	----DO-----	P	R	RW	
		4. Lay Length	B	Physical	----DO-----	Approved Datasheet	----DO-----	P	R	RW	
7	Inner Sheath	1. Type of PVC	B	Visual	Each Setting & at the end of each Drum Length	Approved Datasheet & IS 1554-I	Approved Datasheet & IS 1554-I	P	R	R	
		2. Diameter over Indup Cores	B	Physical	Each Setting & at the end of each Drum Length	Approved Datasheet & IS 1554-I	Approved Datasheet & IS 1554-I	P	R	R	

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		3. Thickness of Inner sheath	C	----DO-----	—DO.....	Approved Datasheet & IS 1554-I	Approved Datasheet & IS 1554-I	P	R	R	
		4. Surface Finish & Colour	B	Visual	—DO.....	Should be generally free from porosity	Should be generally free from porosity	P	R	R	
8	Armouring	1. No. of Strips / wires	B	Visual	Each Setting & Once in a Shift	Approved Datasheet	Approved Datasheet	P	R	R	
		2. Dimension of Strips/wires	B	Physical	—DO.....	Approved Datasheet & IS 3975 -88	Approved Datasheet & IS 3975 -88	P	R	R	
		3. Direction of Lay	B	Visual	Each Setting & in each Drum	----DO-----	----DO-----	P	RW	RW	
		4. Lay Length	B	Physical	Each Setting	----DO-----	----DO-----	P	RW	RW	
		5. Strips / wire welding	B	Visual	In Each Drum	The Joint shall be smooth without burrs	The Joint shall be smooth without burrs	P	R	R	
		6. Diameter over armour	B	Visual	Each Setting & once in Shift	Approved Datasheet	Approved Datasheet	P	R	R	
9	Outer Sheath	1. Type of PVC Compound	C	Physical	Each Setting & twice in a shift	Approved Datasheet & IS 1554-I	Approved Datasheet & IS 1554-I	P	R	R	
		2. Thickness Average/Minimum	C	Physical	At Each Steeing twice in a shift	----DO-----	----DO-----	P	R	R	
		3. Dia over Outer Sheath	B	Physical	Each Setting &	Approved Datasheet	Approved Datasheet	P	R	R	
		4. Colour	B	Visual	----DO.....	Approved Datasheet	Approved Datasheet	P	R	R	
		5. Surface Finish	B	Visual	----DO.....	Surface shall be smooth & free from porosity	Surface shall be smooth & free from porosity	P	R	R	

QUALITY ASSURANCE PLAN
POWER & CONTROL CABLES

Drawing No.P.019141 G11013 E003
Date: 23.09.2024
Project: Hyderabad Mother Station (Composite Works)
Client: BGL
Consultant:PMC

SL NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	AGENCY			REMARKS
								M	C	TPIA	
		6.Embossing/Printing/Sequential Marking	B	Visual	Each Setting & twice in a shift	Approved datasheet & Customer's Specification	Approved datasheet & Customer's Specification	P	R	R	
10	Cable	High Voltage Test	C	Electrical	Applying 3 KV for 5 Min.Between Each Core to all other Core & armoured	Approved Datasheet & IS 5831-1984	Approved Datasheet & IS 5831-1984	P	W	W	
III	**Routine Test**										
11	(Test by Manufacturer only)	1. Conductor Resistance	B	Physical	One Sample from lot of 10 Bobbins/drums or part there of	Approved Datasheet	Approved Datasheet & IS 8130-84	P	W	W	
		2. High Voltage Test	C	Electrical	Min.Between Each Core to all other Core & armoured	Approved Datasheet & IS 5831-1984	Approved Datasheet & IS 5831-1984	P	R	R	
IV	**Acceptance Test**										
12	(Sampling as per IS Spec.)	1. High Voltage Test	C	Electrical	Applying 3 KV for 5 Min.Between Each Core to all other Core & armoured	Approved Datasheet & IS 5831-1984	Approved Datasheet & IS 5831-1984	P	W	W	
		2. Conductor Resistance	B	Physical	One Sample from lot of 10 Bobbins/drums or part there of	Approved Datasheet	Approved Datasheet & IS 8130-84	P	W	W	
		3. Thickness of Insu. & Sheath	C	Physical	Each Setting & twice in a shift	Approved Datasheet & IS1554-Part I	Approved Datasheet & IS1554-Part I	P	W	W	
		4. Insulation Resistance at 27^0 C & 70^0 C	C	Electrical	One samples per lot of 10 MT or part there of Each lot	The Joint shall be smooth without burrs	The Joint shall be smooth without burrs	P	W	W	
		5. Tensile Strength & Elongation	B	Visual	Each Setting & in each Drum	Approved Datasheet	Approved Datasheet & IS 8130-84	P	W	W	
VI		IRN			Document			H	H	P	

LEGEND:

R:Review	H-HOLD	M-Manufacturer	
P:Performed	C-Contractor	W:Witness	

TPIA: Third Party Inspection Agency; Control Authority : Owner/Engineer or their Authorised Inspection Agency.

Note:

1. The Above Testing and acceptance criteria are minimum requirements, however, equipment supplier shall ensure and that the product also comply to the additional requirements as per Technical specifications and data sheets.
2. The supplier shall submit their own detailed QAP prepared on the basis of the above for approval of Owner/Owner's representative and TPIA.
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4. TPIA will have Right to Inspect minimum 10% of all manufacturing activities on each day or as specified above.4.
5. TPIA along with Owner/Owner representative shall review/approve all the documents related to QAP/Quality manuals/Drawings etc.submitted by supplier.
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7. Contractor shall in coordination with Supplier/Sub vendor shall issue detailed Production and Inspection schedule indicating the dates and the locations to facilitate Owner/Owner's representative and TPIA to organise Inspection.

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QUALITY ASSURANCE PLAN
DISTRIBUTION BOARD

Drawing No. P.019141 G11013 E004
Date: 23.09.2024
Project: Hyderabad Mother Station (Composite Works)
Client: BGL
Consultant:PMC

S.No.	COMPONENT/OPERATION	CHARACTERISTICS CHECKED	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
								M	C	TPIA	
1	**BOUGHT OUT ITEMS**										
1.1	Sheet Steel	1. Dimensions (L* W * T) 2. Bend Test 3 Chemical Analysis	Measuring Tape Physical Test Verification of Test Certificate	1 in Lot	Approved Drawing	Test Certificate		P	R	W	
1.2	Wire	1. Dimensions, Size 2. Routine test	Micrometer Multimeter	1 in Lot	Approved drawing	Test Certificate		P	R	W	
1.3	Bus Bars	1. Dimension 2. Conductivity 3. Material Grade	Measuring Tape Conductivity meter Verification of Test Certificate	1 in Lot	Approved drawing	Test Certificate		P	R	W	
1.4	ACB's, MCCB's, Switches, Fuse Contactors, O/L Relay, Timers, MCBs Terminal Blocks, Control, Indicating & Measuring Instruments, CT, PT, Control Transformer & Protection Relays etc.	1. Physical Check 2. Type & Rating 3. Make 4. Coil Voltage 5. Operation 6. Continuity (ON-OFF) 7. Test Certificate (if any)	Visual Visual Visual Visual Electrical Electrical For Record	100%	Approved Drawing	Manufacturer's Catalogue		P	R/W	W	
1.5	Paint	1. Shade & Type	Verification of Packing Slip	100%	Approved Drawing	Approved Drawing		P	W	W	
1.6	Push Buttons, SFU, Indicating lamps, Fuse etc.	1. Physical Check 2. Type & Rating 3. Operation 4. Continuity (ON-OFF)	Visual Visual Electrical Multimeter	100% 100% 10% 10%	Approved Drawing	Approved Single Line Diagram		P	W	W	
2	**IN-PROCESS**										
2.1	Fabrication	1. Welding 2. Frame Size 3. Door Size & dimensions Cut outs 4. Workmanship	Visual Measurement	Sample 100%	Approved Drawings/Specs	Smooth & at same gap As per GA No dent, wrinkle etc.		P	R/W	W	
2.2	Painting	1. Surface preparation 2. Paint Thickness 3. Finish Uniformity	Visual Coat Guage Visual Measurement	100%	Approved Drawings/Specs	No rust Same & Uniform texture As per drawing As per drawing As per specified torque > 25 mm. > 19 mm.		P	W	W	
2.3	Busbaring	1. Material (Al/Cu) 2. Size (Thickness/Width) 3. Busbar Tightening 4. Phase to phase clearance 5. Phase to earth clearance 6. Spacer b/n //el busbar 7. Check for burrs	Visual Visual	100% Sample		equal to busbar size NO Burrs		P	W	W	
2.4	Wiring	1. Size of wire	VERNIER CALIPER	Sample	Approved Drawings/Specs	As per drawing		P	R/W	R/W	
		2. Colour of wire	Visual	100%		AS PER STANDARD		P	R/W	R/W	
		3. Ferrules	Visual	100%	Approved Drawings/Specs	As per drawing		P	R/W	R/W	
		4. Sleeve Size	Visual	100%		AS PER STANDARD		P	R/W	R/W	
		5. Terminals	Visual	100%		As per requirement		P	R/W	R/W	
		6. Wiring Layout	Visual	100%		As per requirement		P	R/W	R/W	
		7.Accessibility	Visual	100%		As per requirement		P	R/W	R/W	
		8.Correctness of wiring	Electrical	100%	Approved Drawings/Specs	As per drawing		P	R/W	R/W	
2.5	Gasket	Fitment	Visual	100%		As per requirement		P	R	R	
2.6	Functional	Functional & interlock checks	Electrical	100%	Approved Drawings/Specs	As per Drawing Scheme		P	W	W	
3	**FINAL INSPECTION**							P			
		a) Verification Of BOM	Visual	100%	Approved Drawings/Specs	As per GA, SLD & BOM		P	R	R	
		Layout & Dimensions						P			
		b) IR-HV-IR Test	Electrical	100%		as per IS 13947		P	W	W	
		c) Functional Checks	Electrical	100%	Approved Drawings/Specs	as per IS 13947		P	W	W	
					as per IS 13947			P			
		d) Fixing Of Gasket	Visual	100%		Proper closing of door		P	W	W	
		e) Operation Of Equip.	Electrical	100%		As per Drawing Scheme		P	W	W	
		g) Finishing Of Panel	Visual	100%		No scratch, dent etc.		P	W	W	

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QUALITY ASSURANCE PLAN
DISTRIBUTION BOARD

Drawing No. P.019141 G11013 E004
Date: 23.09.2024
Project: Hyderabad Mother Station (Composite Works)
Client: BGL
Consultant:PMC

S.No.	COMPONENT/OPERATION	CHARACTERISTICS CHECKED	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
								M	C	TPIA	
		h) Fitting Of Equipments	Visual	100%		No Loose fitting		P	W	W	
		i) CT Ratio / Current Injection	Electrical	on client request				P	R	R	
		j) Physical Inspection	Visual	100%	IS 13947	IP - 42(min)		P	R	R	
4	**PACKING FOR DESPTCH**										
		1.Weather proof packing	Visual	100%	Approved Drawings/Specs	As per requirement		P			
		2. Wooden packing	Visual	100%		As per requirement		P			
		(if required by client)						P			
		3. Each panel Identification	Visual	100%		Project & Panel Name		P			
		4. Display of Top & Front	Visual	100%		Display in Bold letters		P			
	Documentation							P	R	R	
	IRN	INSPECTION RELEASE NOTE						P	H	P	
5	**Commissioning at site**	1. Commissioning as per client requirement		100%				P			
								P	W	W	
								P			
LEGEND:								P			
R:Review		H-HOLD		M-Manufacturer				P			
P:Performed		C-Contractor		W:Witness				P			
TPIA: Third Party Inspection Agency; Control Authority : Owner/Engineer or their Authorised Inspection Agency.								P			
								P			

Note:

1. The Above Testing and acceptance criteria are minimum requirements, however, equipment supplier shall ensure and that the product also comply to the additional requirements as per Technical specifications and data sheets.
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QUALITY ASSURANCE PLAN SILENT GEG SET

Drawing No P.019141 G11013 E005
Date: 23.09.2024
Project:- Hyderabad mother station (composite works)
Client: BGL
Consultant:PMC

S.No	COMPONANTS	CHARACTERSTICS	CLASS	METHOD OF CHECKS	QUALITY OF CHECK	REF. DOCUMENT	ACCEPTANCE NORMS	M	C	TPIA	REMARKS
STAGE - 1											
1	BASE FRAME	DIMENSIONS	MAJOR	STEEL TAPE	100%	Approved DRG.	Approved DRG.	P	R	R	
		FLATNESS	MAJOR	STEIGHT EDGE	100%	Approved DRG.	Approved DRG.	P	R	R	
		FDN HOLES	MAJOR	MEASUREMENT	100%	Approved DRG.	Approved DRG.	P	R	R	
		COMPONANT MOUNTING	MAJOR	BY SCALE / FIXTURE	100%	Approved DRG.	Approved DRG.	P	R	R	
		HOLES									
2	FUEL TANK	CAPACITY CHECKING	MAJOR	DIMENSION MEASUREMENT	100%	Approved DRG.	Approved DRG.	P	R	R	
		LEAKAGE	MAJOR	WATER FILLING / DIESEL FILL	100%			P	R	R	
		THICKNESS AND FITTINGS	MAJOR	GUAGE AND VISUAL	100%			P	R	R	
3	BATTERIES	DAMAGE	MAJOR	VISUAL	100%			P	W	W	
4	LEADS	DAMAGE	MAJOR	VISUAL	100%			P	W	W	
5	ALTERNATOR	DEMAGES DURING TRANSIT	MAJOR	VISUAL	100%			P			
		INSULATION TEST	MAJOR	MEGER	100%	T.C.	T.C.	P	R	R	
		MEASUREMENT OF SHAFT	MAJOR	DIAL							
		AND KEY		CALLIPER	100%	Approved DRG.	Approved DRG.	P	R	R	
		DIMENSIONS TO DETERMINE									
		HUB MACHINING FOR COUPLING	MAJOR	DIAL/CALIPER				P	R	R	
		ENGINE COMPONENTS	MAJOR	VISUAL	100%	Packing list		P	R	R	
6	AMF PANEL	DIMENSIONS	MAJOR	VISUAL	100%	Approved DRG.	Approved DRG.	P	R	R	
		STEEL THICKNESS	MAJOR	VISUAL	100%	Approved DRG.	Approved DRG.	P	R	R	
		IP CLASS	MAJOR	VISUAL	100%	Approved DRG./IS 2147	Approved DRG./IS 2147	P	R	R	
		TERMINAL BLOCK/WIRING	MAJOR	VISUAL	100%	Approved DRG.	Approved DRG.	P	R	R	
		MCCB's, Switches, Fuse Contactors, O/L Relay, MCBs Terminal Blocks, Control, Indicating & Measuring Instruments, CT, PT,	MAJOR	VISUAL ELECTRICAL	100%	Approved DRG.	Approved DRG./Manufacturer's Catalogue/As per owner's approved vendor list and as per IS 3156, IS 2705	P	R	R	
		KWH/KW/AMMETER/FREQUENCY METER	MAJOR	VISUAL	100%	Approved DRG.	Approved DRG./Calibration Reports	P	R	R	
		HV /IR TEST	MAJOR	ELECTRICAL	100%	IS4722/IEC 34	T.C.	P	W	W	
STAGE - 2											
7	HUB HEATING	TEMPERATURE	MAJOR	TEMPERATURE PYROMETER	RANDOM			P	R	R	
8	ALLIGNMENT	RADIAL AND AXIAL DISPLACEMENT	MAJOR	BY DIAL GAUGE & FIXTURES	100%	Spec. Sheet	As per reference standard.	P	R	R	
9	END PLAY	AXIAL CRANK SHAFT	MAJOR	DIAL & MAGNETIC BASE	100%	Spec. Sheet		P	R	R	
10	HT NUTS,BOLTS	TIGHTNESS	MAJOR	TORQUE WRENCH	RANDOM	Spec. Sheet		P	R	R	
11	ACCESSORIES, FITTINGS,HOSE, CONNECTIONS	LOSE FITTINGS	MAJOR	VISUAL	RANDOM	Genset Check List		P	R	R	
12	FUAL,WATER,LUB, OIL LEAKAGES	LEAKAGES	MAJOR	EACH SET IS RUN FOR							
				30 min. TO VERIFY LEAKS	100%	NIL		P	R	R	
				INCLUDING ANY ABNORMAL							
				SOUND.							

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			QUALITY ASSURANCE PLAN SILENT GEG SET				Drawing No P.019141 G11013 E005					
							Date: 23.09.2024					
							Project:- Hyderabad mother station (composite works)					
							Client: BGL					
							Consultant:PMC					
S.No	**COMPONANTS**	**CHARACTERSTICS**	**CLASS**	**METHOD OF CHECKS**	**QUALITY OF CHECK**	**REF. DOCUMENT**	**ACCEPTANCE NORMS**	**M**	**C**	**TPIA**	**REMARKS**	
STAGE - 3												
12	TRANSIENT DAMAGES OF PANEL BOX	CHECKING DENT / BEND	MAJOR	VISUAL	100%		PANEL SHOULD BE OK EXTERNAL	P	R	R		
13	METERS / INSTRUMENTS	RANGE / MAKE TERMINATION FITTINGS	MAJOR	VISUAL	100%	AS PER DRG	DRG	P	R	R		
14	RELAYS	WIRING TRIP SETTING AUX-V FUNCTIONING	MAJOR	SECONDARY INJECTION & SUPPLY VOLT PHYISICAL / FUNCTIONAL TEST	100%	DRG MAKERS	AS PER REQ. BY CUSTOMER	P	R	R		
15	CURRENT TRANFORMERS	VA	MAJOR	VISUAL	100%	AS SPECIFIED		P	R	R		
16	TRANSFORMERS	CLASS OF ACCURACY	MAJOR	VISUAL	100%	AS SPECIFIED		P	R	R		
		CTR	MAJOR	VISUAL	100%	AS SPECIFIED		P	R	R		
		POLORITY	MAJOR	POLORITY TESTER	100%	AS SPECIFIED	Approved Data Sheet	P	R	R		
17	OVERALL WIRING	FUNCTIONAL	MAJOR	PHYISICAL FUNCTIONAL TEST	100%	AS SPECIFIED		P	R	R		
		INSULATION		1000 V MEGER	100%	AS SPECIFIED		P	R	R		
		FINISH		VISUAL	100%	AS SPECIFIED		P	R	R		
18	BREAKER	FUNCTIONAL	MAJOR	PHYISICAL OPERATION	100%			P	R	R		
		TRIP SETTING	MAJOR	REFERENCE TEST CHECK				P	W	W		
				SPECIFIED BY MAKER								
STAGE - 4												
19	**LOAD TEST**	OPERATING / FUNCTIONAL PARAMETERS	MAJOR	BY WATER RESISTANCES METHOD AT UNITY P.F.	100%	AS PER APPROVED DATA SHEET / DRAWINGS	During load test - This parameters to be recorded. A) Measurment of all performance parameters like Volatge Current, Power, Frequency, speed, temperatures, RPM droop B) Voltage regulation at 100% load (No Load to full Load) C) Recording of waveform at 100% load. D) Check of fuel consuption at 100% load.	P	W	W		
		R-Y-B PHASE CURRENT ,	MAJOR	BY WATER RESISTANCES	100%			P	W	W		
		VOLTAGE FREQUENCY		METHODS AT UNITY P.F.				P	W	W		
		LUB OIL AND WATER TEMPERATURE	MAJOR	BY WATER RESISTANCES	100%			P	W	W		
				METHODS AT UNITY P.F.				P	W	W		
		R.P.M.DROOP	MAJOR	BY WATER RESISTANCES	100%			P	W	W		
				METHODS AT UNITY P.F.				P	W	W		
		FUNCTIONAL TEST OF OSS.HWT.LOP	MAJOR	BY CREATING EXTERNAL CONDITIONAL	100%			P	W	W		
		H.V.TEST,NOISE LEVEL TEST	MAJOR	BY H.V.TEST KIT AND	100%			P	W	W		
		& Vibration Test		MEASURING LEAKAGE CURRENT,VIBROMETER								
		LOAD TRIAL	MAJOR	BY WATER RESISTANCES / LOAD BANK METHOD S AT UNITY P.F	100%	**NOTE** : LOAD TEST WILL BE WITNESSED BY CLIENT / CLIENT'S REPRESENTATIVE			W	W		
		(a) 0% Load without Load										
		(b) 25% Load		…do…								
		(c)50% Load		…do…		* LOAD TEST WILL BE CARRIED AT WORKS						
		(d) 100% Load		…do…		* LOAD TEST WILL BE ALSO CARRIED AT SITE AS PER AVAILABLE LOAD						
		(e) 110% Load		…do…								

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QUALITY ASSURANCE PLAN SILENT GEG SET

Drawing No P.019141 G11013 E005
Date: 23.09.2024
Project:- Hyderabad mother station (composite works)
Client: BGL
Consultant:PMC

S.No	COMPONANTS	CHARACTERSTICS	CLASS	METHOD OF CHECKS	QUALITY OF CHECK	REF. DOCUMENT	ACCEPTANCE NORMS	M	C	TPIA	REMARKS
STAGE - 5											
20	**PAINTINGS**	THICKNESS & ATHESTIC ASPECTS		METHOD	VISUAL CHECKS	RANDOM		P	R	R	
21	**DOCUMENTS**	1) ENGINE TEST CERTIFICATE			VISUAL	100%		P	R	R	
		2)OPERATION MANNUAL									
		3) MAINTENANCE MANNUAL									
		4) PARTS CATALOG									
		5) ALTERNATOR USER'S HANDBOOK									
		6) ALTERNATOR TEST CERTIFICATE									
		7) ALTERNATOR WARRANTY CARD									
		8) ENGINE WARRANTY CARD									
		9)PANEL DRAWING									
		10) BPPL TEST CERTIFICATE									
		11) BATTERY WARRANTY CARD									
		12) PO/MTC/COMPLIANCE REPORT									
22	**Final Release**	IRN					As Per Specification	H	H	P	
LEGEND:											
R:Review		H-HOLD		M-Manufacturer							
P:Performed		C-Contractor		W:Witness							
TPIA: Third Party Inspection Agency; Control Authority : Owner/Engineer or their Authorised Inspection Agency.											

Note:

1. The Above Testing and acceptance criteria are minimum requirements, however, equipment supplier shall ensure and that the product also comply to the additional requirements as per Technical specifications and data sheets.
2. The supplier shall submit their own detailed QAP prepared on the basis of the above for approval of Owner/Owner's representative and TPIA.
3. Supplier shall submit Calibration certificates of all Instruments/Equipment to be used for Inspection and Testing to TPIA with relevant procedures and updated standards for TPIA review/Approval.
4. TPIA along with Owner/Owner representative shall review/approve all the documents related to QAP/Quality manuals/Drawings and Test Certificates submitted by supplier/manufacturer.
5. Wherever W/R is indicated, Inspection Engineer shall decide the option to be exercised for the particular stage and supplier.
6. TPIA shall issue 3.2 certificate as per BS EN 10204.

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QUALITY ASSURANCE PLAN
TRANSFORMER

Drawing No. P.019141 G 11013 E006
Date: 23.09.2024
Project: MS Hyderabad Composite Works
Client: BGL
Consultant:PMC

S.No	COMPONENTS	CHARACTERSTICS	TYPE OF CHECK	QUANTUM OF CHECK	REF. DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	M	C	TPIA	REMARKS
1	MATERIAL										
1.1	COPPER CONDUCTOR	DIMENSIONS	Actual Measure	15%	IS-12444 IS-7404/IS 13730	As Per Design	T.C	P	R	R	
		SURFACE FINISH	Visual Examination	15%		Visual	T.C	P	R	R	
		CONDUCTIVITY	Actual Measure	-		-	T.C	P	R	R	
1.2	LAMINATIONS	DIMENSIONS	Actual Measure	25%	As Per Design	To the Permitted tolerance	Inspection Record	P	R	R	
		SURFACE FINISH	Visual Examination	25%	Supplier Scope	Visual	Inspection Record				
1.3	PRESS BOARD	DIMENSIONS	Actual Measure	10%	IEC-60641-2-2004/IS-1576-1992	To the Permitted tolerance	Supplier Test Certificate	P	R	R	
1.4	OIL	RESISTIVELY TAN DELTA	Chemical Analysis	As Per Sample		-	Supplier Test Certificate	P	R	R	
1.5	FINISH PAINT	COLOR,TOUCH,DRY,Covering CAPACITY	Chemical Analysis	10%		-	Supplier Test Certificate	P	R	R	
2	IN PROCESS INSPECTION										
2.1	CORE BUILDING	Window Dimension	Actual Measure	100%	Internal sheet Design	To Manufacturing Tolerance	Process Inspection record	P	R	R	
		Core Length	Actual Measure	100%	Internal sheet Design	To Manufacturing Tolerance	Process Inspection record	P	R	R	
		Megger Test For Core Yoke Bolts	Actual Measure	100%	As Per IS 2026	> 500 Mega Ohm	Process Inspection record	P	R	R	
		Core Diameter	Actual Measure	100%	Internal sheet Design	To Manufacturing Tolerance	Process Inspection record	P	R	R	
2.2	WINDING	Conductor Dimensions	Actual Measure	50%	Internal Design	To Permitted Tolerance	Process Inspection record	P	R	R	
		Diameter of Formers	Actual Measure	100%	Internal Design	To Permitted Tolerance	Process Inspection record	P	R	R	
		OD of Winding	Actual Measure	100%	Internal Design	To Permitted Tolerance	Process Inspection record	P	R	R	
		Transposition	Visual	100%	Internal Design	To Permitted Tolerance	Process Inspection record	P	R	R	
		Continuity	Continuity Test	100%	Internal Design	As Per Design Sheet	Process Inspection record	P	R	R	
2.3	COIL ASSEMBLY	Top & Bottom Insulation	Visual	100%	Internal Design	To Manufacturing Tolerance	Process Inspection record	P	R	R	
		Internal Insulation	Visual	100%	Internal Design	To Manufacturing Tolerance	Process Inspection record	P	R	R	
2.4	CORE COIL ASSEMBLY	Maximum Dia Of Core	Actual Measure	100%	Internal Design	To Manufacturing Tolerance	Process Inspection record	P	R	R	
		ID Of Coil Assembly	Actual Measure	100%	Internal Design	To Manufacturing Tolerance	Process Inspection record	P	R	R	
		Lead Position	Visual	100%	Internal Design	As Per Design	Process Inspection record	P	R	R	
		Connection	Visual	100%	As Per Design	As Per Design	Process Inspection record	P	R	R	
		Joints	Visual	100%	As Per Design	As Per Design	Process Inspection record	P	R	R	
		Clearance	Actual Measure	100%	Internal Design	Minimum To Be Maintained	Process Inspection record	P	R	R	
		Drying	Insulation Resistance Test	100%	As Per Design	As Per Design Sheet	Process Inspection record	P	R	R	
		Megger	Testing	100%	As Per Design	> 500 Mega Ohm	Process Inspection record	P	R	R	
		Clamping & Pressing	Wdg-Height	100%	As Per Design	As per Design	Process Inspection record	P	R	R	
		HV Test Of Clamp & Core	Testing	100%	As Per IS 2026	As Required	Process Inspection record	P	R	R	

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QUALITY ASSURANCE PLAN
TRANSFORMER

Drawing No. P.019141 G 11013 E006
Date: 23.09.2024
Project: MS Hyderabad Composite Works
Client: BGL
Consultant:PMC

S.No	COMPONENTS	CHARACTERSTICS	TYPE OF CHECK	QUANTUM OF CHECK	REF. DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	M	C	TPIA	REMARKS
2.5	Tanking	Clearance In Tank	Visual	100%	As Per Design	As Per Design	Process Inspection Record	P	R	R	
2.6	Tank Fabrication	Plate Making & Preparation	Visual	100%	As Per Design	As Required	Process Inspection Record	P	R	R	
		Welding	Visual	100%	As required	As Required	-	P	R	R	
2.7	Unit Assembly	Final Dimension	Actual Measure	100%	Manufacturing Tolerance	Manufacturing Tolerance	Inspection Record	P	R	R	
		Painting	Visual	100%	Visual	Visual	Inspection Record	P	R	R	
3	**FINAL INSPECTION**										
3.1		Measurement Of Resistance	Actual Test	100%	IS 1180/2026	To Withstand	Final Test Report	P	W	W	
3.2		Measurement Of Ratio Test	Actual Test	100%	IS 1180/2026	To Withstand	Final Test Report	P	W	W	
3.3		No Load Test at 100 % rated Volatge	Actual Test	100%	IS 1180/2026	To Withstand	Final Test Report	P	W	W	
3.4		Exciation Current Measurement At rated Volatge	Actual Test	100%	IS 1180/2026	To Withstand	Final Test Report	P	W	W	
3.5		Separate Source Volatge Withstand Test	Actual Test	100%	IS 1180/2026	To Withstand	Final Test Report	P	W	W	
3.6		Induced Over VolatgeWithstand Test	Actual Test	100%	IS 1180/2026	To Withstand	Final Test Report	P	W	W	
3.7		Measuremnet Of Insulation resitance	Actual Test	100%	IS 1180/2026	To Withstand	Final Test Report	P	W	W	
3.8		Measurement of Load loss at 50 % &100% Load Impedance	Actual Test	100%	IS 1180/2026	To Withstand	Final Test Report	P	W	W	
3.9		Measurement of Vector Group Test	Actual Test	100%	IS 1180/2026	To Withstand	Final Test Report	P	W	W	
3.10		Oil Leekage Test	Actual Test	100%	IS 1180/2026	As Required	Final Test Report	P	W	W	
3.11		Temperature Rise Test	Actual Test	100%	IS 1180/2026	As per Design	Final Test Report	P	W	W	
		Tank Pressure Test	Actual Test	100%	IS 1180/2026	To Withstand	Final Test Report	P	W	W	
4	**Final Release**	IRN				As Per Specification		H	H	P	

LEGEND:

R:Review H-HOLD M-Manufacturer
P:Performed C-Contractor W:Witness
TPIA: Third Party Inspection Agency; Control Authority : Owner/Engineer or their Authorised Inspection Agency.

Note:

1. The Above Testing and acceptance criteria are minimum requirements, however, equipment supplier shall ensure and that the product also comply to the additional requirements as per Technical specifications and data sheets.
2. The supplier shall submit their own detailed QAP prepared on the basis of the above for approval of Owner/Owner's representative and TPIA.
3. Supplier shall submit Calibration certificates of all Instruments/Equipment to be used for Inspection and Testing to TPIA with relevant procedures and updated standards for TPIA review/Approval.
4. TPIA along with Owner/Owner representative shall review/approve all the documents related to QAP/Quality manuals/Drawings and Test Certificates submitted by supplier/manufacturer.
5. Wherever W/R is indicated, Inspection Engineer shall decide the option to be exercised for the particular stage and supplier.
6. TPIA shall also Review the Test certificates submitted by the manufacturer.

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	TECHNICAL DATA SHEET UPS SYSTEM	**P.019141 G11087 E101**

AC UPS SYSTEM

P.019141 G11087 E101

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TECHNICAL DATA SHEET UPS SYSTEM:

A	**Site conditions**				
1	Ambient temperature,		3	Altitude:	<1000m
	Maximum ambient temperature:	45°C	4	Atmospheric condition:	Highly corrosive
	Minimum ambient temperature:	5°C	5	Location: Indoor-Air-conditioned room.	
	Design ambient temperature:	50/0 °C	6	Applicable specification - PTS UPS	
2	Design temperature for battery sizing	10 °C			
B	**Input power supply**				
1	Voltage :	415V ±10%	3	Phase : TPN	
2	Frequency :	50Hz ± 3%	4	System fault level : 35 KA : As per SLD	
C	**System requirements**				
1	Equipment tag no.:		11	Type of battery : VRLA	
2	Type of inverter:	IGBT/Transistorised	12	Battery backup time : Refer PTS-UPS system	
3	Rating :	kVA(0.8 P.F.)		Description / kVA / Backup time (mins.)	
4	Phase :			Instrumentation	
5	Output voltage :	230V ±1%		Telecom	
6	Output frequency :	50Hz ±1%		Critical Lighting	
7	Mode of operation :				
8	Load power factor		13	Battery rack : Double row double tier	
	Rated : 0.8 (lag)		14	IP of enclosure: IP-42 min.	
	Variation : 0.6-1.0 (lag)		15	Cable entry: bottom	
9	Fault diagnostic unit :		16	Colour shade: RAL 7032	
10	Cell booster				
D	**UPS distribution board** (Outgoing feeder details)				
	1 Incomer Rating 2 Mounting - wall 3 Nos of outgoing feeders 4 KVA rating of feeders 5 Switching rating of fuse 6 Voltmeter - yes 7 Busbar material - copper 8 Paint - RAL 7032 * Refer SLD for more detail of UPSDB				
F	**Specific requirements**				
	a) All interconnecting cables between all panels of UPS system are included in vendor's scope				
G	**UPS system**				
1	Make :		9	Noise level : db	
2	Type designation :		10	Guaranteed overall dimensions of UPS system except	

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3	Rating : kVA at 0.8 p.f.			UPSDB and battery,			
4	Mode of operation :			- Length:		mm	
5	Output voltage distortion under the following conditions,			- Depth:		mm	
	For 50% step load : V± %			- Height:		mm	
	For 100% step load : V± %		11	Efficiency of each rectifier and inverter module including input and output transformer			
	For 100% step unload : V± %						
	Power supply interruption and restoration : V± %			At 100% load : %			
				At 75% load : %			
	Load transferred to bypass line : V± %			At 50% load : %			
	When one inverter gets faulty and load transferred to healthy inverter : V± %			At no load : %			
			12	Efficiency of bypass stabiliser including input transformer,			
6	Phase angle distortion under the following conditions, (for three phase inverter only)			At 100% load : %			
	For 50% step load : 120°± %			At 75% load : %			
	For 100% step load : 120°± %			At 50% load : %			
	For 100% step unload : 120°± %			At no load : %			
	Power supply interruption and restoration : 120°± %		13	Heat loss for the total system : kW			
			14	Overall efficiency of UPS system			
	Load transferred to bypass line : 120°± %						
	When one inverter gets faulty and load transferred to healthy inverter : 120°± %						
7	Maximum recovery time to reach steady state after above disturbances : milli sec.			At 100% load : %			
				At 75% load : %			
8	Redundancy of cooling system :			At 50% load : %			
				At no load %			
H	**Inverter**						
1	Rating : kVA		10	Short circuit capacity & duration :			
2	No. of phase(s) :		11	Output voltage/phase angles (for 3 phase only),			
3	Steady state output voltage,			For 30% unbalance load :			
	Nominal : V			For 40% unbalance load :			
	Variation : V			For 50% unbalance load :			
4	Output voltage adjustment range at rated load :			For 100% unbalance load :			
			12	Type of control circuit :			
5	Input DC voltage,		13	Max. allowable rating of outgoing feeders for fault clearance of feeder fault by UPS with mains bypass supply back up,			
	Nominal : V						
	Range : V						
6	Frequency variation limit for inverter when phase locked with mains :			- With fast acting semiconducting fuses :		amps.	
7	Allowable unbalance between phases : (for 3 phase only)			- With normal HRC fuses :		amps.	
8	Harmonic distortion at inverter output at rated load,						
	For linear load:						
	For non linear load:						

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9	Overload capacity & duration :		
	For 110% load: min.		
	For 125% load: min.		
	For 150% load: sec.		
I	**Static switches**		
1	No. of static switches in the UPS system :	3	Type of static switch :
2	Current rating at specified ambient,	4	Transfer time,
	Continuous : A		Synchronised mode : milli sec
	Short time : A		Unsynchronised mode : milli sec
J	**Battery charger (Connected to Grid Supply)**	4	Output voltage range under,
1	Current rating :		Float charging condition : V
2	Output voltage accuracy under specified input		Boost charging condition : V
3	Maximum ripple content on DC side with battery	5	Maximum harmonic content in input current :
	Connected :	6	Input transformer rating : kVA
	Dis Connected :		
K	**Manual transfer devices**	3	Rating
1	Make		Continuous :
2	Type designation		Short time :
L	**Battery**		
1	Make :	11	Overall rack dimension
2	Type designation		Length : mm
3	Type :		Depth : mm
4	AH rating :		Height mm
5	End cell voltage :	12	Battery charging requirements,
6	Nominal Voltage :	13	Nominal voltage/cell : V
7	Boost charging time :	14	Float voltage/cell V
8	No. of cells in each bank :	15	Boost charging voltage/cell :
9	No. of battery banks :	16	Container type :
10	No. of racks :	17	No. of recommended air changes/hour for battery room : m3
M	**Step-down bypass transformer with solid state voltage stabiliser**		
1	Make :	5	Accuracy of stabiliser : %
2	Type designation	6	Type of control :
3	Rating : kVA	7	Type of cooling :
4	Voltage ratio :	8	Type of stabiliser :
N	**UPS distribution board**		
1	Make :	6	Overall dimensions,
2	Type designation :		Length : mm
3	Rating :		Depth : mm
4	Degree of protection		Height mm
5	No. of outgoing Feeder / rating of each		
O	**Cell booster**		

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1	Make :	5	Overall dimensions
2	Type designation :		Length: mm
3	Voltage range		Depth: mm
4	Current range		Height mm
P	**Reliability**		
1	Safety factor used for selecting the components	4	MTBF/MTTR:
2	Electronic devices	5	Availability factor:
3	Electrical devices		

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BHAGYANAGAR GAS LIMITED (BGL)

TENDER DOCUMENT FOR CONSTRUCTION OF MOTHER STATIONS IN HYDERABAD GA.

POWER & CONTROL CABLE

P.019141 G11087 E002

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	TECHNICAL DATA SHEET – POWER & CONTROL CABLE	P.019141 G11087 E002

TECHNICAL DATA SHEET (To be furnished by Vendor)

1.0	Make	
2.0	Voltage Grade 1.1 KV	
3.0	Type of cable FRLS A2XFY/A2XWY/2XWY/2XFY	
4.0	Standard referred	
5.0	Conductor	
	a) Normal cross sectional area b) Shape of the conductor c) Max. D.C. resistance at 20 Deg. C. d) Number of strands e) Material - H4 Grade Aluminium as per IS:8130 latest/ Annealed plain copper as per IS:8130 latest f) Type (stranded/solid) - Stranded	
6.0	Insulation	
	a) Type and material of Insulation : XLPE confirming to IS:7098, Pt.-1 b) Thickness of insulation mm c) Color Scheme/Core Identification d) Extruded e) Diameter over insulation f) Dielectric strength (kV/mm)	
7.0	Armor	
	Type Material Galvanized steel strip/ Round wire Nominal Thickness Diameter over armor	
8.	Outer Sheath	
	a) Nominal thickness/OD of each strip b) Material FRLSH-C2, Type-ST-2 of IS:5831 c) Minimum Thickness d) Extruded	
9	Approximate overall diameter	
	1. Diameter over armour (mm) 2. Diameter under the armour (mm)	
10	Normal drum length Standard length of cable per drum (m)	

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11	AC resistance of the conductor at maximum operating Temperature	
12	Approximate reactance per phase at 50 Hz.	

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14	Current Rating	
a)	In ground 20° C (A)	
b)	In air 30°C (A)	
c)	Maximum conductor temperature during continuous Operation	
d)	Maximum conductor temperature during short Circuit	
e)	Short circuit rating	
f)	Maximum permissible bending radius	
g)	1. Overloading a) Current rating (A) b) Cycle 2 Heat stability °C a) Under continuous operation (°C) – 90 b) Under short circuit (°C) - 250 3 Short circuit capacity for one second(KA) 4 Minimum bending radius (where D is the overall diameter of cable)- 12 X D 5 Approx. Weight of the cable(Kg/cm) 6 Maximum DC resistance of cable at 20° C (Ohm/km) Main / Neutral 7 Maximum AC resistance of cable at 70° C (Ohm/km) 8 Reactance per phase at 50 Hz.(Ohm/km) 9 Capacitance per phase (μF/km)	
NOTE: Station wise Quantities of cables shall be worked out by EPC on the sizing calculations.		

** Refer PTS for further details.

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BHAGYANAGAR GAS LIMITED

TENDER DOCUMENT FOR CONSTRUCTION OF MOTHER STATIONS IN HYDERABAD GA

ELECTRICAL DISTRIBUTION BOARD

P.019141 G11087 E103

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TECHNICAL DATA SHEET (TO BE FURNISHED BY VENDOR)

1.0 GENERAL

1.1	Make	:	
	IP Class of Enclosure	:	Min IP 52
	Rating	:	415 V AC, 3Ph N, 50 Hz, (Refer SLD & PTS Elect.)
	Thickness of Sheet Steel	:	2mm CRCA sheet steel
	Treatment	:	
	Painting	:	RAL 7032
	Overall Dimension	:	
	LBH	:	
	Space heater rating of each panel	:	
	Weight of the Distribution Board	:	
	Earth bus Details	:	
	Method of fixing	:	
	Method of Cable Entry	:	
	Type	:	Fixed type

2.0 BUS BAR

2.1	Size		
	a) Horizontal Bus Bar	:	
	b) Vertical Bus Bar	:	
	c) Ground	:	
2.2	Minimum Clearance		
	a) Between Phases	:	
	b) Between Phase and earth	:	
2.3	Minimum creepage distance	:	
2.4	Current Rating	:	Refer SLD
	a) Continuous	:	
	b) Short Time for 1 second	:	
2.5	Temp. rise over ambient	:	
	a) For Continuous Load	:	
	b) For Short Time Load	:	
2.6	Fault Level	:	
2.7	Supports :		
	a) Materials	:	
	b) Make	:	
	c) Voltage	:	
	d) BIL	:	

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2.8	Bus bar insulation	:
2.9	Bus bar phase identification mark	:

3.0 MINIATURE CIRCUIT BREAKER

3.1	Make	
3.2	Rated Voltage	
3.3		
	a) Rated Insulation Voltage	
	b) Breaker rated voltage	
	c) Short time Breaking capacity.	
	d) Trip Curve	

4.0 CURRENT TRANSFORMER

4.1	Make	:
4.2	Type of primary winding	:
4.3	Ratio	:
4.4	Rated Burden	:
4.5	Accuracy class 1 for metering & 5P10 for protection	:
4.6	Type – Cast Resin	

5.0 POTENTIAL TRANSFORMER

5.1	Make
5.2	Type – Cast Resin
5.3	Type of primary winding
5.4	Rated primary voltage – 500V
5.5	Rated output
5.6	Ratio
5.7	Rated Burden
5.8	Accuracy class I

6.0 SWITCHES

6.1	Make
6.2	Material of contracts
6.3	Rated Voltage
6.4	Rated Thermal Current
6.5	Duty

7.0 FUSE

7.1	Make
7.2	Type of HRC fuse

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7.3	Rated Voltage
8.0	**RELAYS**
8.1	Application
8.2	Make
9.0	**INSTRUMENTS AND METERS**
9.1	Application
9.2	Make
9.3	Maker's type
9.4	Ref. Standard
9.5	Operating Principle
9.6	Rated Voltage / current
9.7	Burden at rated voltage / current
9.8	Operating range
9.9	Scale range
9.10	Accuracy class min. 1
10.0	**CONTRACTOR**
10.1	Make & Model
10.2	Rated Voltage
10.3	Rated Current
	AC3 Duty
	AC4 Duty
10.4	Rated Thermal current
10.5	Short Circuit capacity
10.6	Making Capacity
10.7	Breaking Capacity
10.8	Switching frequency
10.9	Life
10.10	Coil burden (VA) - Pickup & Hold
10.11	Nos of auxiliary contacts (NO + NC)
11.0	**MOULDED CASE CIRCUIT BREAKER**
11.1	Make
11.2	Rated Voltage
11.3	Power Frequency withstand
	a) Impulse withstand voltage
	b) No. of Poles / Ph
	c) Rated Insulation Voltage
	d) Breaker rated voltage

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e) Type of release for incomer feeder – Microprocessor based

f) Type of release for outgoing feeders: - Thermo magnetic / static for overload and short circuit. Additional module for earth fault to be provided.

g) Indications for on / off / Trip: - Required

h) Rotary handle with door interlock facility: Required

i) Settings for microprocessor-based release:

Adjustable overload time characteristic

Time delayed short circuit

Instantaneous short circuit

j) Setting for thermal magnetic release: -

Adjustable overload

Rated thermal current in air inside panel at design temperature short circuit capacity.

12.0 PROTECTIVE RELAYS

i. Type of relays numerical as per BOM / SLD

ii. Type of release microprocessor based for incomers – thermos magnetic / static for outgoing feeders

iii. Make

A. UNDER VOLTAGE RELAY

i. Type microprocessor based (numerical type)

ii. Make

** Refer SLD for relay/switches/breaker or any further requirement.

13.0 Quantity

Refer SOR.

Refer PTS – Electrical Distribution Board

∑ ∑ ∑

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	TECHNICAL DATA-SHEET VRLA BATTERY	**P.019141 G11087 E104**

BHAGYANAGAR GAS LIMITED (BGL)

TENDER DOCUMENT FOR CONSTRUCTION OF MOTHER STATIONS IN HYDERABAD GA

TECHNICAL DATASHEET –VRLA BATTERY
P.019141 G11087 E104

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	TECHNICAL DATA-SHEET VRLA BATTERY	**P.019141 G11087 E104**

TECHNICAL DATA SHEET (To be furnished by Vendor)

1	Item No. as per MR	
2	Manufacturer's name	
3	Type of Construction– VRLA maintenance free	
4	Type and catalogue no of cell–	**VRLA Maintenance free**
5	Ampere hour capacity	
6	No. of Cells	
7	Nominal cell voltage	
8	Cell voltage at the end of full discharge at 10 hours/ 5 hours rate	
9	Specific gravity of electrolyte at the end of full charging at 27 ˚ C.	
10	Specific gravity of electrolyte at the end of full discharge at 10 hours/5 hours rate at 27 ˚ C	
11	Quantity of electrolyte per cell (liters)	
12	Weight of each cell with electrolyte (kg)	
13 a	Max safe boost charging rate (amperes)	
13 b	Permissible ripple content	
14	Suggested boost charging rate (amperes)	
14 a	Suggested boost charging time (hrs)	
14 b	No. of recommended air changes/ hour for battery room(m3)	
15	Max boost charging voltage per cell	
16 a	Recommended Float charging voltage per cell	
16 b	Maximum float charging voltage range per cell	
17 a	Float charging current range (amperes))	
17 b	Permissible ripple content	
18	AH Efficiency at 10 hours / 5 hour rate	
19	Short circuit current of the battery bank	
20	Short circuit withstand time (sec.)	
21	Max. Allowable temp. of electrolyte which the cells can with stand without injurious effect	
	i) Continuously	
	ii) For short periods	

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22	Type of positive plate	
23	Type of negative plate	
24	No. of +ve and –ve plates per cell	

	TECHNICAL DATA-SHEET VRLA BATTERY	**P.019141 G11087 E104**

25	Material and thickness of separators	
26	Amp hour capacity at min. ambient 27^0C	
26.1	10 hours rate to end cell voltage at Sl. No. 8 above	
26.2	5 hours rate to end cell voltage at Sl. No. 8 above.	
26.3	2 hours rate to end cell voltage at Sl. No. 8 above.	
26.4	1 hour rate to end cell voltage at Sl. No 8 above.	
26.5	30 minutes rate to end cell voltage at Sl. No. 8 above	
26.6	No. of cells in each banks	
26.7	No. of racks	**02**
27	Dimensions of battery rack(W X D X H) in mm	
28	Battery bank back up hours	**Refer PTS**

**** Refer PTS - Electrical UPS for further detail.**

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BHAGYANAGAR GAS LIMITED (BGL)

TENDER DOCUMENT FOR CONSTRUCTION OF MOTHER STATIONS IN HYDERABAD GA

SILENT GAS ENGINE GENERATOR SET

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Date: 2026.09.11 18:16:52 IST

1	**GAS ENGINE**	
1.1	Engine Make & Model No.	*
1.2	Reference Standards.	*
1.3	Number of cylinders.	*
1.4	Continuous output at N.T.P.	*
1.5	Continuous output at the site condition as specified in specification sheet.	*
1.6	Fuel gas consumption at	
	a) 100% load.	*
	b) 75% load.	*
1.7	Specification of the recommended gas and its calorific value.	*
1.8	Lubricating oil consumption.	*
1.9	Time interval from the moment of mains failure.	
	a) to come to full speed.	*
	b) to take 100% of rated load.	*
1.10	Time interval between each successive attempt.	*
1.11	Efficiency of the Engine at	
	a) 75% of rated load.	*
	b) 100% of rated load.	*
1.12	Method of Engine starting.	-Electronics.
1.13	Type of cooling system.	-Radiator Cooling
1.14	Approximate A Hr. Capacity at 10 hr. rate of discharge at 24 volts for starting and control system.	*
1.15	Over load capacity for 1 hour.	*
1.16	Over load capacity for 5 minutes.	*

GENERATOR

1.1	Make	*
1.2	Maker's type	Industrial Power train
1.3	Reference Standards	*
2	**RATING**	
2.1	Rated voltage with ± (KV)	*
2.2	Rated Frequency with ± (Hz)	*
2.3	Rated Speed (RPM)	*

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2.4	Rated output (KW)	*
	i) Continuous under site conditions.	
3	**EXECUTION**	
3.1	Type of Enclosure.	*
3.2	Degree of Protection.	*
3.3	Rotation (as Viewed from the engine side)	*
3.4	Cooling method.	Radiator Cooling
4	**INSULATION**	
4.01	Class of insulation	
	i) Stator	*
	ii) Rotor	*
4.02	Material of Insulation	
	i) Stator	*
	ii) Rotor	*
4.03	Winding Replaceable at site (Yes/No).	*
5	**PERFORMANCE**	
5.01	Current at	
	a) 100% load	*
	b) 75% load	*
5.02	Voltage regulation and efficiency at 0.8 power factor and at	
	a) 100% load	*
	b) 75% load	*
5.03	Power factor at	
	a) 100% load	*
	b) 75% load	*
6	**LOSSES**	
6.1	Total guaranteed losses (KW).	*
6.2	Efficiency.	*
7	**COOLING**	
7.1	Type of Cooling.	*
7.2	Type of Fan	*
7.3	Material of construction of fan.	*

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8 LUBRICATION SYSTEM

8.01 Type

a) Grease *
b) Oil bath *

8.02 Bearing type and Nos.

a) Driving end *
b) Non-driving end *

8.3 On-line lubrication facility *

8.4 Specification of Lubrication. *

8.5 Interval of lubrication *

8.6 Quantity of Lubrication

a) Recharging *
b) Replacement *

9 MECHANICAL DATA

9.1 Frame Size *

9.2 Dimensional Drg. No. *

9.3 Total Weight of Generator *

9.4 Permissible vibration limits *

9.5 Noise level *

10 ACCESSORIES INCLUDED

10.1 Anti vibration mounting pads *

10.2 Cable glands *

10.3 Cable lugs / connectors *

10.4 Earthing Terminals *

10.5 Lifting eye bolt *

10.6 Name Plate *

10.7 Drain Plug *

11 CABLE BOX

11.1 Mains cable box *

11.2 Neutral cable box *

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12 CONTROL PANEL

12.1 Make *

12.2 Maker's type *

12.3 Reference Standard *

12.4 IP class of enclosure *

12.5 Type of Sheet Steel *

12.6 Thickness of Sheet Steel *

12.7 Treatment *

12.8 Painting *

12.9 Maximum temperature rise *

12.10 Overall dimension *

L B H

13 BUSBARS

13.1 Material *

13.2 Size

a) Horizontal Bus bar *
b) Vertical Bus bar *
c) Ground *

13.03 Minimum clearances

a) Between phases *
b) Between phase and earth*

13.4 Minimum creepage distances.

13.5 Current Rating

a) Continuous *
b) Short time for 1 Second *

13.06 Temperature rise over ambient

a) for continuous load *
b) for short time current *

13.07 Supports

a) Material *
b) Make*
c) Voltage class *
d) BIL *

13.8 Bus bar insulation *

13.9 Bus bar phase identification mark. *

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14	**MCCB / ACB**	
14.1	Make	*
14.2	Maker's type	*
14.3	Reference Standard	*
14.4	Short circuit capacity	*
14.5	Short circuit category	*
14.6	Type Testing Authority	*
14.7	Rated Voltage	*
14.8	Maximum Operating Voltage	*
14.9	No. of poles	*
14.10	Rated operating duty	*
14.11	Over Current & Short Circuit Protection	*
15	**CURRENT TRANSFORMER**	
15.1	Make	*
15.2	Maker's type and reference standard	*
15.3	Type of primary winding	*
15.4	Ratio	*
15.5	Rated Burden	*
15.6	Accuracy class	*
15.7	Insulation Material	*
15.8	Insulation class	*
16	**INSTRUMENT AND METERS**	
16.1	Application	*
16.2	Make	*
16.3	Maker's type	*
16.4	Reference Standard	*
16.5	Operating Principle	*
16.6	Rated Voltage / Current	*
16.7	Burden at rated voltage/current	*
16.8	Operating range	*
16.9	Scale range	*

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16.10	Type of Scale	*
16.11	Accuracy	*
17	**CONTROL SWITHCES**	
17.1	Make	*
17.2	Maker's type	*
17.3	Reference Standard	*
17.4	Rated voltage	*
17.5	Rated thermal current	*
17.6	Utilization category	*
18	**PUSH BUTTON**	
18.1	Make	*
18.2	Maker's type	*
18.3	Reference Standard	*
18.4	Current rating of contacts at rated voltage	*
19	**ACOUSTIC ENCLOSURE**	
19.1	Modular Construction (Yes / No)	*
19.2	Material of construction	*
19.3	Overall Dimension	*
	L B	
	H	
19.4	Thickness of material of construction (SWG)	*
19.5	Type of painting	*
19.6	Material of insulation	*
19.7	Density of insulation (KG / M^3)	*
19.8	Thickness of insulation (MM)	*
19.9	Type & Thickness of insulation covering	*
19.10	Type & thickness of overall metallic covering sheet	*
19.11	Type of silencer used for engine exhaust	*
19.12	Type of attenuators at air inlet and exhaust	*
19.13	Capacity of Air blower / Fan	*
19.14	Noise level inside the enclosure (dB) (A)	*
19.15	Noise level at 1 meter from enclosure (dB) (A)	*

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20	**SIGNAL LAMPS**	
20.1	Make	*
20.2	Maker's type	*
20.3	Reference Standard	*
20.4	Rated voltage(V)	*
20.5	Rated Wattage(W)	*
20.6	Type	*

N.B -'*' marked information to be furnished by vendor.

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	TECHNICAL DATA SHEET– SOLAR SYSTEM	**P.019141 G11087 E005**

BHAGYANAGAR GAS LIMITED (BGL)

TENDER DOCUMENT FOR CONSTRUCTION OF MOTHER STATIONS IN HYDERABAD

SOLAR PANEL SYSTEM

P.019141 G11087 E005

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Date: 2026.09.11 18:16:52 IST

	TECHNICAL DATA SHEET– SOLAR SYSTEM	P.019141 G11087 E005

1. **TECHNICAL DATASHEET (To be furnished by vendor)**

Applicable To: Proposal Purchase As Built
Vendor shall complete Data Sheet with information not otherwise provided by Owner.
Owner:
Facility:
Tag Number:
Location:
Manufacturer/Model No.:
Service:

1. Site / Environment conditions:
2. No. of systems / service:
3. Application:
4. Type/model no. & country of origin *:
5. Load / Output voltage: 6 kW/ 415V
6. Total output required:
7. Ripple output:
8. Daily load demand:
9. Earthing:
10. Battery backup required for: 30 mins
11. Battery type: VRLA
12. Battery rating:
13. Make/model no. Country of origin of battery *:
14. Type of alternative energy source available location
    a. Solar panels:
    b. Power controller:
    c. Battery:
15. Location of power controller: Indoor
16. Expected life span *:
17. Area classification: Safe
18. Insulation data:
19. Degree of protection of power controller enclosure & temp. Class:
20. Power controller unit painting type *:
21. Color shade of finish coat:
22. No. Of panels / modules required *:
23. Battery charging and power control scheme:
24. Type & material of hardware to be used:
25. Whether erection, testing & commissioning in vendor's scope: Yes No
26. Additional information / requirements:
27. Reference codes:

Note:

- Data to be filled by supplier with its bid in the supplier data column, those data shall be in accordance with standard specification

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NOTES

TYPICAL CABLE TRAY INSTALLATION DETAILS

Rev.	D M Y	Modifications	Drawn	Checked	Approved	Validated
0	07.10.16	APPROVED	RKS	PR	KJ	SKH

SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS

Size	Scale	Sheet	Drawing No.	Rev.
A3	NTS	01 of 62		

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NOTES :

1- IN THE FOLLOWING SHEETS, EXACT DIMENSIONS X, Y, Z FOR CABLE SUPPORTS SHOULD BE DETERMINED ON SITE ACCORDING TO THE LOCATION,INSTALLATION DRAWING DONE FOR BUILDINGS AND AREAS.

2- THESE ERECTION DETAILS COULD BE ADAPTED ACCORDING TO NEEDS ON SITE.

3- THIS DOCUMENT IS A GUIDE LINE FOR CABLE TRAY INSTALLATION CONTRACTOR TO HELP HIM IN THE DEFINITION OF ITS SCOPE OF DESIGN AND SUPPLY.

4- MATERIAL SHOWN IN THIS DOCUMENT CAN BE ADAPTED BY CABLE TRAY INSTALLATION CONTRACTOR

Rev.	D M Y	Modifications	Drawn	Checked	Approved	Validated
0	07.10.16	APPROVED	RKS	PR	KJ	SKH

SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS

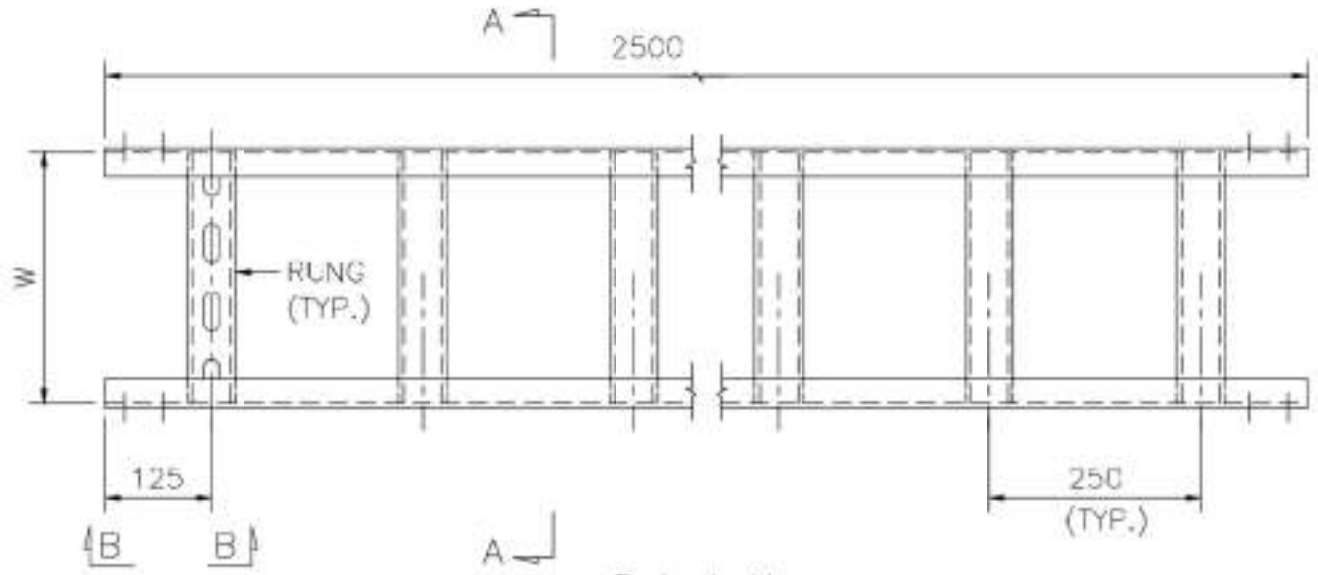
Size A3 | Scale NTS | Sheet 02 of 62

Drawing No. | Rev.

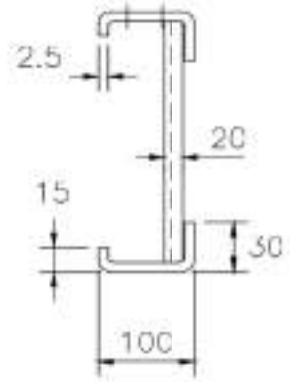
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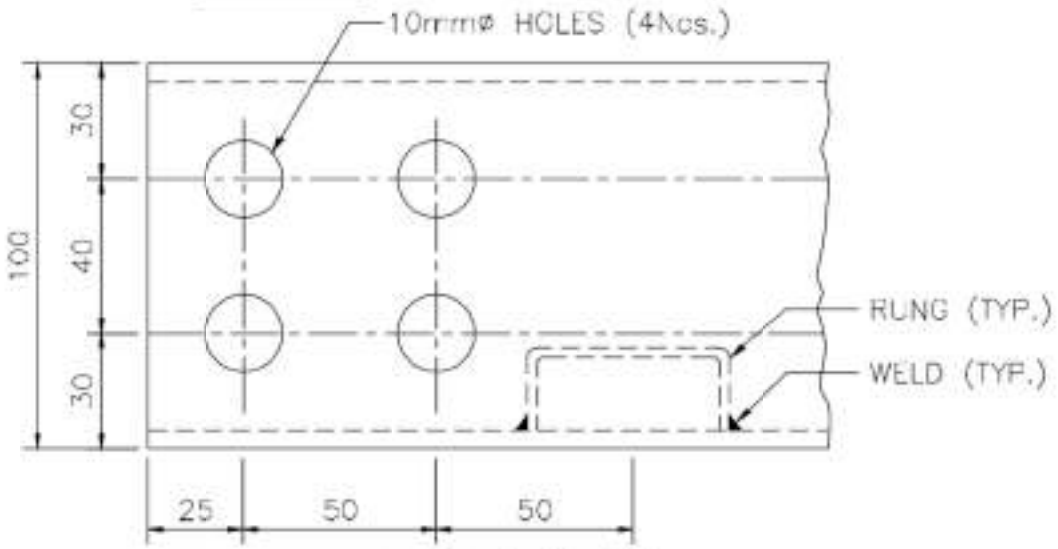
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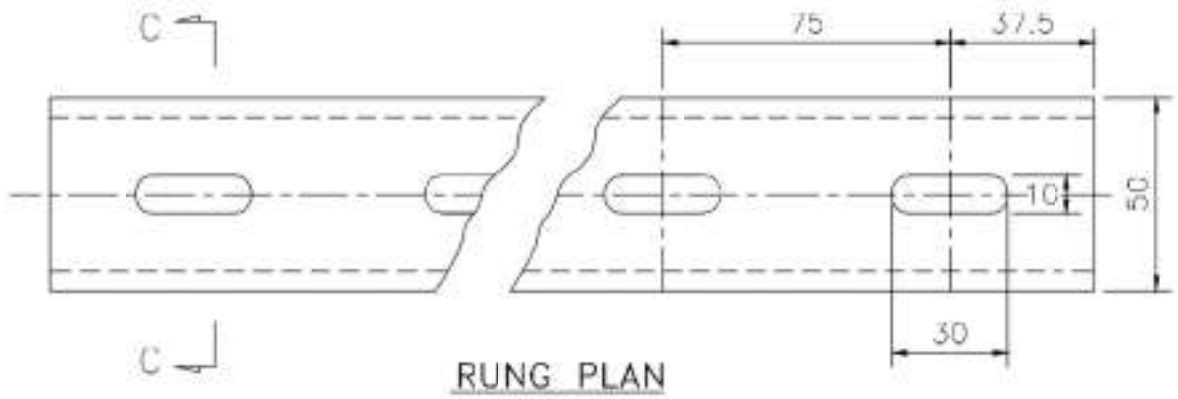
PLAN



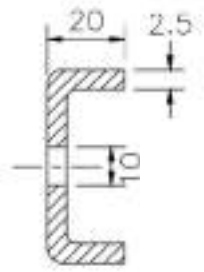
SECTION 'A-A'



SECTION 'B-B'



RUNG PLAN



SECTION 'C-C'

MATERIAL – 12 GAUGE (2.5MM) M.S.SHEET/G.S/AL/FRP (AS PER BOQ)
INSIDE TRAY WIDTH (W) – 150,300,450,600,800MM (AS PER BOQ)

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. M.S. SHEET SHALL CONFORM TO IS3362: 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 TRAY SHALL BE SUPPLIED COMPLETE WITH MATCHING COUPLER PLATES WITH REQUIRED HARDWARE.
5. CABLE TRAYS SHALL DESIGN FOR 3000mm SUPPORT SPAN UNLESS NOTED OTHERWISE FOR SPECIFIED TRAY LOADING.

0	07.10.16	APPROVED	RKS	PR	KJ	SKH

Drawing No. GGNG-E-20714-3010 Rev. 0

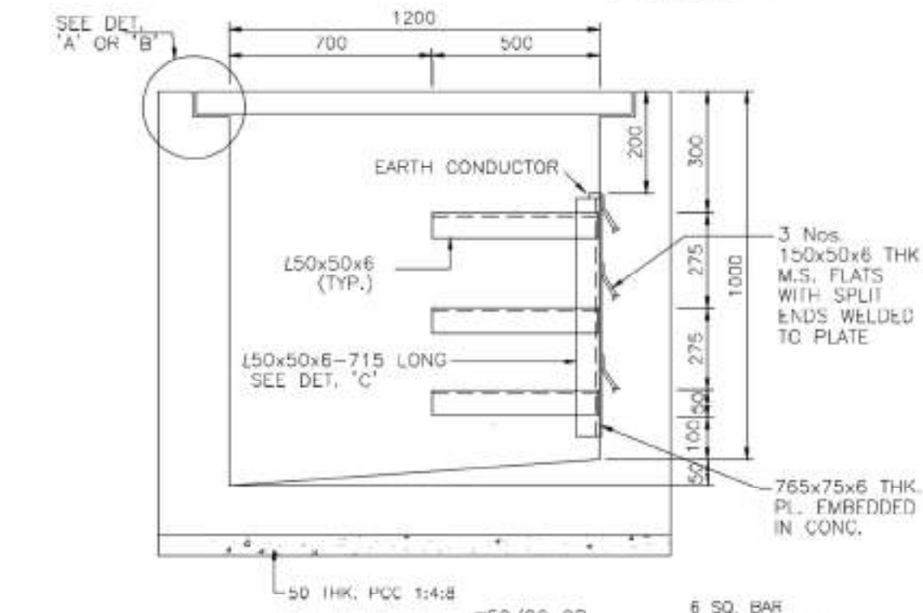
TRACTEBEL ENGIE

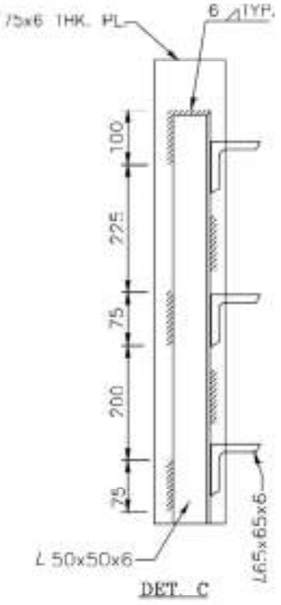
Civil and Architectural Works for development and construction of CNG Mother Station in Hyderabad GA
Bid Document No: BGL/780/2026-27
Volume II of II

Bhadyanagar Gas Limited

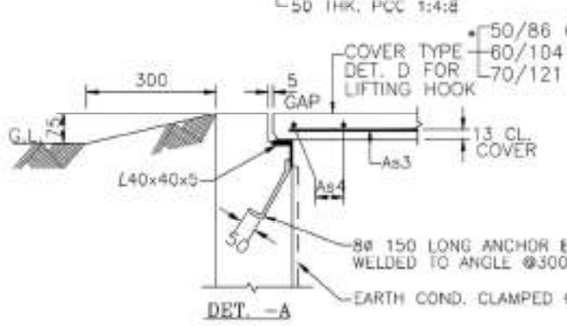
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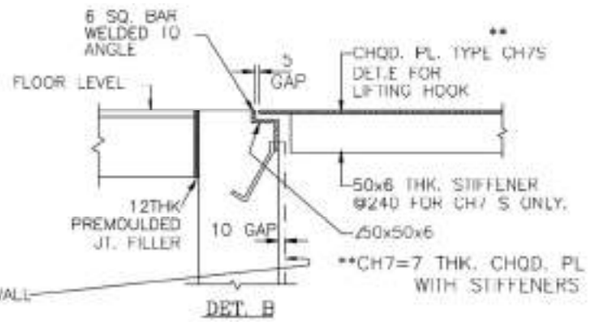




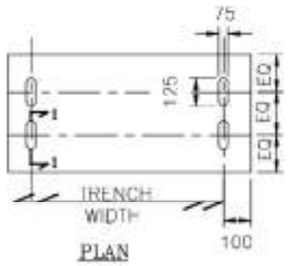
DET. C



DET. -A



DET. B

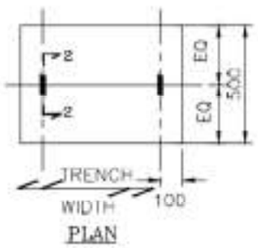


PLAN

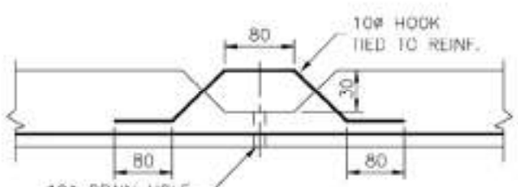
*

R C COVER TYPE	THICKNESS mm.	As3	As4
50/86	50	7-6ø	9-6ø
60/86	60	6-8ø	7-8ø
70/181	70	5-8ø	7-8ø

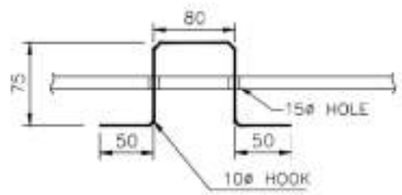
60/104 MEANS 60mm. THK.x86 Kg. COVER WEIGHT OF 600mm COVER WIDTH. PROVIDE TWO COVERS OF 300mm WIDTH FOR EVERY 10m LENGTH OF TRENCH.



PLAN



SECT. 1-1
DET. D



SECT. 2-2
DET. E

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. STRUCTURAL STEEL SHALL BE AS PER IS 2062:1992

Rev.	D M Y	Modifications	Drawn	Checked	Approved	Validated
0	07.10.16	APPROVED	RKS	PR	KJ	SKH

SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRENCH TYPE

TRACTEBEL ENGIE

Size A3 | Scale NTS | Sheet 04 of 62

Drawing No. GGNG-E-20714-3010 | Rev. 0

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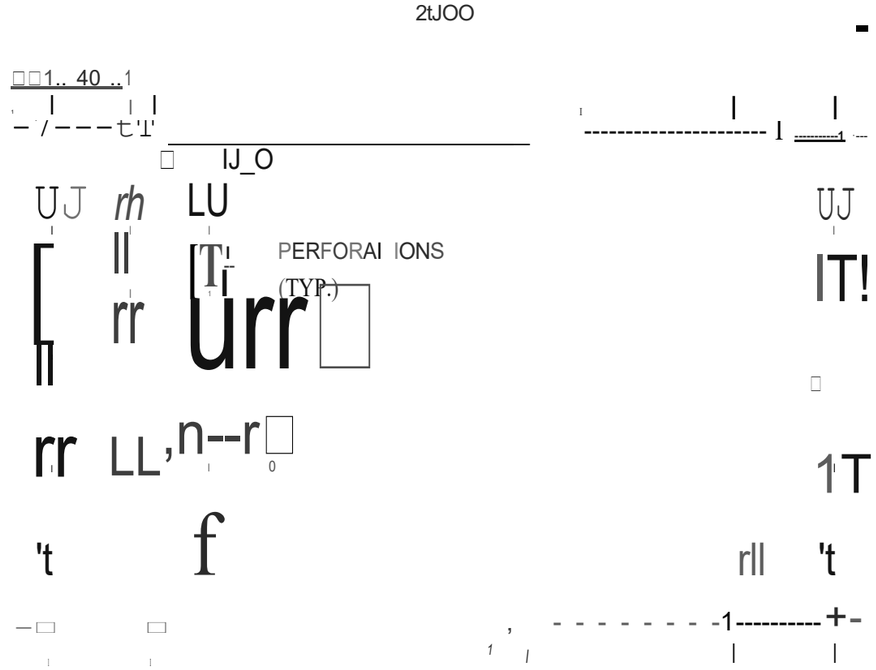
2 3 4

A

B

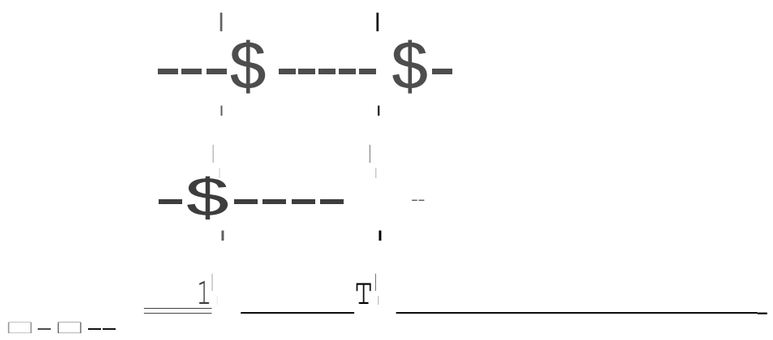
C

D



PLAN

END VIEW



SECTION tA-A'

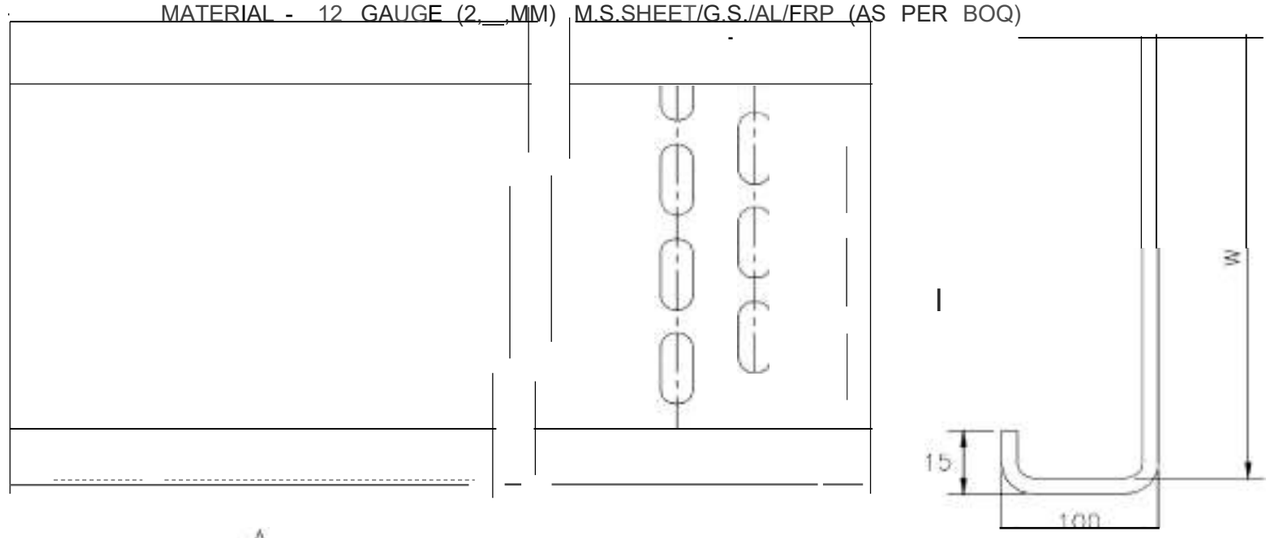
NOTES

1. ALL DIMENSIONS ARE IN t.IM.
2. M.S. SHEETSHALL CONFORM TO 152062: 1992 OR EQUIVALENI INTERNATIONAL STANDARDS AND HOT DIP GALVANIZING SHALL BE DONE "5 PER IS4759: 1996 OR EQUIVALrnl INTERNATIONAL STANDARDS. CABLE TRAY SUPPLIED WITH OTHER MATERIALS SHALL CONFIRMEDTO RELEVANT IS/INTERNATIONAL STANDARDS.
3. THE MATERIAL DIMENSIONAL DETAILS SHOWN ARE TYPICAL FOR GS STRESS.
4. EACH CABLE TRAY SHALL BE SUPPLIED COMPLETEWITH MATCHING COUPLER PLATES WITH Rf.QUIRIO HARDWARE.
5. CABLE TRAYS SHALL DESIGN FOR 3000mm SUPPORT SPAN UNLESS NOTED OTHERWISE FOR SPECIFIEDTRAY LOADING.

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INSI E WI0H- (W) - 100,150,300,450,600,S00MM (AS FER BOQ)
MATERIAL - 12 GAUGE (2,__,MM) M.S.SHEET/G.S./AL/FRP (AS PER BOQ)



E

Rev.	D M Y	Modifications	Drawn	Checked	Approved	Validated
0	b7.10.1t	APPROVED	RKS	PR	KJ	SKH

SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
PERFORATED TYPE CABLE TRAY

IRACTEBEL... C!!NGle

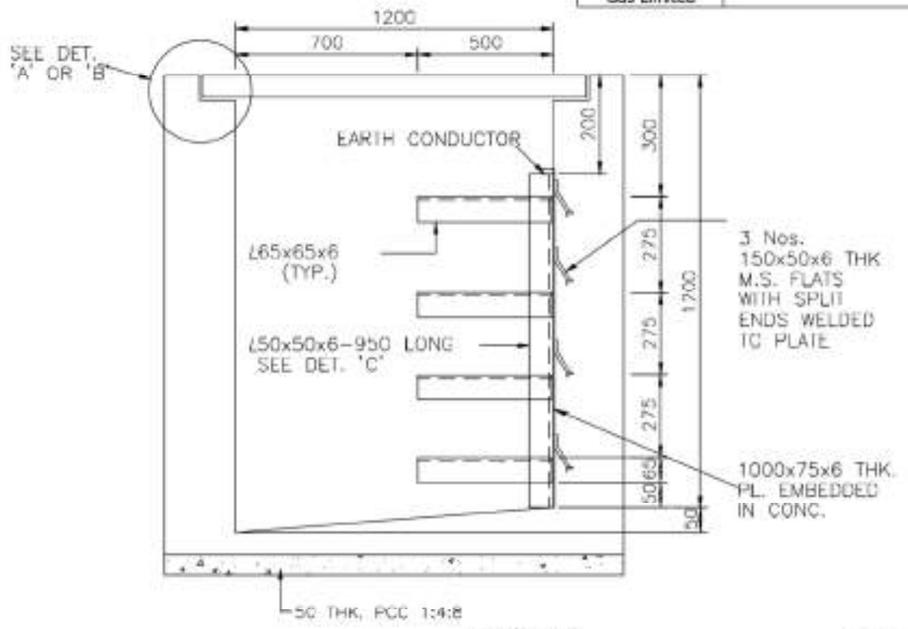
Size	Scale	Sheet
A3	NTS	05 of 62

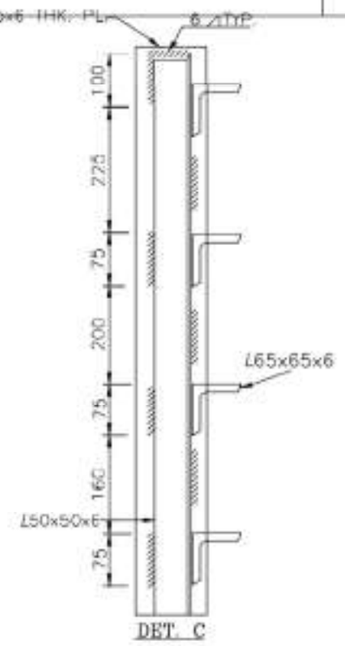
Drawing No. GGNG-E-20714-3010 Rev. 0

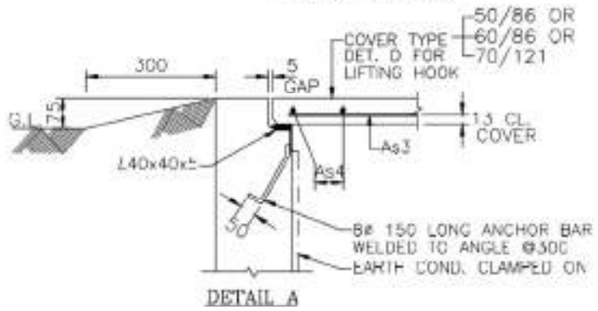
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NOTES

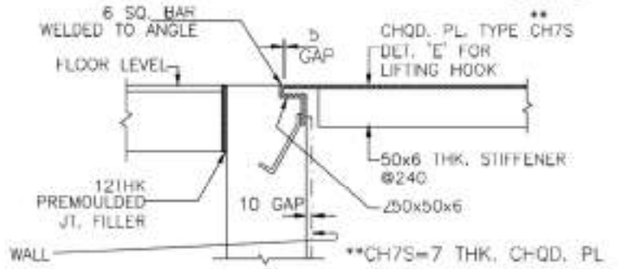
1. ALL DIMENSIONS ARE IN MM.
2. STRUCTURAL STEEL SHALL BE AS PER IS 2062:1992







DETAIL A

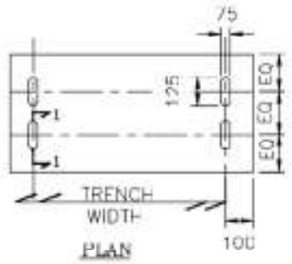


DETAIL B

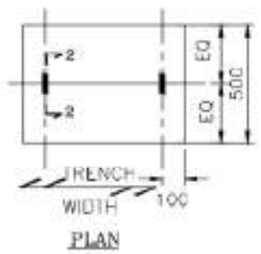
*

R C COVER TYPE	THICKNESS mm.	As3	As4
50/86	50	7-6ø	9-6ø
60/104	60	6-8ø	7-8ø
70/121	70	5-8ø	7-8ø

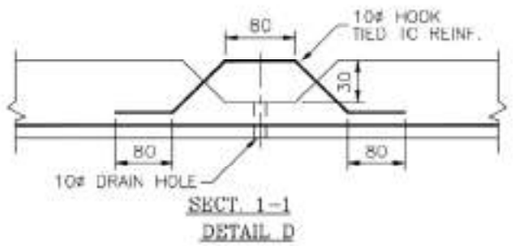
60x104 MEANS 60mm. THK.x104 Kg. COVER WEIGHT OF 600mm COVER WIDTH, PROVIDE TWO COVERS OF 300mm WIDTH FOR EVERY 10m LENGTH OF TRENCH.



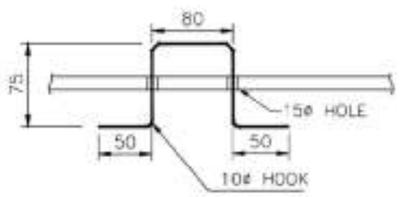
PLAN



PLAN



SECT. 1-1
DETAIL D



SECT. 2-2
DETAIL E

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0	07.10.16	APPROVED	RKS	PR	KJ	SKH

SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRENCH TYPE

TRACTEBEL ENGIE

Size A3 | Scale NTS | Sheet 06 of 62

Drawing No. GGNG-E-20714-3010 | Rev. 0

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2 3 4

A

45° DIRECT VERTICAL ELBOW

D TAIL-'X'

B

RUNG(TYP.)

INSIDE

45y'.JANGLE VERTICAL CCLPLER PLATES (TYP.)

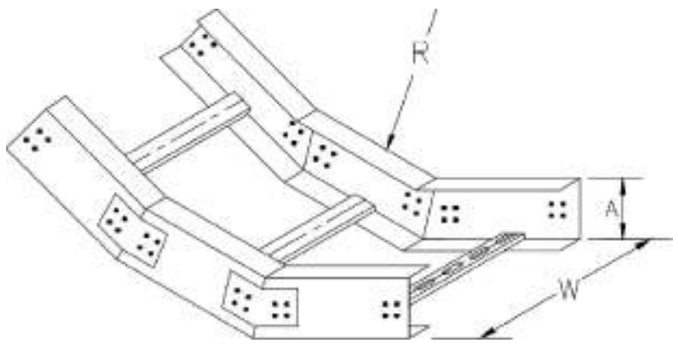
OUTSIDE

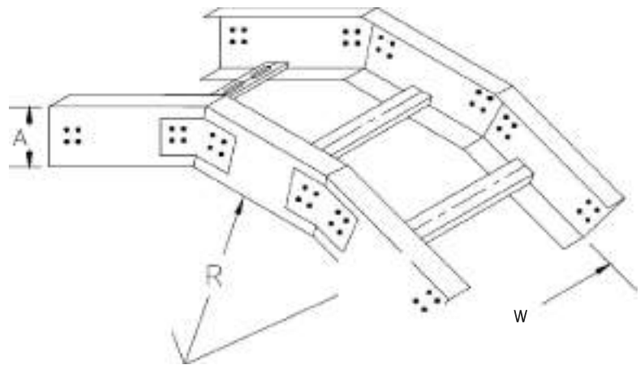
10 /IJ HOLES 4Nos.

DETAIL-X

C

45° VERTICAL RADIUS ELBOW





D

OUTSIDE **INSID□**

(W) INSIDE WIOI H OF I RAY 150,300,4'.J0,600,800MM (AS PER EOO)

(A) DEPTH CF TRAY □ 1 OOMM UNLESS NOTED

(R) BEf\DING RADILS (AS PER 600)

NOTES

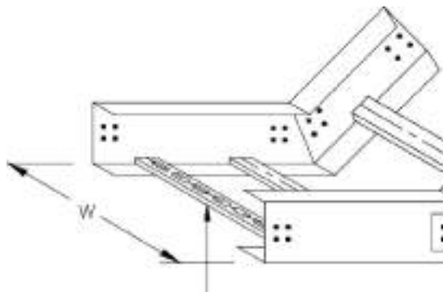
1. ALL DIMENSIONS ARE IN MM.
2. MATERIAL - 12 GAUGE(2.5MM) M.S. SHEET/G.S/AL/FRP (AS PER BOO)
3. M.S. SHEET SHAU CONFORM TO IS2062: 1992 OR c.QUIVALINt INTERNATIONAL STANDARDS AND HOT DIP GALVANIZING SHALL BE DONE AS PER IS4759: 1996 OR IQUIVALINI INTERNATIONALSTANDARDS. CABLE TRAY SUPPLIED WITH OTHER MATERIALS SHALL CONFIRMED TO RELEVANT IS/INTERNATIONAL STANDARDS.
4. EACH CABLE TRAY SHALL BE SUPPLIED COMPLETE WITH MATCHING COUPLER PLATES WITH REOIJIRED HARDWARE.
5. ALL TRAY FITTINGS SHALL BE SUPPLIED COMPLETE WITH MATCHING ANGLE HORIZONTAL COUPLER PLATES & HARDWARE. ALTERNATIVELY WELDED ASSEMBLY MAY BE SUPPLIEDFOR G.S. CABLE TRAY FITTINGS.

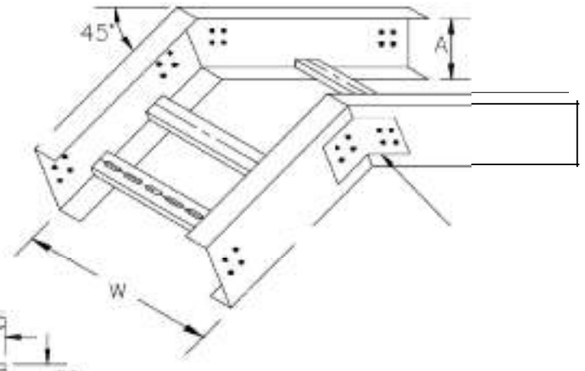
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Date: 2026.09.11 18:16:52 IST

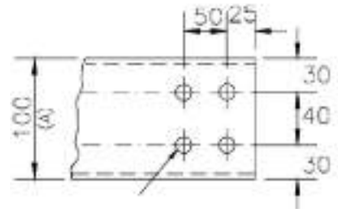
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E







SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRAY ACCESSORIES

IRACTEBEL

C!!NGle

Size A3 Scale NTS Sheet 0 Z_d_62_1

Drawing No. GGNG-E-20714-3010 Rev. 0

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2 3

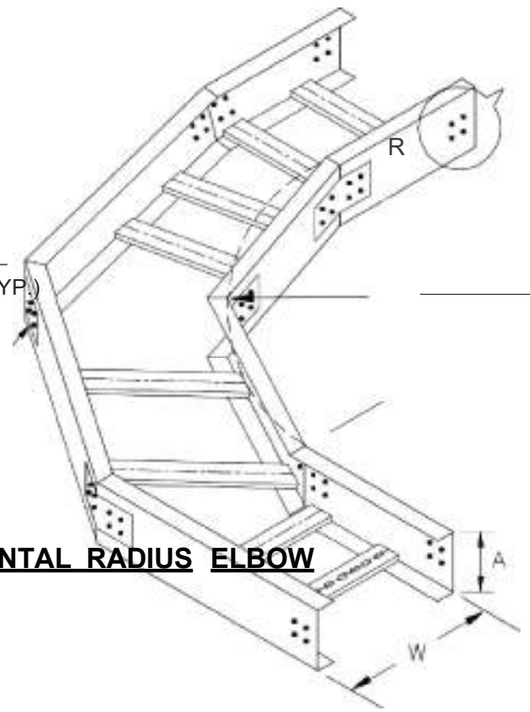
A

B

C

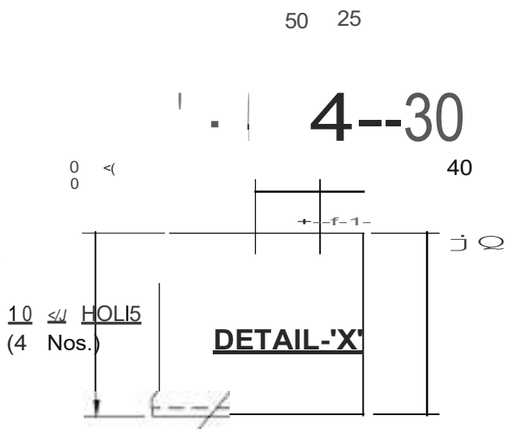
D

CETAIL-'X'

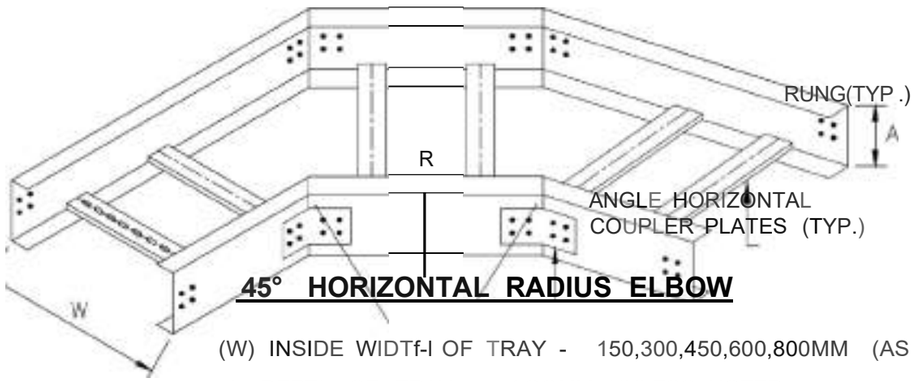


ANGLE HORIZONTAL COUPLER PLATES (TYP.)

90° HORIZONTAL RADIUS ELBOW



DETAIL-'X'



45° HORIZONTAL RADIUS ELBOW

(W) INSIDE WIDTH OF TRAY - 150,300,450,600,800MM (AS PER 600)

(A) DEPTH OF TRAY - 100MM UNLESS NOTED

(R) BENDING RADIUS (AS PER BOO)

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. MATERIAL - 12 GAUGE(2.5MM) M.S. SHEET/G.S/AL/FRP (AS PER BOO)
3. 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.
4. EACH CABLE TRAY SHALL BE SUPPLIED COMPLETE WITH MATCHING COUPLER PLATES WITH REQUIRED HARDWARE.
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.

0	7.10.1	APPROVED	RKS	PR	KJ	SKH

Scale

Sheet

Drawing No.: GGNG-E-20714-3010

Rev.: 0

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2 3 4

A

90° VERTICAL RADIUS ELBOW

W □

r/

7

f ?

B

ANGLE VERTICAL
CCUFLER PLATES (TYP.)

INSIDE

50 2:i

C

W

0
O<(

40

JO

10 ç HOLES
(4Nos.)

DETAIL-'X'

D

RUNG(TYP.)

OUTSIDE

(W) INSIDE WIDTH OF TRAY - 150,300,450,600,80CMM (AS PER BOO).

(A)
DEPTf
-J OF

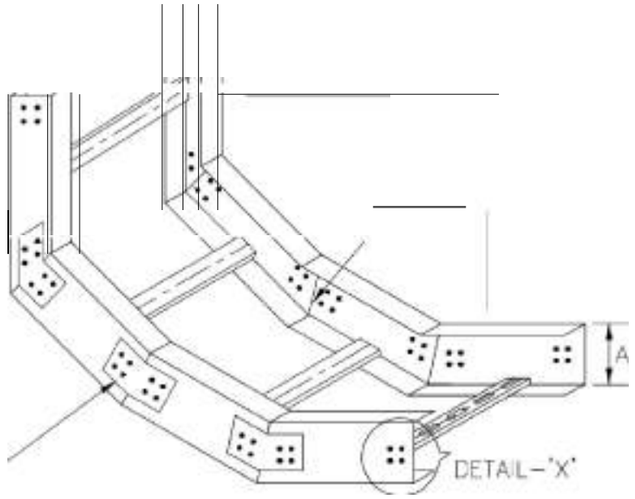
T - R A Y 1 O

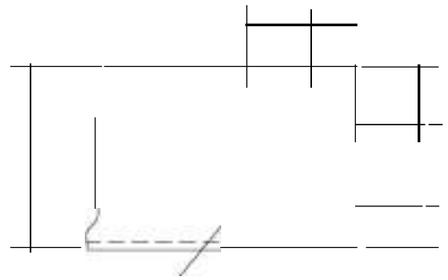
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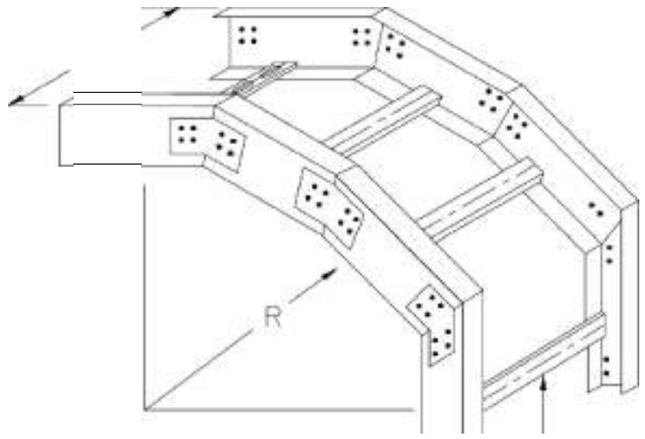
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NLESS NOTED.

(R) BENDING RADIUS (AS FER BOO).







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SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRAY ACCESSORIES

lRACTEBEL
C!!NGIe

Size A3 | Scale NTS | Sheet 09 of 62

Drawing No. | Rev.

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2 3 4

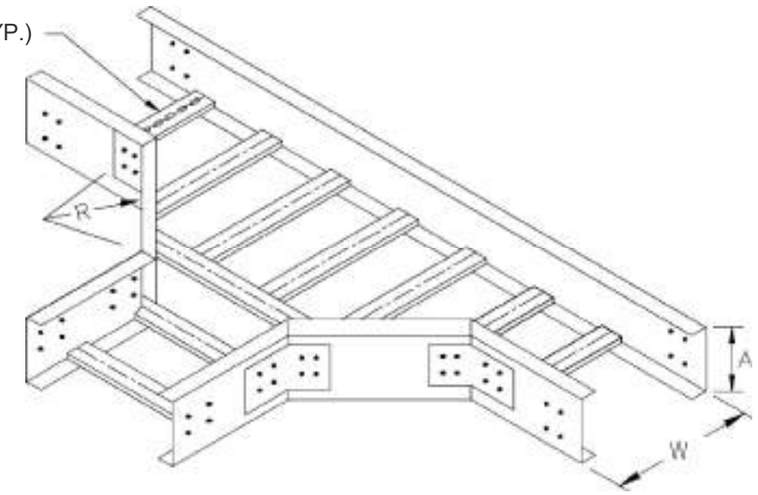
A

B

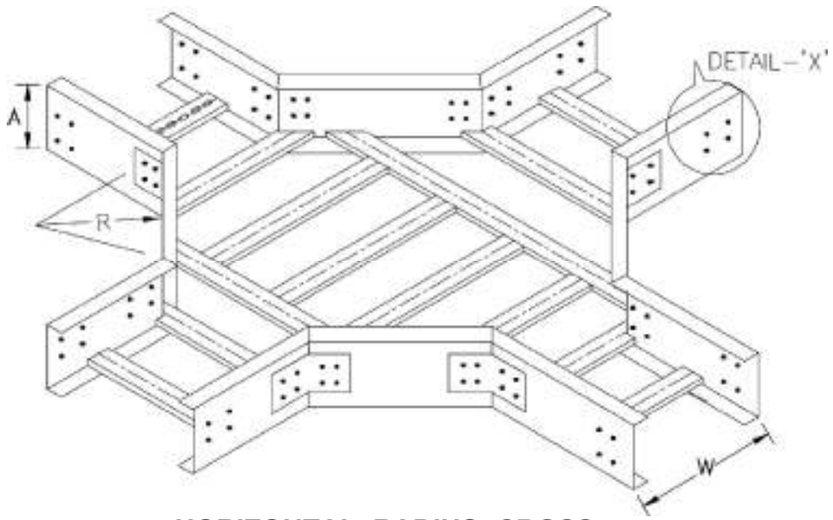
C

D

RIJNC(TYP.)



HORIZONTAL RADIUS TEE



50 25

4--30

40

4--

30

10 itJ HOLc.S
(4Nos.)

DUAIL-'X'

HORIZONTAL RADIUS CROSS

(W) INSIDE WIDTH OF TRAY 150,300,450,600,800MM (AS PER BOO)

(A) DEPTH OF TRAY - 1OOMM UNLESS NOTED

(R) BENDING RADIUS (AS PER BOO)

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. MATERIAL - 12 GAUGE(2.5MM) M.S. SHEET/G.S/AL/FRP (AS PER BOO)
3. M.S. SHEET SHALL CONFORM TO IS2062: 1992 OR EQUIVALENI INTERNATIONAL STANDARDS AND HOT DIP GALVANIZING SHALL BE DONE AS PER 154759: 1996 OR EQUIVAL[N'I INTERNATIONAL STANDARDS. CABLE TRAY SUPPLJED WITH OTHER MATERIALS SHALL CONFIRMED TO RELEVANT IS/INTERNATIONAL STANDARDS.
4. EACH CABLE TRAY SHALL BE SUPPLIED COMPLETE WITH MATCHING COUPLER PLATES WITH REQUIRED HARDWARE.
5. ALL TRAY FITTINGS SHALL BE SUPPLIED COMPLETE WITH MATCHING ANGLE HORIZONTAL COUPLER PLATES & HARDWARE. ALTERNATrvELY WELDED ASSEtIBLY MAY BE SUPPLIED FOR G.S. CABLE TRAY FITTINGS.

0	7.10.1	APPROVED	RKS	PR	KJ	SKH

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SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRAY ACCESSORIES

TRACTEBEL
C!!NGIe

Size A3 Scale NTS Sheet 10 of 62

Drawing No. Rev.

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2 3 4

A

B

C

D

NOTES

1. All DIMENSIONS ARE IN MM.
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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.

W

STRAIGHT REDUCER

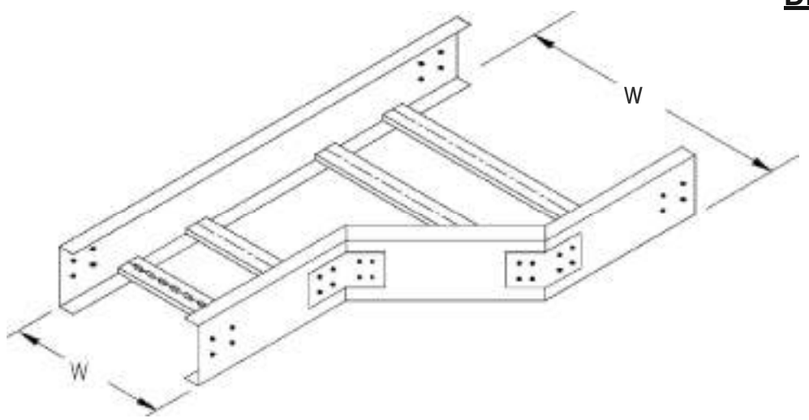
50 25

40

30

10 0 HOLES
(4Nos.)

DETAIL-'X'



RIGHT TO LEFT HA D REDUCER

(W) INSIDE WIDII-- OF IRAY 150,..500,4::i0,600,800MM (AS FIR BOO)

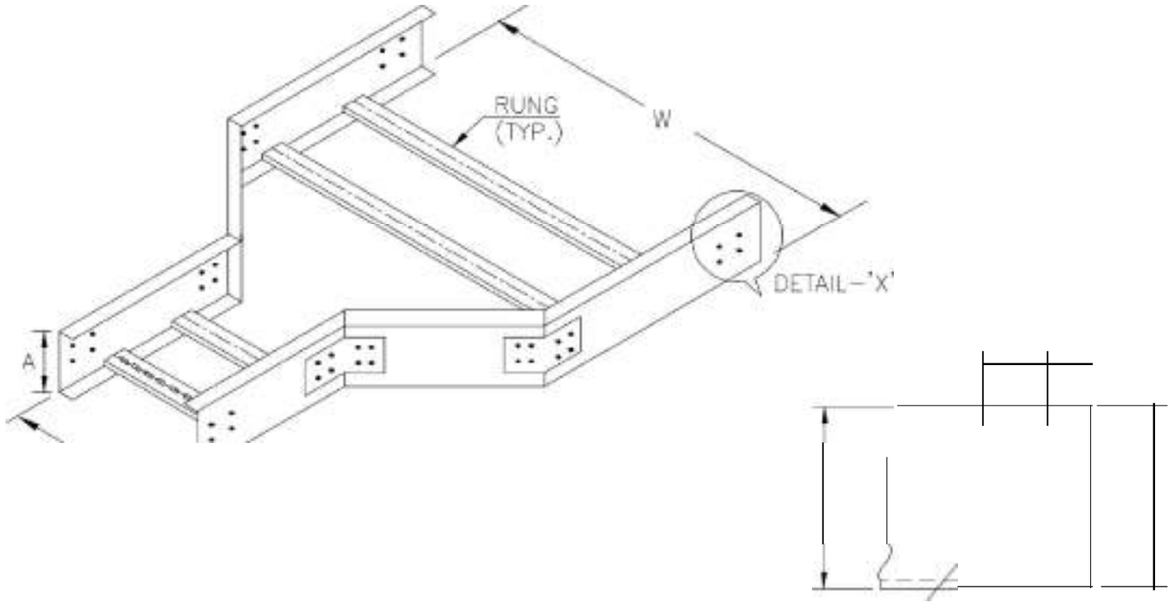
(A) E Ir OF I RAY - 1 OOMM LNU:.SS NO I ED

0 7.10.1 APPROVED RKS PR KJ SKH

GGNG-E-20714-3010 0

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SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRAY ACCESSORIES

IRACTEBEL
C!!NGle

Size A3 | Scale N_S | Sheet 11 of 62

Drawing No. | Rev.

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1 2 3 4

SEE DET.

'A' OR B

1400
750 650

A

EARTr CONDUCTO□

L6'.:Jx6'.:Jx6 (TYP.)

L50x50x6- 715 LONG □ SEE DET. 'C'

3 Nos. 150x'.:JOx6 THK M.S. FLATS WITH SPLIT I:J\I>S WELI>c.I> TO PLATE

B

□.765x75x6 THK. PL. Etv'BEDDED IN CONC.

L'..10 IHK. PCC 1:4;8

7ox6 rHK. PL, 6 /1 IYP.

L65x65x6

L50□.'..10x6/

DETAIL C

NOTES

1. ALL DIMENSIONS ARE IN **MM.**
2. STRUCTURAL STEEL SHALL BE AS PER IS 2062:1992

COVER TYPE-160/130 OR 50/108 OR

DET.DFOR 80/1j LIFTING HOOK

3 CL. COVER

C

L10,10,5-

r°')' □0 □8¢ 150LONG ANCHOR BAR WELDED TO ANGLE @JOO EARTH COND. CLAMPED ON

DETAIL A

6 SQ. BAR WELDED TO ANGLE FLOOR LEVEL

CHQD. PL. IYPI:. CH IS 5 GAP LIFTING HOOK

12THK PREMOULDED JT. FILLER

L.sox6 THK. STIFFENER @z4o

10 G6£: L50x50x6

WALL--------=-t-=---'\,---_-□1LI- **CH7S=7 THK. CHQD. PL

DI::TAIL B

W!'JH sl·IFF1:.r-,_rns

D

W!Olr

100

PLAN

R C COVER IYPt	THICKNESS mm.	Asj	As4
50/108	·'.J0	7-6¢	9-6¢
60/L.50	60	6-8¢	7-Sr/J
80/173	80	5-8¢	7-5¢

60x130 MEANS 60mm. THK.x130 Kg. COVER WEIGHT OF 600mm COVER WIDTH. PROVIDE TWO COVERS OF 300mm WIDTH FOR EVERY 1Om LENGTH OF TRENCH.

WIDTr 100

10¢ HOOK

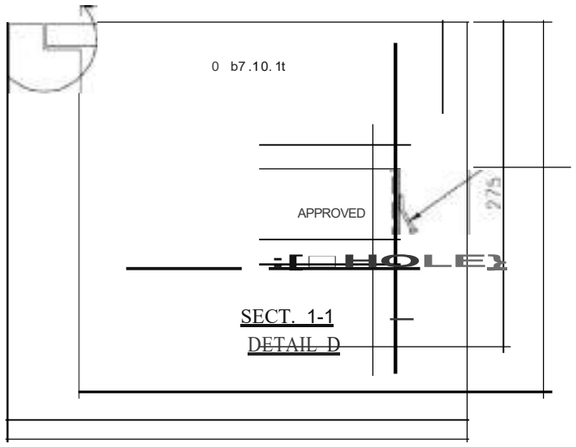
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80

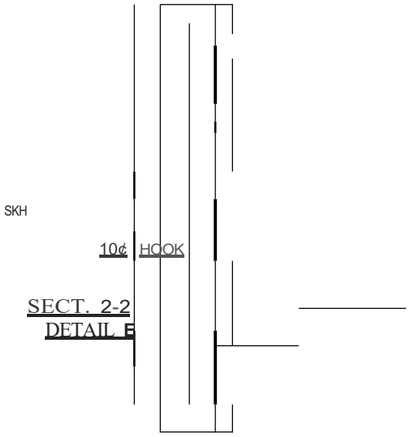
"-.._15¢ HOLE

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Date: 2026.09.11 18:16:52 IST

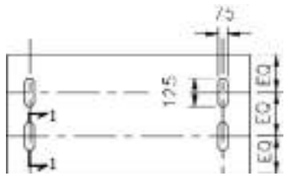
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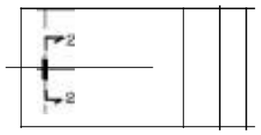
RKS PR KJ SKH



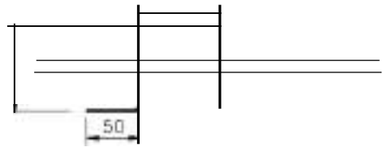
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Rev.	D	M	Y	Modifications	Drawn	Checked	Approved	Validated

SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRENCH TYPE

IRACTEBEL

Size A3 | Scale NTS | Sheet 12 of 62 | 1

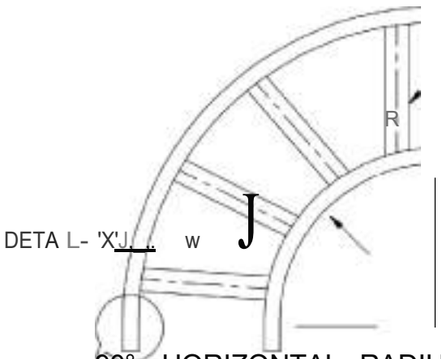
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Drawing No. GGNG-E-20714-3010 | Rev. 0

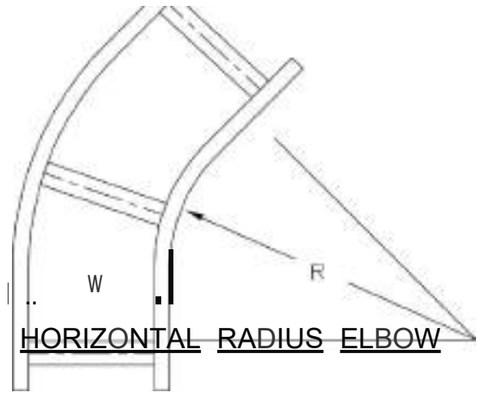
Digitally signed by Pradeep Kumar Yadav
Date: 2026.09.11 18:16:52 IST

RUNG(TYP.)

2 3



90° HORIZONTAL RADIUS ELBOW



45° HORIZONTAL RADIUS ELBOW

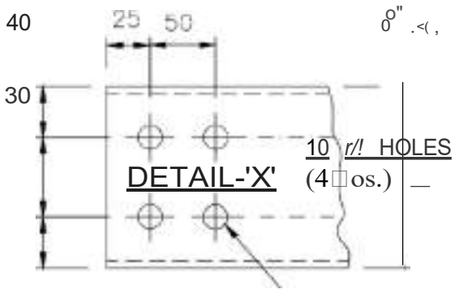
30

40

(W) INSI E WIDTH OF-1RAY - 150,300,450,600,800MM (AS PER 00)

(A) DEPTH OF TRAY - 1OOMM UNLESS NOTED

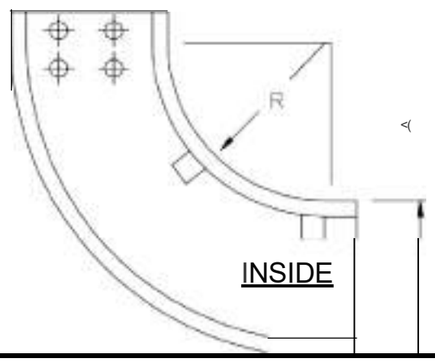
(R) BENDING RADIUS (AS PER BOO)



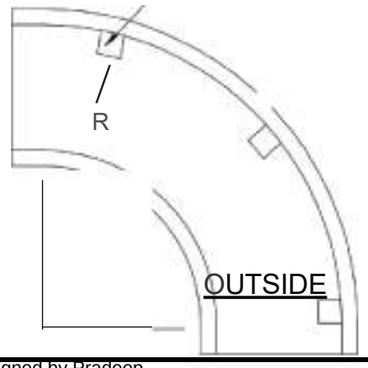
DETAIL-'X'

90° VERTICAL MOULDED RADIUS ELBOW

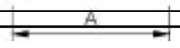
RUNG(TYP_)



INSIDE



OUTSIDE



NOTES

1. ALL DIMENSIONS ARE IN MM.
2. MATERIAL - 12 GAUGE(2.5MM) M.S. SHEET/G.S/AL/FRP (AS PER BOO)
3. M.S. SHEET SHALL CONFORM TO IS2062: 1992 OR EQUIVALENI INIERNATIONAL STANDARDS AND HOT DIP GALVANIZING SHALL BE DONE AS PER IS4759: 1996 OR EQUIVALENI INTERNATIONAL STANDARDS. CABLE TRAY SUPPLIED WITH OTHER MATERIALS SHALL CONFIRMED TO RELEVANT IS/INTERNATIONAL STANDARDS.
4. EACH CABLE TRAY SHALL BE SUPPLIED COMPLETEWITH MATCHING COUPLER PLATES WITH RIOUIRIU HARDWARE.
5. ALL TRAY FITTINGS SHALL BE SUPPLIED COMPLETEWITH MATCHING ANGLE HORIZONTAL COUPLER PLATES & HARDWARE. ALTERNATM:LY WELIDED ASSEMBLY MAY BE SUPPLIED FOR G.S. CABLE TRAY FITTINGS.

0	7.10.1	APPROVED	RKS	PR	KJ	SKH

Scale — Sheet — of 62

Drawing No.: GGNG-E-20714-3010 Rev.: 0

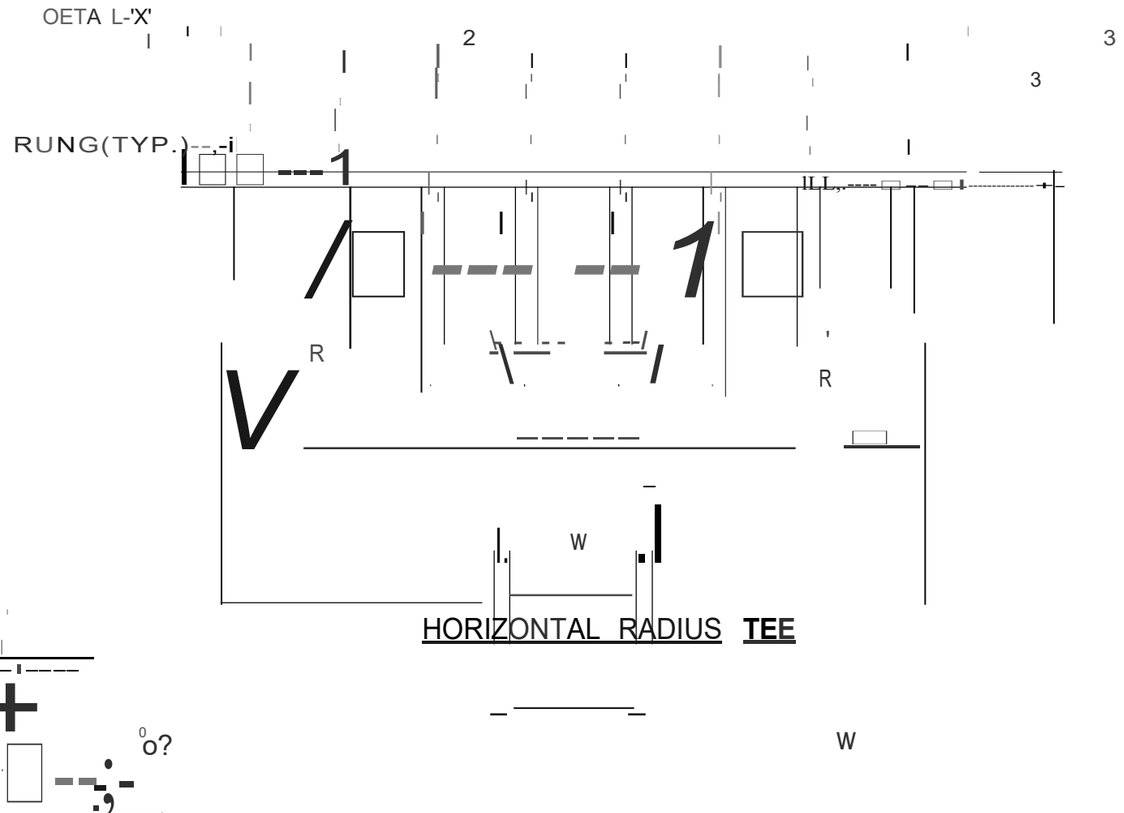
TRACTEBEL ENGINEERING

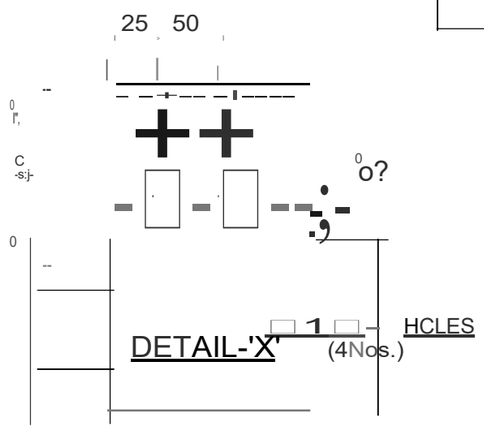
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Date: 2026.09.11 18:16:52 IST

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E

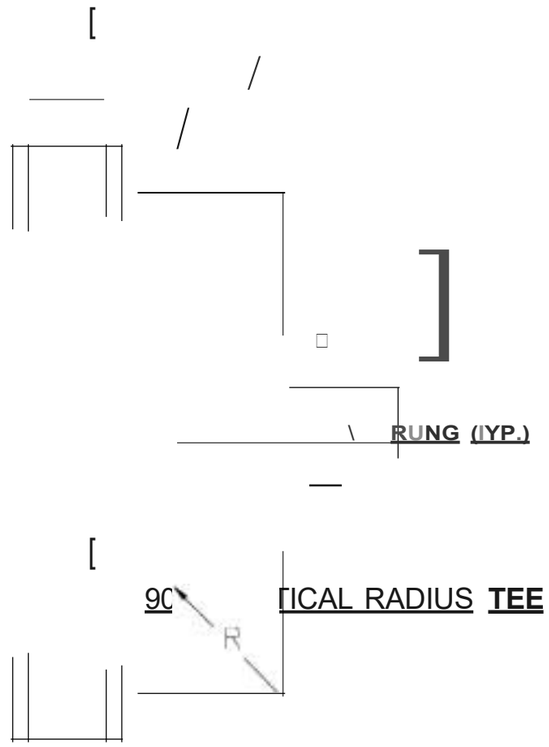
Digitally signed by Pradeep Kumar Yadav
Date: 2026.09.11 18:16:52 IST





(W) - INSIDE WIDTH OF TRAY-150,300,450,600,SOOMM (AS PER 600)

(A) - DEPTH OF TRAY-1OOMM UNLESS NOTED
( ) - BENDING RADIUS (AS PER clOO)



90° VERTICAL RADIUS TEE

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. MATERW. - 12 GAUGE(2.5MM) M.S. SHEET/G.S/AL/FRP (I>S PER BOO)
3. M.S. SHEET SHALL CONFORM TO IS2062: 1992 OR EQUIVALENI INTERNATIONAL STANDARDS AND HOT DIP GALVANIZING SHALL BE DONE AS PER IS4759: 1996 OR IQUIVALINI INTERNATIONAL STANDARDS. CABLE TRAY SUPPLIED WITH OTHER MATERIALS SHALL CONFIRMED TO RELEVANT IS/INTERNATIONAL STANDARDS.
4. EACH CABLE TRAY SHALL BE SUPPLIED COMPLETE WITH MATCHING COUPLER PLATES WITH REQUIRED HARDWARE.
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.

0	07.10.1t	APPROVED	RKS	PR	KJ	SKH

Scale

Sheet 1S of 62

Drawing No. GGNG-E-20714-3010 Rev. 0

IRACTEBEL ENGINEERING

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1 2 3 4

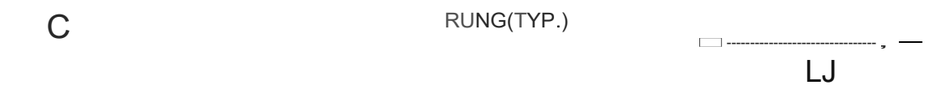
A

B

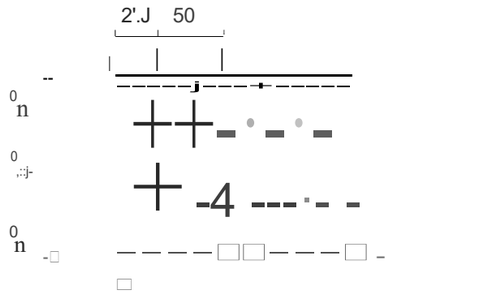
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D

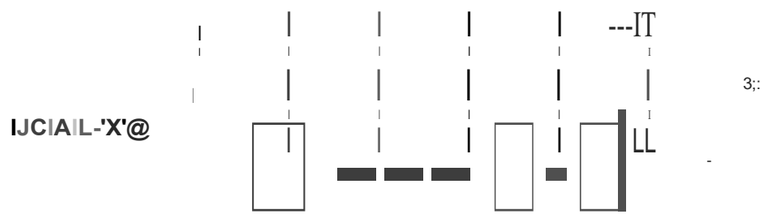
45° VERTICAL RADIUS ELBOW

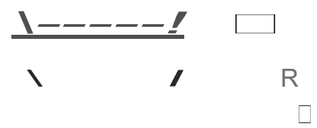






DETAIL-'X'





HORIZONTAL RADIUS CROSS

NOTES

1. All DIMENSIONS ARE **IN MM.**
2. MATERIAL - 12 GAUGE(2.5MM) M.S. SHEET/G.S/AL/FRP (AS PER BOQ)
3. M.S. SHEET SHALL CONFORM TO IS2062: 1992 OR EQUIVALENI 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.
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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.

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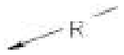
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(W) INSIDE WIDT OF TRAY - 150,300,450,600,800MM (AS PER BOO)

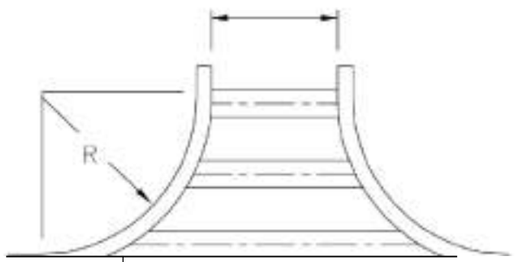
(A) DEPTf- OF TRAY - 1 OOMM UNLESS NOTEC

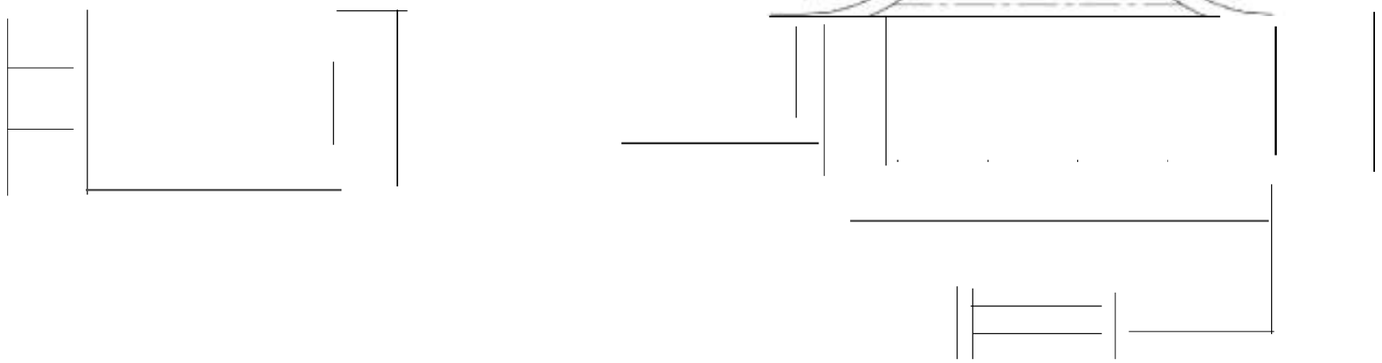
(R) BENDING RADIUS (AS PER 600)

E









Rev.	D M Y	Modifications	Drawn	Checked	Approved	Validated
0	b7 .1 0. 1t	APPROVED	RKS	PR	KJ	SKH

SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRAY ACCESSORIES

IRACTEBEL

Size	Scale	Sheet
A3	NTS	15 of 82

C!!NGle

Drawing No. GGNG-E-20714-3010 Rev. 0

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1 2 3 4

A

B

C

D

SEE DET. 'A' Ori 'B

1400

750 650

EARTH CONDUCTOR

4 Nos. 150x50x6 THK M.S. FLATS WITH SPLIT

L65x6'.:>x6

(TYP.)

Et\DS WELDED 10 PLAlt.

L50x50x6 LONG

Sl:.I:. D1:. 7.

IHK. PCC 1:4:6

PL. EMBl:.DDt.D IN CONC,

150/108 OR

COVER TYPE 60/130 OR DET. D FOR 80/173 LIFTING HOOK

300

11 GAP

L40x40x!J-

WELDED TO ANGLE @300

EARTH COND. CLAMPED ON

75xE THK. L. 6 /1 LYP.

L50x50x6

L6:ix6'.:>x6

D□T. C

6 SQ. BAR 5 CHQD PL. IYPI:. CH /S

WI:.LI)c.I) TO FLOOR LEVEL

GAP

DET. T' FOR LIFTING HOOK

12THK PREMOULDE

10 G.8£

L'.50x□OxE

WALL **CH/5=7 THK. CHQD. PL

DET. B WI I H STIFFENERS

WIDTH

PLAN

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. STRUCTURAL STEEL SHALL BE AS PER IS 2062:1992.

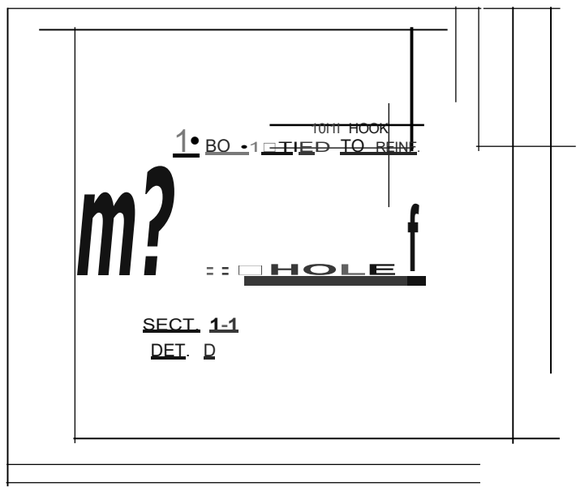
*

R C COYt. TYPE	IHICKNt.•• mm.	Asj	As4
50/108	50	7-61il	9-6¢
60/130	60	6-8¢	8----8¢
80/173	80	5-8¢	8----8¢

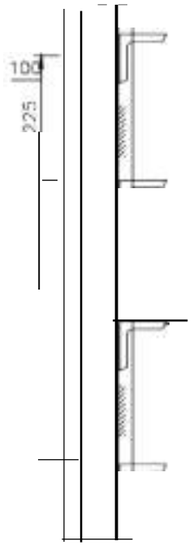
60x 130 MEANS 60mm. 1HK.x 130 Kg. COVER WEIGHT OF 600mm COVER WIDTH. PROVIDE TWO ADDITIONAL SECTIONS FOR EVERY WIDTH FOR EVERY 1Om LENGTH OR PART THEREOF.

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Date: 2026.09.11 18:16:52 IST

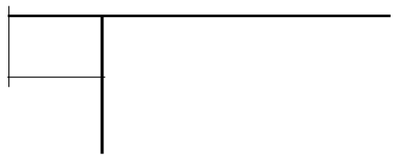
...cation or transmition to third parties is forbidden without its prior approval.



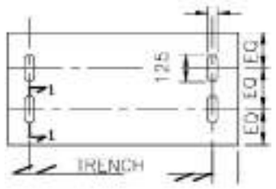
SECT. 1-1
DET. D



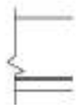
SECT. 2---2
DET. E

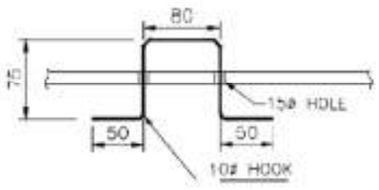


DET. A



PLAN





Rev.	D M Y	Modifications	Drawn	Checked	Approved	Validated
0	b7.10.1t	APPROVED	RKS	PR	KJ	SKH

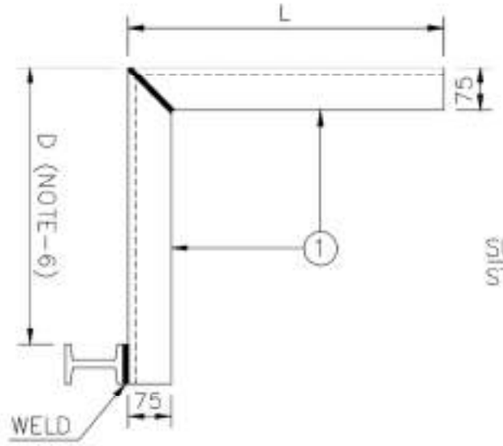
SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRENCH TYPE

Size	Scale	Sheet
A3	NTS	16 of 62

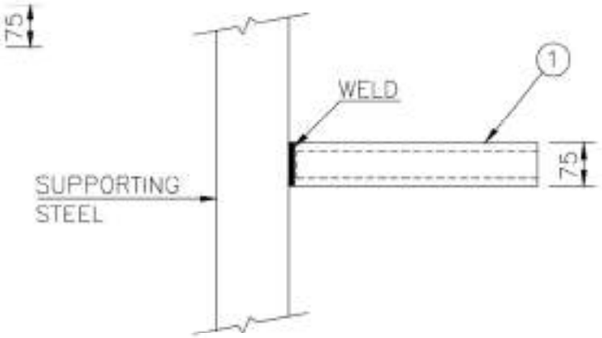
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Drawing No. GGNG-E-20714-3010 Rev. 0

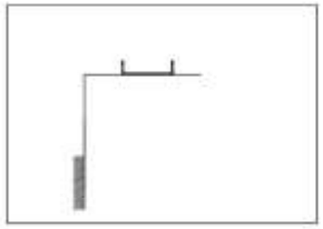
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Date: 2026.09.11 18:16:52 IST



ELEVATION



PLAN



TYPE-2A

TABLE-1

TRAY WIDTH	L	REMARKS
100	250	
150	300	

TABLE-2

ITEM NO	DESCRIPTION	LENGTH	QTY Nos.	REMARKS
1	ISMC 75	D + L	1	FOR 'L' REF.TABLE-1

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. FULL LENGTH FILLET WELD WITH RETURNED ENDS TO BE MINIMUM 4MM.
3. ISMC 75 SHALL BE AS PER IS 2062: 1992.
4. WELDING SHALL BE DONE AS PER IS 816: 1969.
5. DIMENSION 'D' TO SUIT ELEVATION OF TRAY AS GIVEN ON CABLE TRAY LAYOUT DRAWING.

Rev.	D M Y	Modifications	Drawn	Checked	Approved	Validated
0	07.10.19	APPROVED	RKS	PR	KJ	SKH

SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRAY CEILING MOUNTED SINGLE SUPPORT

TRACTEBEL ENGIE

Size A3 | Scale NTS | Sheet 17 of 62

Drawing No. | Rev.

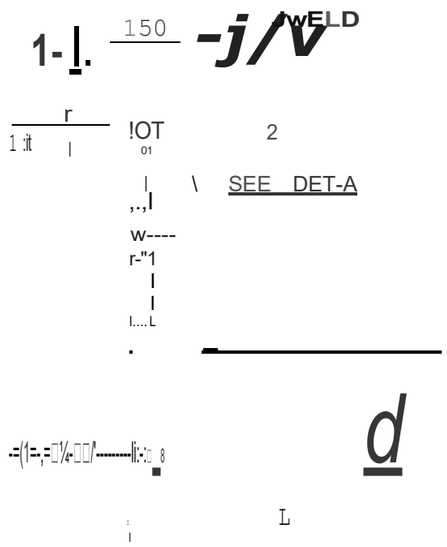
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Date: 2026.09.11 18:16:52 IST

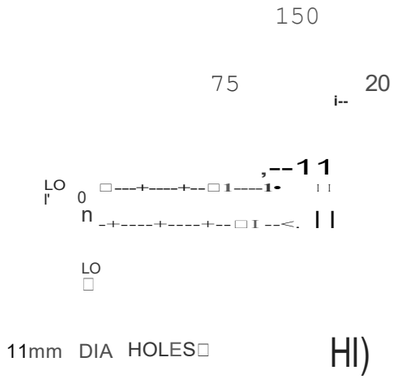
Digitally signed by Pradeep Kumar Yadav
Date: 2026.09.11 18:16:52 IST

NOTES

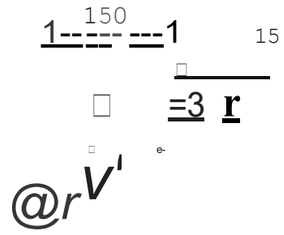
1. ALL DIMENSIONS ARE IN MM.
2. FULL LENGTH FILLETWELD WITH RETURNED ENDS TO BE MINIMUM 4MM.
3. DIMENSION 'O' TO SUIT ELEVATION OF THE TRAY AS GIVEN ON CABLE TRAY LAYOUT DRAWING.
4. STRUCTURAL STEEL SHALL BE AS PERIS 2062: 1992.
5. NUTS AND BOLTS SHALL BE AS PER IS 1363 (PART-1,2,3): 1992/IS I 367(PART-5) 1980.
6. WASHERS SHALL BE AS PER IS 2016: 1967.

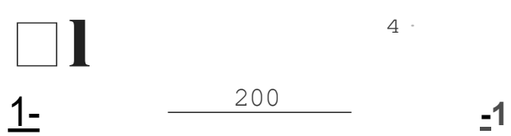


ELEVATION



DETAIL-A





DETAIL-8

TYPE-2B

IABLE-1

TRAY WIDTH	L	REMARKS
100	200	
150	250	
300	400	
450	550	
600	700	

TABLE-2

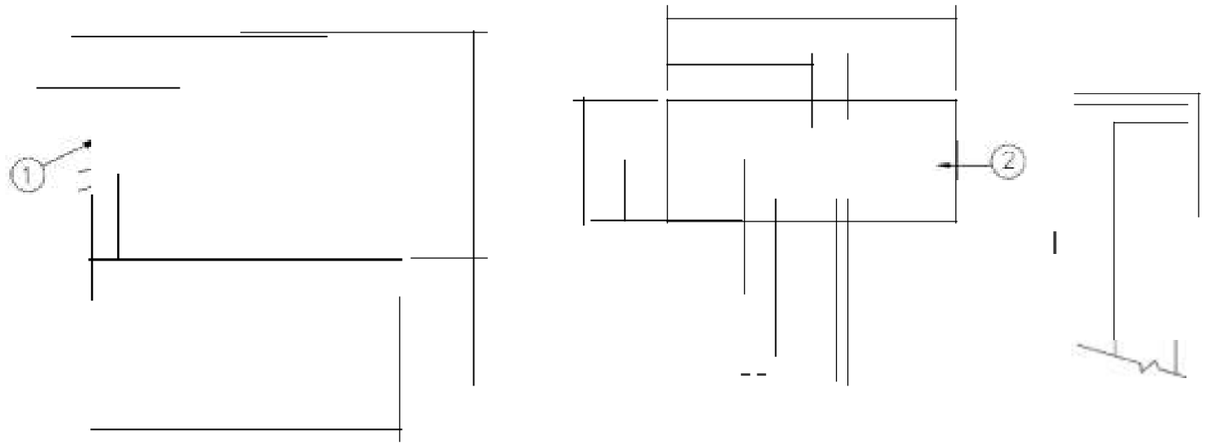
NC	DESCRIPTION	LENGTh MM	QTY No.	RIMARKS
CD	ISA 50x50x6	0+200	1	f-OR 'D' E .NOTE.4
@	ISA 75x50x6	150	1	
@	ISA 50x50x6	L	1	FCR 'L' RIf-. fABLE-1
0	ISA 50x50x6	200	1	01\LY FOR 6O0MM TRAY
®	BOLT/NUT(II/10)	JC	2	
®	SPRING WASHER (M10)		2	

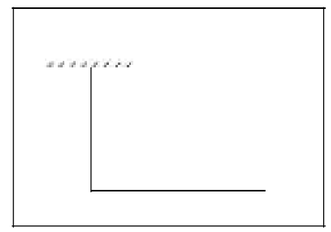
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0	b?.10.11	APPROVED	RKS	PR	KJ SKI
D M Y		Modifications	Drawn	Checked	Approved Validat

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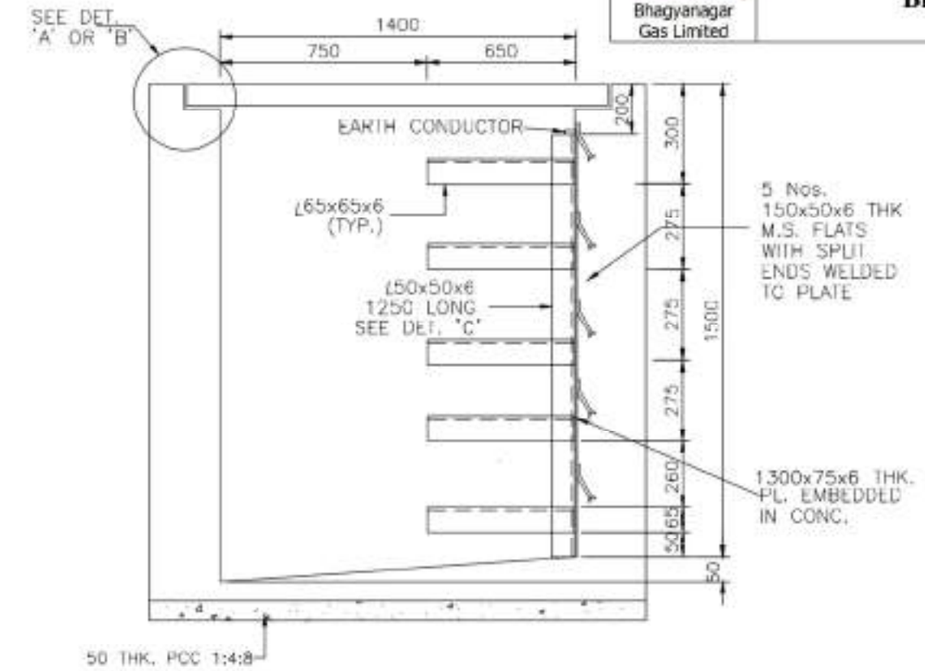
SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS ted
CABLE TRAY CEILING MOUNTED SINGLE SUPPORT

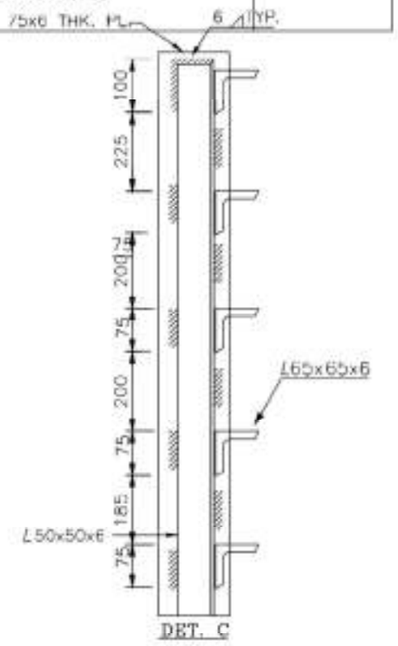
IRACTEBEL

Size A3 Scale NTS Sheet 1 18 of 62

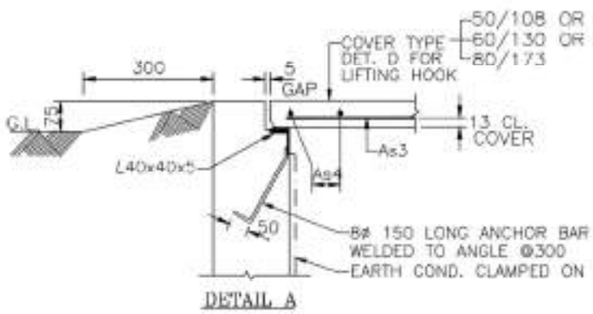
Drawing No. GGNG-E-20714-3010 Rev. 0

Digitally signed by Pradeep Kumar Yadav
Date: 2026.09.11 18:16:52 IST

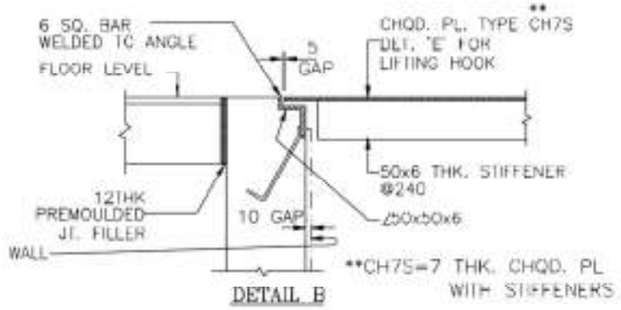




DET. C



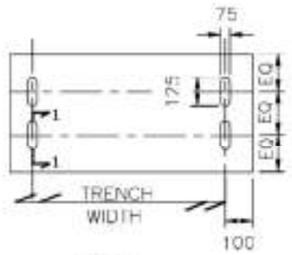
DETAIL A



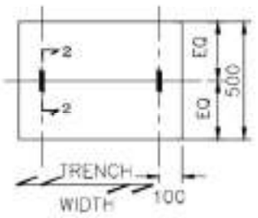
DETAIL B

R C COVER TYPE	THICKNESS mm.	As3	As4
50/108	50	7-6ø	10-6ø
60/130	60	6-8ø	8-8ø
80/173	80	5-8ø	8-8ø

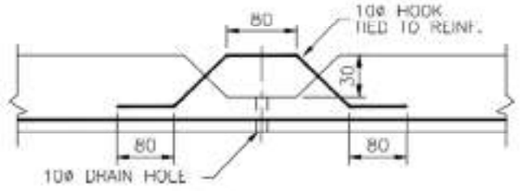
60x130 MEANS 60mm. THK.x130 Kg. COVER WEIGHT OF 600mm COVER WIDTH. PROVIDE TWO COVERS OF 300mm WIDTH FOR EVERY 10m LENGTH OF TRENCH.



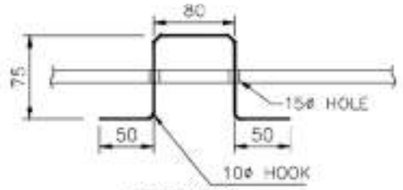
PLAN



PLAN



SECT. 1-1
DETAIL D



SECT. 2-2
DETAIL E

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. STRUCTURAL STEEL SHALL BE AS PER IS 2062:1992

Rev.	D M Y	Modifications	Drawn	Checked	Approved	Validated
0	07.10.16	APPROVED	RKS	PR	KJ	SKH

SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRENCH TYPE - 1415

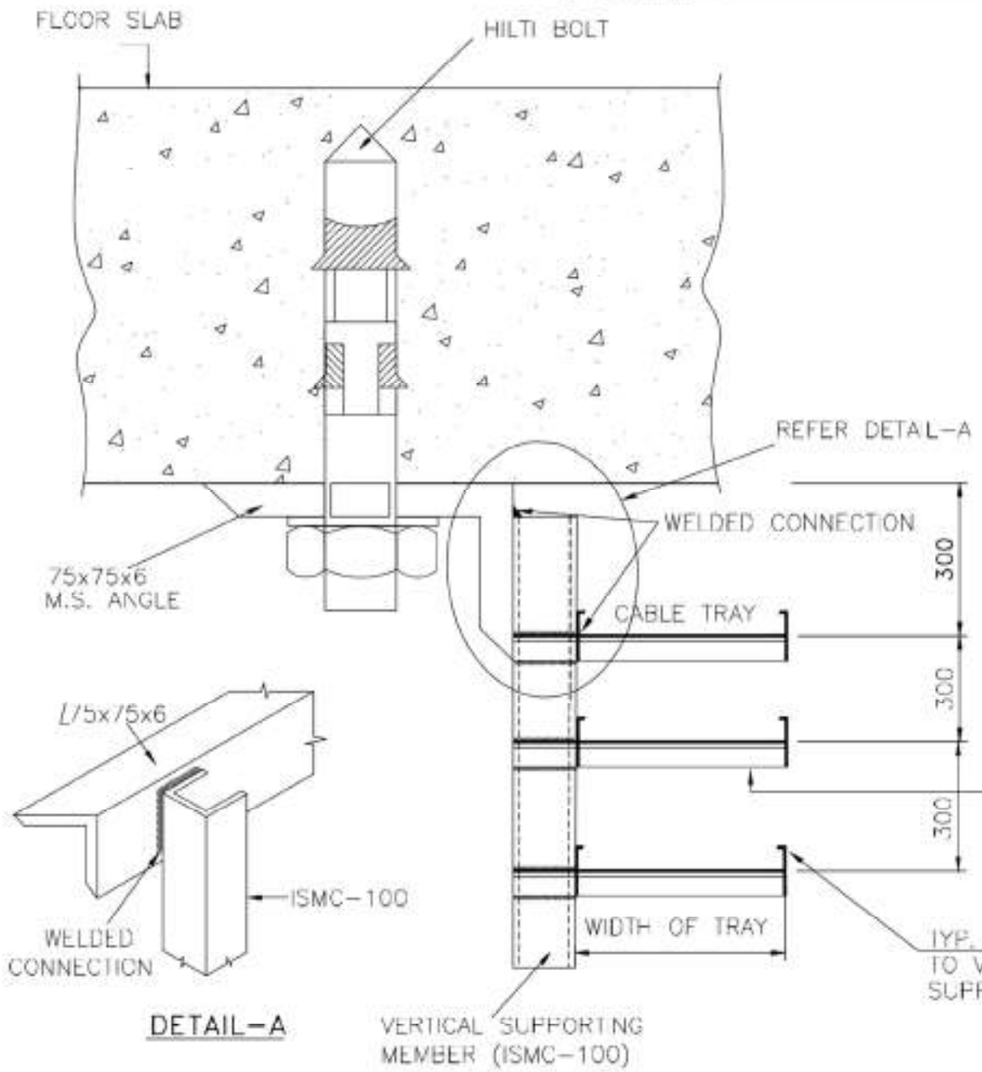
TRACTEBEL ENGIE

Size A3 | Scale NTS | Sheet 19 of 62

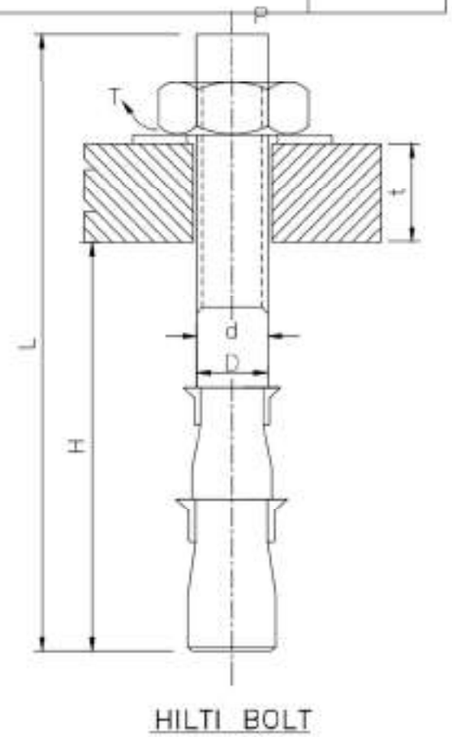
Drawing No. GGNG-E-20714-3010 | Rev. 0

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DETAIL-A



HILTI BOLT

HILTI BOLT DETAILS

SIZE	BOLT DIA (D) mm	BOLT LENGTH (L) mm	DRILL DIA (c) mm	DEPTH OF HOLE (H) mm	FIXING HEIGHT (t) mm	MAXIMUM PULLOUT LOAD (P) Kg	TORQUE AT SF-4 (T) Kg.f.m.
M10x90	10(3/8")	90	10	45	25	1620	0.81
M10x150	12(1/2")	150	13	80	40	2700	1.62

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. BOLT SIZE M10x90 SHALL BE USED FOR TOTAL WEIGHT (INCLUDING CABLES, CABLE TRAY ACCESSORIES) UP TO 200 Kgs/METER AND M10x150 SHALL BE USED FOR TOTAL WEIGHT ABOVE 200 Kgs/METER AND UP TO 500 Kgs/METER.
3. STRUCTURAL STEEL SHALL BE AS PER IS 2062: 1992.
4. WELDING SHALL BE DONE AS PER IS 816: 1969.

Rev.	D M Y	Modifications	Drawn	Checked	Approved	Validated
0	07.10.16	APPROVED	RKS	PR	KJ	SKH

SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRAY MOUNTING ARRANGEMENT CTMH (TYPE-A2)

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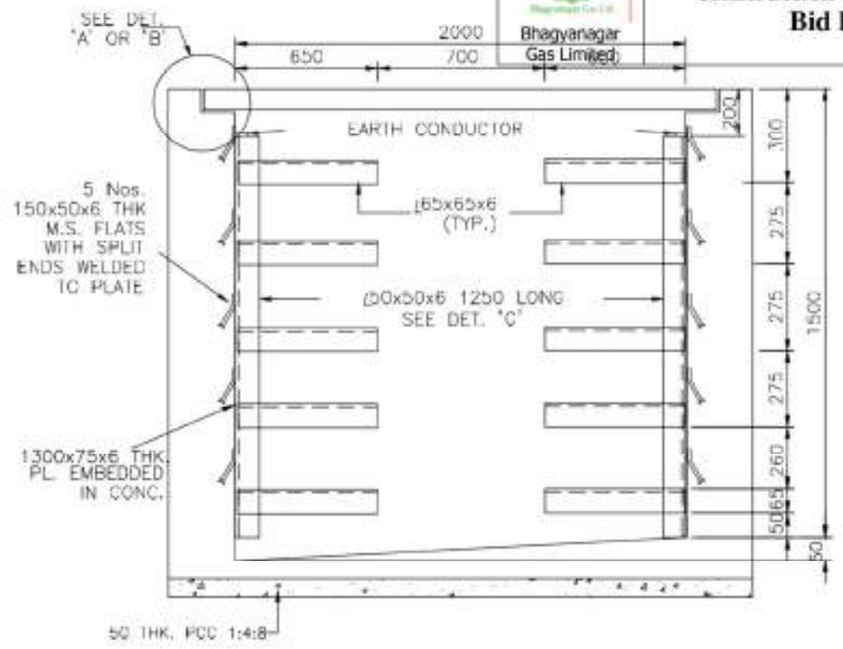
Size A3 | Scale NTS | Sheet 20 of 62

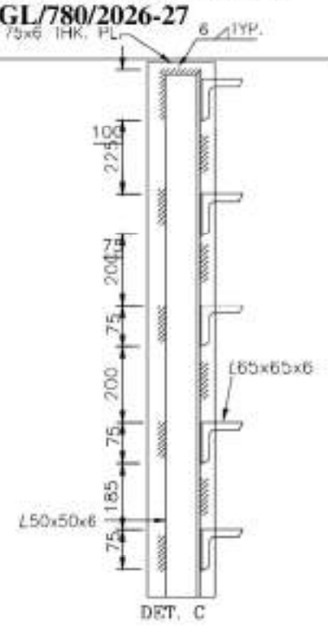
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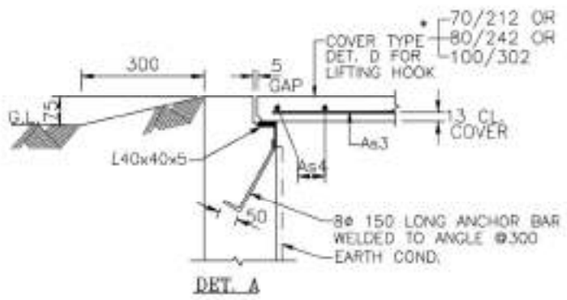
Digitally signed by Pradeep Kumar Yadav
Date: 2026.09.11 18:16:52 IST

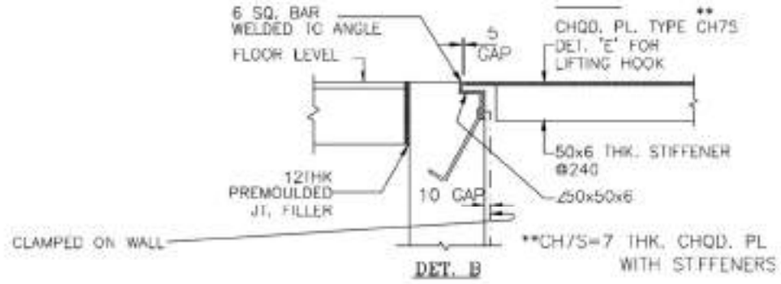
Drawing No. GGNG-E-20714-3010 Rev. 0

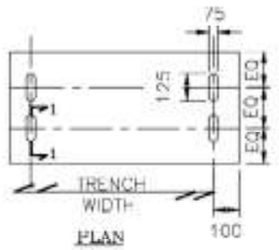
Bhagyanagar Gas Limited





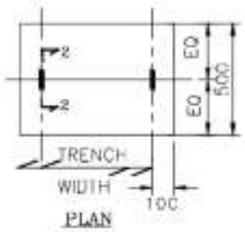


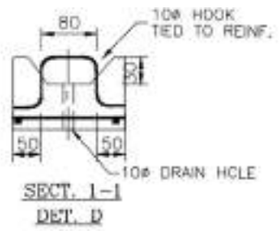


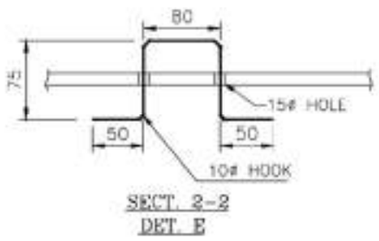


R C COVER TYPE	THICKNESS mm.	As3	As4
70/212	70	5-8ø	11-8ø
80/242	80	5-8ø	11-8ø
100/302	100	6-8ø	11-8ø

70x130 MEANS 70mm. THK,x212 Kg. COVER WEIGHT OF 600mm COVER WIDTH, PROVIDE TWO COVERS OF 300mm WIDTH FOR EVERY 10.0m LENGTH OF TRENCH.







NOTES

1. ALL DIMENSIONS ARE IN MM.
2. STRUCTURAL STEEL SHALL BE AS PER IS 2062:1992.

Rev.	D M Y	Modifications	Drawn	Checked	Approved	Validated
0	07.10.16	APPROVED	RKS	PR	KJ	SKH

SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRENCH TYPE - 2015

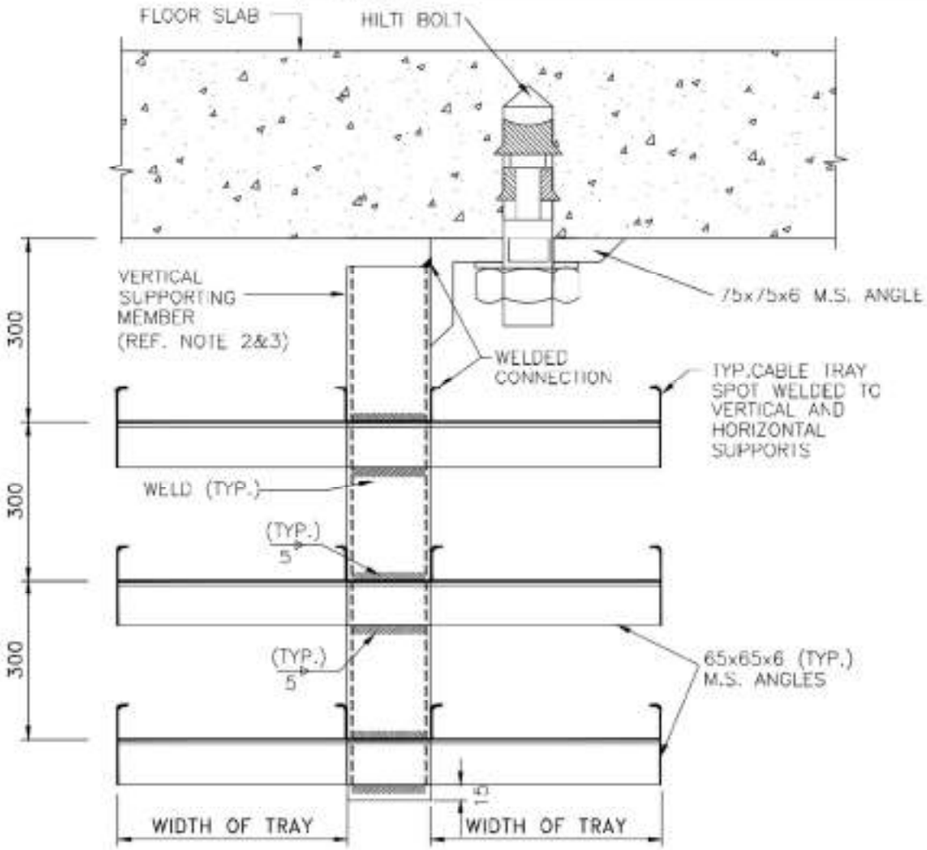
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Size A3 | Scale NTS | Sheet 21 of 62

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DRAWING TYPICAL FOR CTMH-T3

HILTI BOLT DETAILS

SIZE	BOLT DIA (D) mm	BOLT LENGTH (L) mm)	DRILL DIA (d) mm	DEPTH OF HOLE (H) mm	FIXING HEIGHT (t) mm	MAXIMUM PULLOUT LOAD (P) Kg	TORQUE AT SF-4 (T) Kg.f.m.
M10x90	10(3/8")	90	10	45	25	1620	0.81
M10x150	12(1/2")	150	13	80	40	2700	1.62

SL.NO.	TYPE OF MOUNTING	NO. OF TIERS
1	CTMH-T1	1
2	CTMH-T2	2
3	CTMH-T3	3
4	CTMH-T4	4

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. ISMC 75 UP TO TWO TIERS.
3. ISMC 100 FOR MORE THAN TWO TIERS.
4. BOLT SIZE M10x90 SHALL BE USED FOR TOTAL WEIGHT (INCLUDING CABLES, CABLE TRAY ACCESSORIES) UP TO 200 Kgs/METER AND M10x150 SHALL BE USED FOR TOTAL WEIGHT ABOVE 200 Kgs/METER AND UP TO 500 Kgs/METER.
5. STRUCTURAL STEEL SHALL BE AS PER IS 2062: 1992.
6. WELDING SHALL BE DONE AS PER IS 816: 1969.

Rev.	D M Y	Modifications	Drawn	Checked	Approved	Validated
0	07.10.16	APPROVED	RKS	PR	KJ	SKH

SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRAY MOUNTING ARRANGEMENT CTMH (TYPE-B2)

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Size A3 | Scale NTS | Sheet 22 of 62

Drawing No. GGNG-E-20714-3010 | Rev. 0

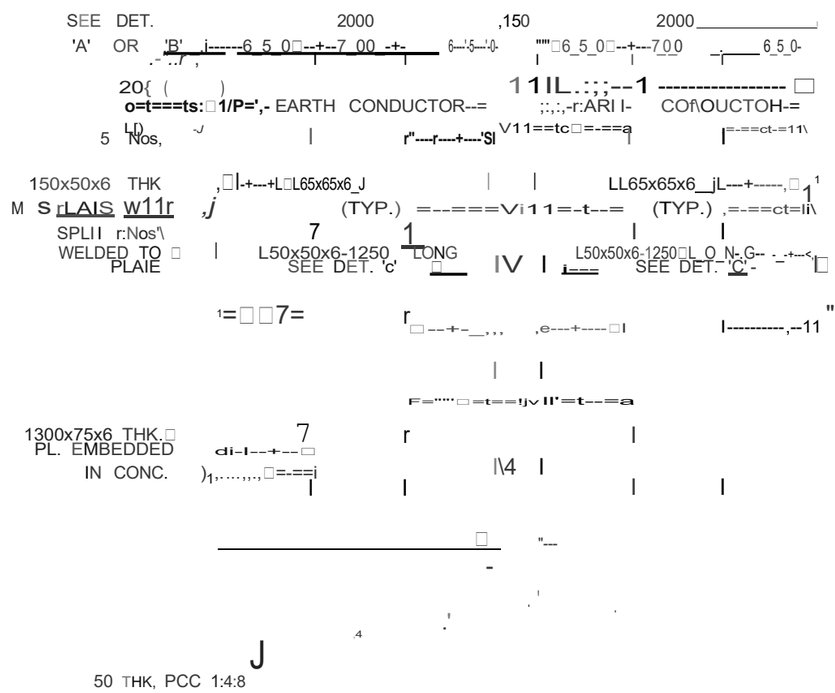
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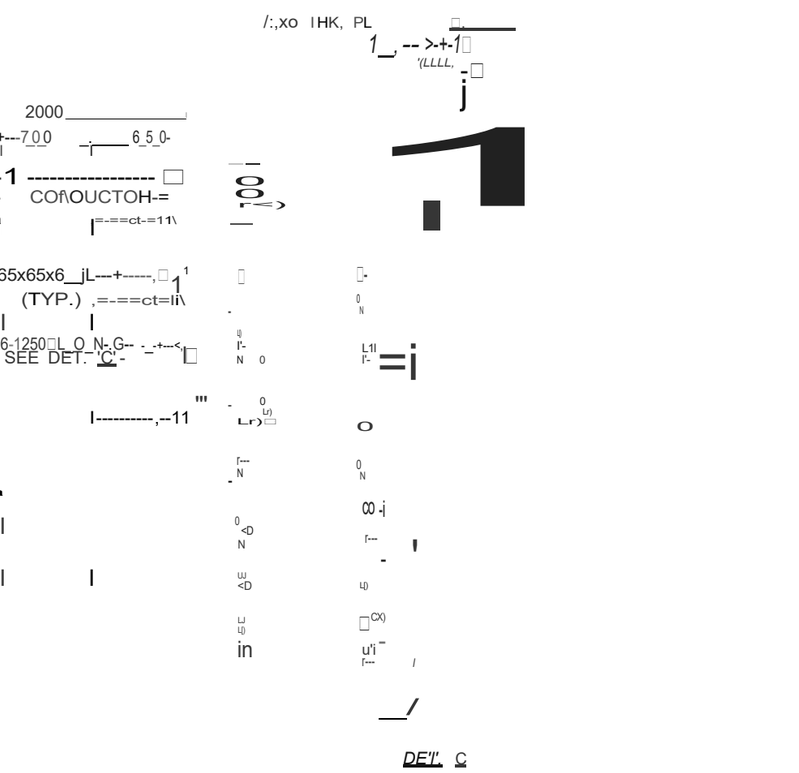
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1 2 3 4

NOTES

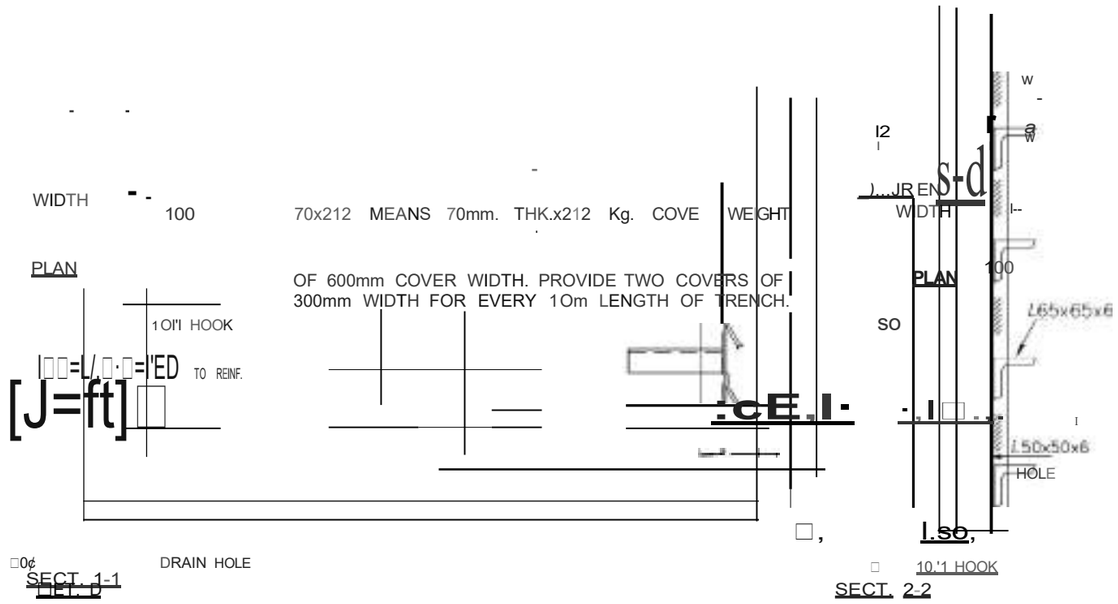
1. ALL DIMENSIONS ARE IN MM.
2. STRUCTURAL STEEL SHALL BE AS PER IS 2062:1992.

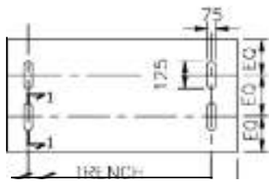


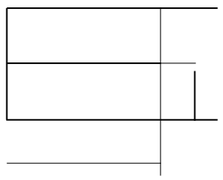


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0	b7.10.1t	APPROVED	RKS	PR	KJ	SKH
Rev.	D M Y	Modifications	Drawn	Checked	Approved	Validated

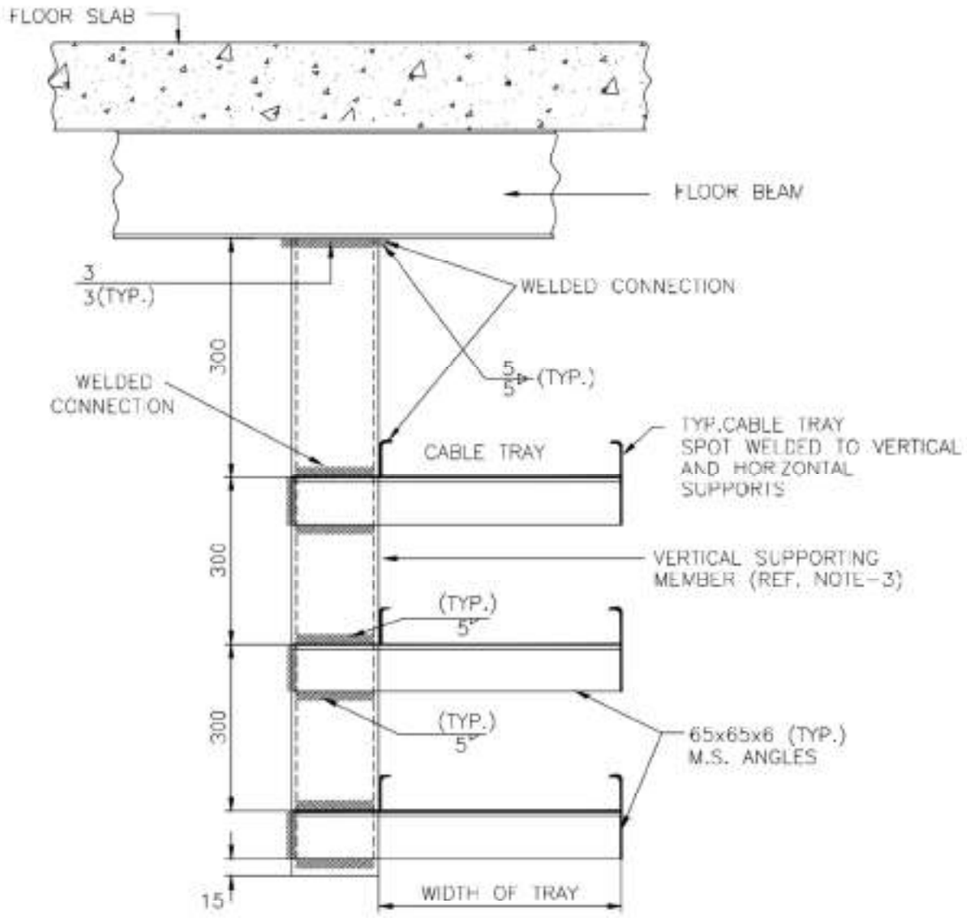
SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRENCH TYPE 2/2013

Size	Scale	Sheet
A3	NTS	23 of 62

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Drawing No. GGNG-E-20714-3010 Rev. 0

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DRAWING TYPICAL FOR CTMH-T3

SL.NO.	TYPE OF MOUNTING	NO. OF TIERS
1	CTMH-T1	1
2	CTMH-T2	2
3	CTMH-T3	3
4	CTMH-T4	4

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. 75x75x8 M.S. ANGLE FOR ONE TIER.
3. ISMC 100 FOR MORE THAN ONE TIER.
4. STRUCTURAL STEEL SHALL BE AS PER IS 2062:1992.
5. WELDING SHALL BE DONE AS PER IS 816: 1969.

Rev.	D M Y	Modifications	Drawn	Checked	Approved	Validated
0	07.10.16	APPROVED	RKS	PR	KJ	SKH

SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRAY MOUNTING ARRANGEMENT CTMH (TYPE-C)

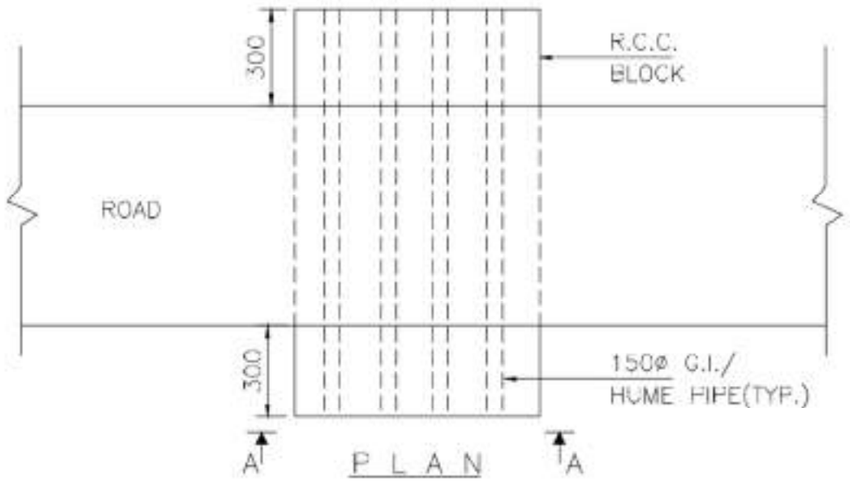
TRACTEBEL ENGIE

Size A3 | Scale NTS | Sheet 24 of 62

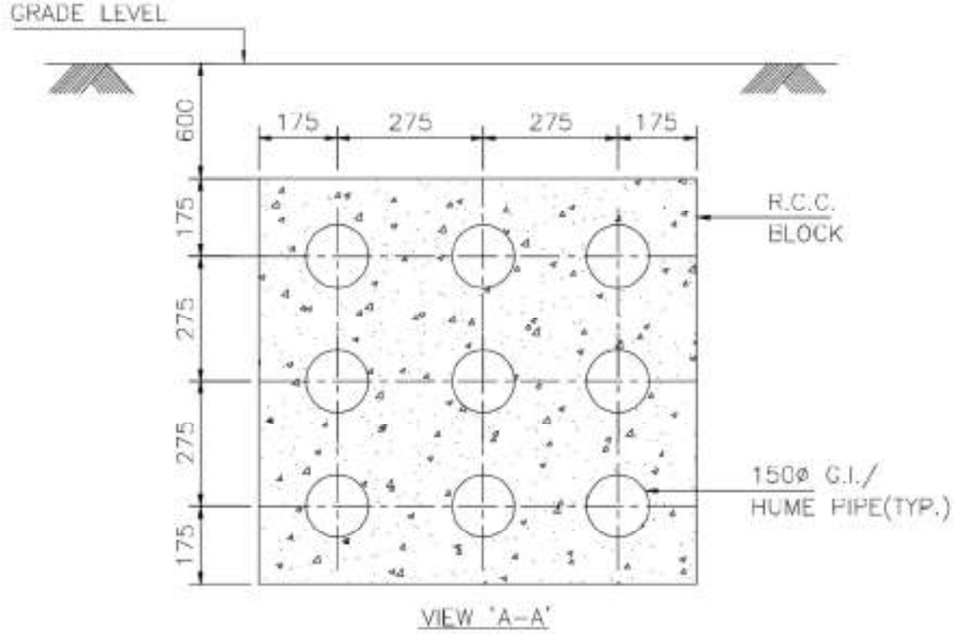
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PLAN



VIEW 'A-A'

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. R.C.C. BLOCK SHALL BE PROVIDED AT A MINIMUM DEPTH OF 800mm FROM THE GRADE LEVEL AND SHALL BE EXTENDED BY 300mm ON EITHER SIDES OF THE ROAD UNLESS OTHERWISE SPECIFIED.
3. G.I./HUME PIPE SIZES INDICATED ARE FOR INFORMATION ONLY AND EXACT SIZE AS PER PROJECT REQUIREMENT SHALL BE ADOPTED.

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0	07.10.16	APPROVED	RKS	PR	KJ	SKH

SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE INSTALLATION PRACTICE BELOW/CROSSING ROAD

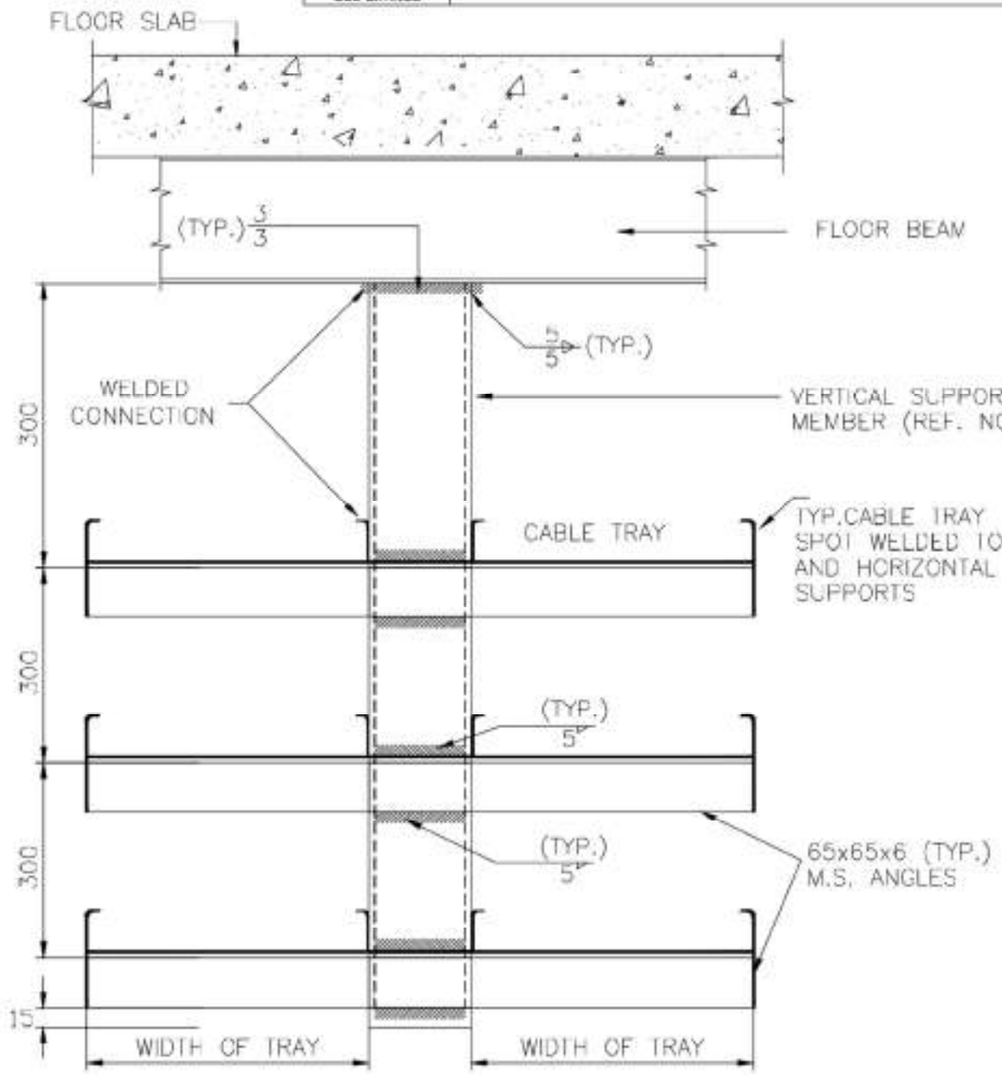
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Size A3 | Scale NTS | Sheet 25 of 62

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Drawing No. GGNG-E-20714-3010 Rev. 0



DRAWING TYPICAL FOR CTMH-T3

SR.NO.	TYPE OF MOUNTING	NO. OF TIERS
1	CTMH-T1	1
2	CTMH-T2	2
3	CTMH-T3	3
4	CTMH-T4	4

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. 75x75x6 M.S. ANGLE FOR ONE TIER.
3. ISMC 100 FOR MORE THAN TWO TIERS.
4. STRUCTURAL STEEL SHALL BE AS PER IS 2062: 1992.
5. WELDING SHALL BE DONE AS PER IS 816: 1969.

Rev.	D M Y	Modifications	Drawn	Checked	Approved	Validated
0	07.10.16	APPROVED	RKS	PR	KJ	SKH

SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRAY MOUNTING ARRANGEMENT CTMH (TYPE-D)

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Size	Scale	Sheet
A3	NTS	26 of 62

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Drawing No. GGNG-E-20714-3010 Rev. 0

1 2 3 4

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. LEAVE SPACE FOR LATER ADDITION OF AT LEAST 2 CABLES AND 15% AVERAGE SPARE SPACE REGARDLESS OF FUTURE EXTENSION.

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D

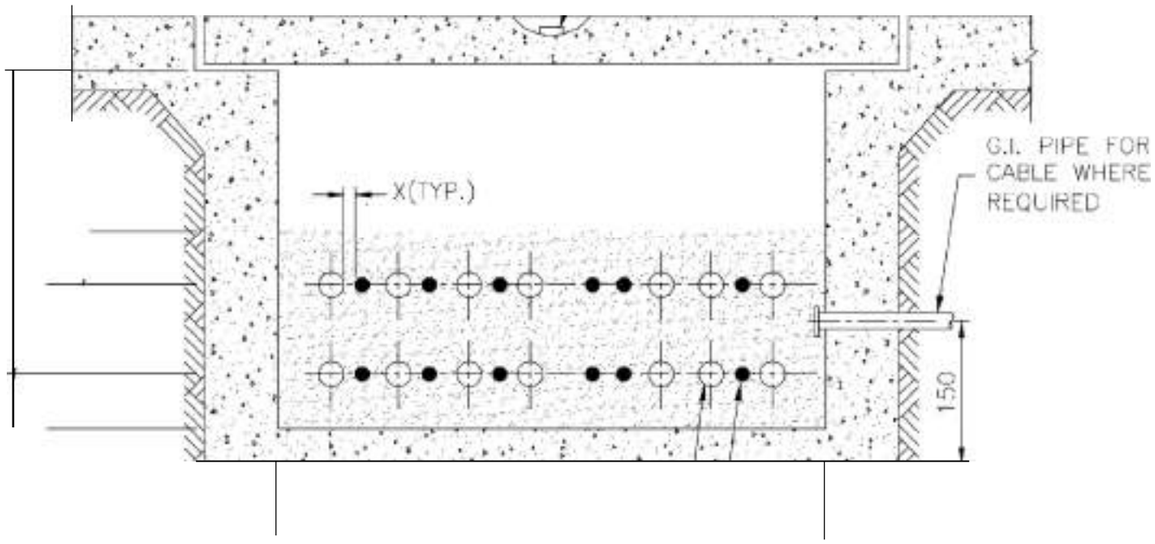
X - OVERAL IAMETE OF THE IGGER OF THE TWO CABLES

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Date: 2026.09.11 18:16:52 IST

Rev.	D M Y	Modifications	Drawn	Checked	Approved	Validated
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E



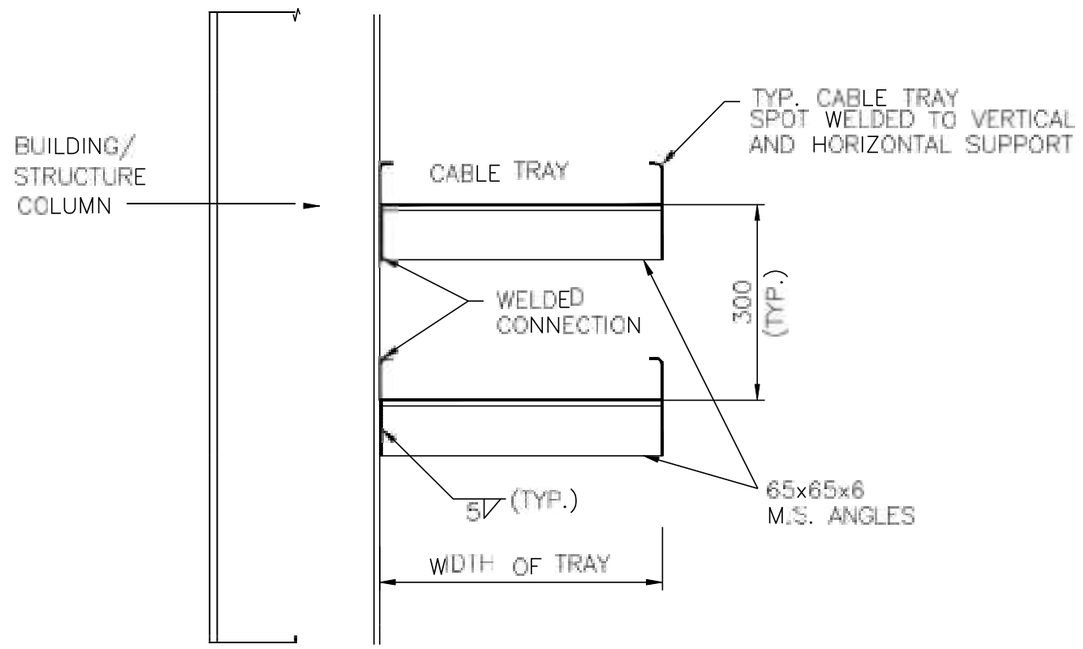
SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLES DIRECTLY BURRIED IN TRENCH (IN PAVED AREA)

IRACTEBEL C!!NGle

Size A3 | Scale NTS | Sheet 27 of 62

Drawing No. GGNG-E-20714-3010 | Rev. 0

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Date: 2026.09.11 18:16:52 IST



DRAWING TYPICAL FOR CTMH–T2

SR.NO.	TYPE OF MOUNTING	NO. OF TIERS
1	CTMH–T1	1
2	CTMH–T2	2
3	CTMH–T3	3
4	CTMH–T4	4

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. STRUCTURAL STEEL SHALL BE AS PER IS 2062: 1992.
3. WELDING SHALL BE DONE AS PER IS 816: 1969.

Rev.	D M Y	Modifications	Drawn	Checked	Approved	Validated

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E

SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRAY MOUNTING ARRANGEMENT CTMH (TYPE-E)

Size A3 | Scale NTS | Sheet 28 of 62

Drawing No. GGNG-E-20714-3010 | Rev. 0

0	07.10.16	APPROVED	RKS	PR	KJ	SKH

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Date: 2026.09.11 18:16:52 IST

1 2 3 4

A

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CABLI: IRAY

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WELDED CONNECTION

CONCRETE GRADE M200-_,_-..,

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65x65x6 M.S. AI\GLE

75x75x6 M.S. ANGLE

1/2

C

1.-..---– .. WIOIH OF IRAY

DRAWING TYPICAL □OR CIMH-1-2

HILTI BCLT DETAILS

SIZE	BULT CIA (D) mm	BOLT LENGTH (L) rrm)	CRILL DIA (d) mrr	De.PIH OF HOLE (H) mm	FIXING HEIGHT (t) rrm	MAXIMLM PULLOUT LOAD (P) Kg	IORQIJE AT SF-4 (T) Kg.f.m.
M1 Ox90	10(3/8")	90	10	45	25	1620	0.81
M1 Ox1 0	12(1/2")	1 0	13	80	40	2/00	1.62

D

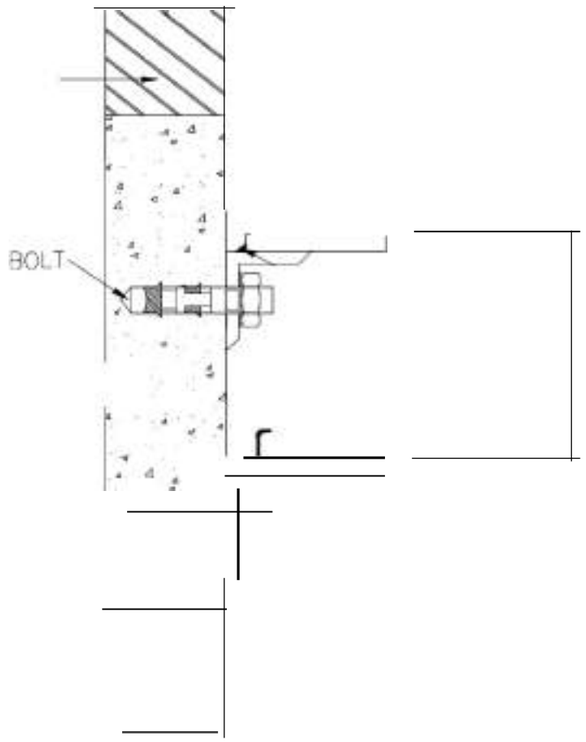
NOTES

1. ALL DIMENSIONS ARE IN MM.
2. BOLT SIZE M10x90 SHALL BE USED FOR TOTAL WEIGHT (INCLUDING CABLES, CABLE TRAY ACCESSORIES) UP TO 200 Kgs/METER MD MIOxl50 SHALL BE USED FOR TOTAL WEIGHT ABOVE 100 Kgs/METER AND UP TO 500 Kgs/METER.
3. STRUCTURAL STEEL SHALL BE AS PER IS 2062: I 992.
4. WELDING SHALL BE DONE AS PER IS 816: 1969.

SL. NO.	IYPE OF MOUNTING	NO. OF TIERS
1	C1rv'H-T1	1
2	Cirv'H-12	2

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SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRAY MOUNTING ARRANGEMENT CTMH (TYPE-F2)

IRACTEBEL

Size	Scale	Sheet		
A3	NTS	29	of	62

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Drawing No.	Rev.
GGNG-E-20714-3010	0

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1 2 3 4

A

WELD(TYP.)

□ □"-□"-¥□ □-I□ □ □ □"-□'0

□ --E 1¥1□.._ ....._,.._1...,. .....,,.___ -\<'w1

V

ANCHOR rASII:.□I:.RS
I:.AVY DUIY IYPE, BOLT DIA. 16MM
AT I:.VI::.RY 1 MI:.IRI:.

B

AL

100

400
(TYP.)

JA

16 GAUGE STEEL SrEET COVER
rIXI:.D IO M.S. SUPPORIS 6Y
6<t M.S SCREWS @ 300MM (TYP.)

PLAN

TO SUIT NO. OF TRAYS

WI Ir!OE IRAY

C

WI: LI)
(TYP.) □

t---. ..._

- ..- ISMC 100

PERFORATED
CABLE TRAYS

PERFORATED
CABLE TRAY"'□

kd

D

□-++ . ...-65X65X6
M.S. ANGLE
(TYP.)

-r LOOR

WELD
(TYP□

200x200x10 (TYP.) THICK M.S. PLATE INSERT IN FLOOR SLAB BY CIVIL CONTRACTOR.

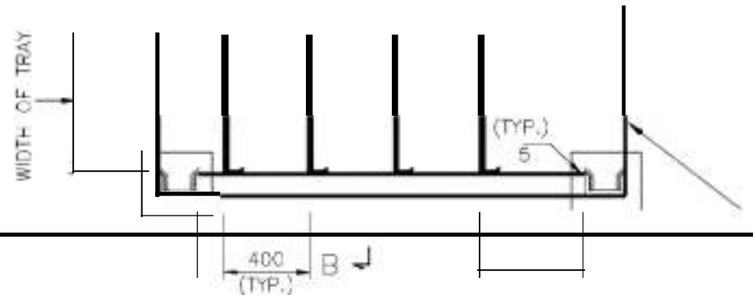
NOTES

1. N.L DIMENSIONS ARE IN MM.
2. NUMBER OF TRAYS WILL BE AS PER RI:.QUIRI:.MENI.
3. FOR OUTDOOR USE, THE VERTICAL SUPPORTS TO BE SUITABLY GROUTED IN CONCRETE FOUNDATION OR WELDEDTO AVAILABLE STEEL STRUCTURES.
4. STRUCTURAL STEEL SHALL BE AS PER IS 2062: 1992.
5. WELDING SHALL BE DONE AS PER IS 816: 1969.

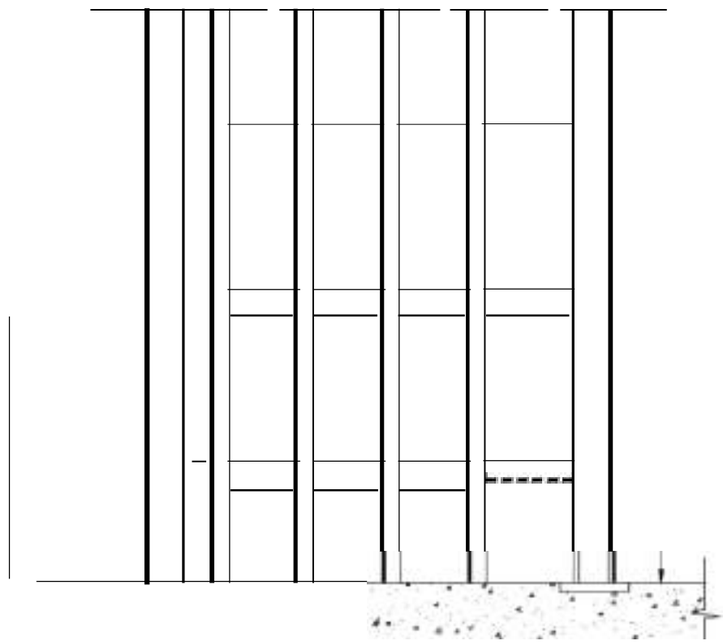
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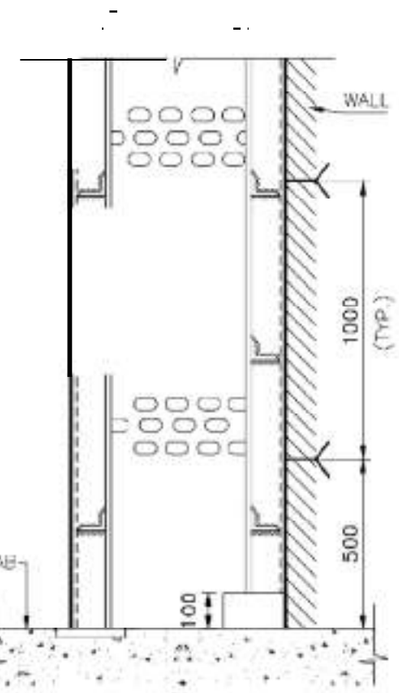
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SECTION A-A



SECTION B-B





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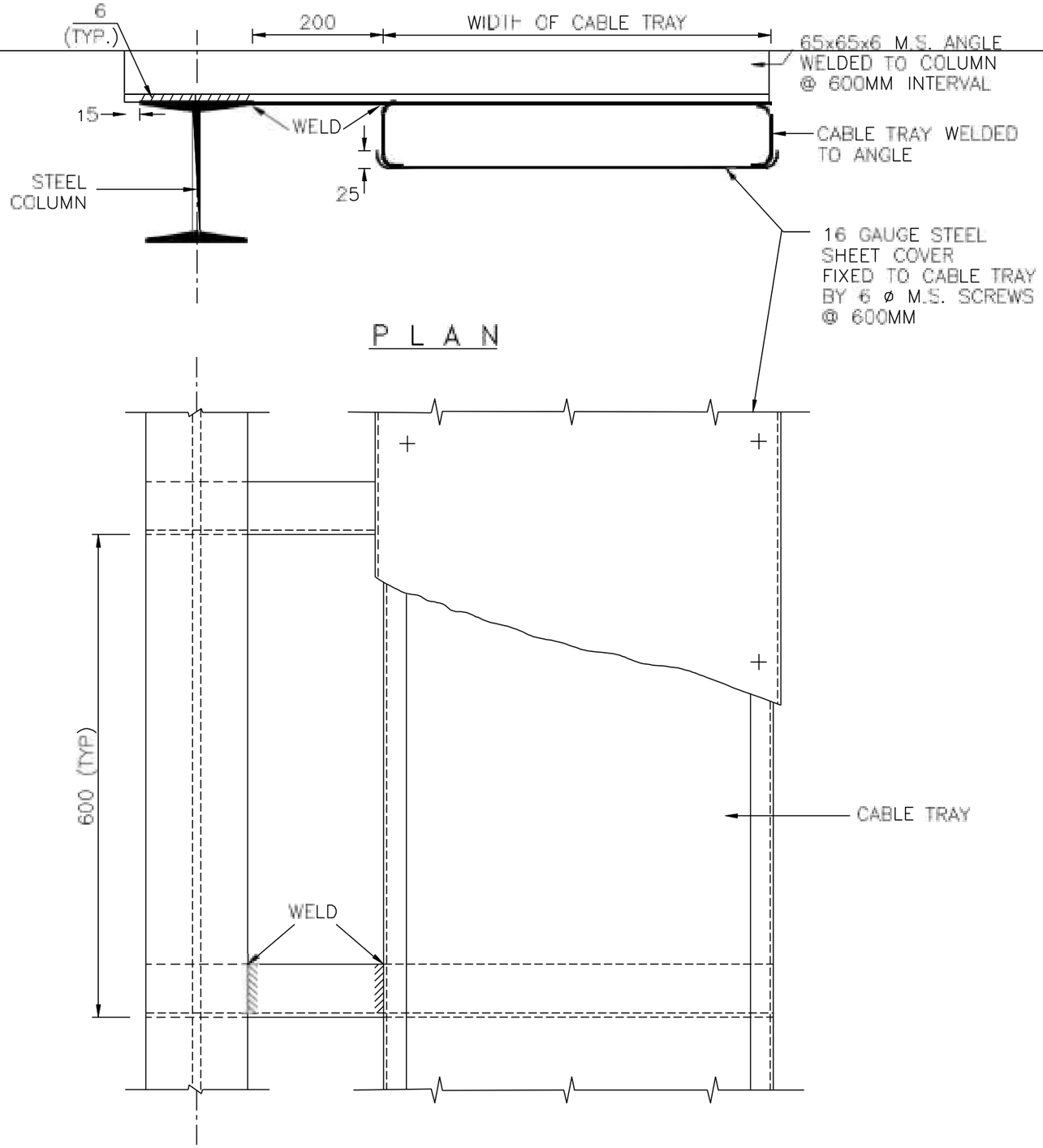
SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRAY MOUNTING ARRANGEMENT CTMV (TYPE-A)

lRACTEBE□--A3□1 Size Scale NTS Sheet 30 of 62

C!!NGle

Drawing No. GGNG-E-20714-3010 Rev. 0

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NOTES

1. ALL DIMENSIONS ARE IN MM.
2. STRUCTURAL STEEL SHALL BE AS PER IS 2062: 1992.

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SUBJECT: TYPICAL CABLE TRAY INSTALLATION DETAILS

ELEVATION

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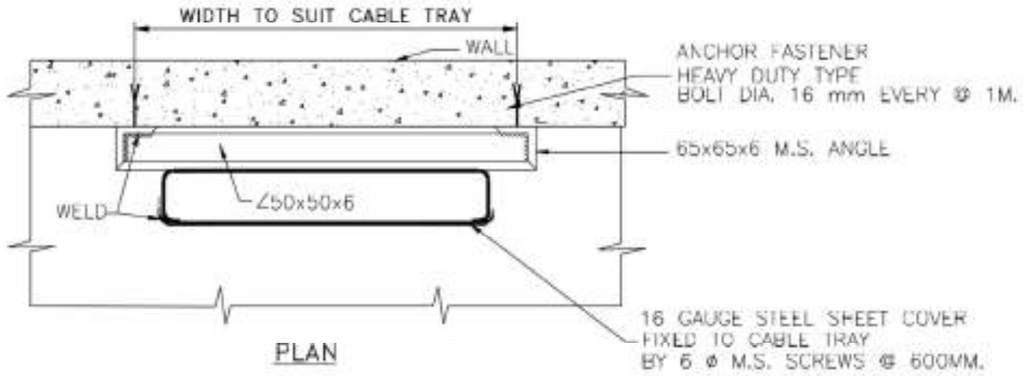
CABLE TRAY MOUNTING ARRANGEMENT CTMV (TYPE-B)

Size	Scale	Sheet
A3	NTS	31 of 62

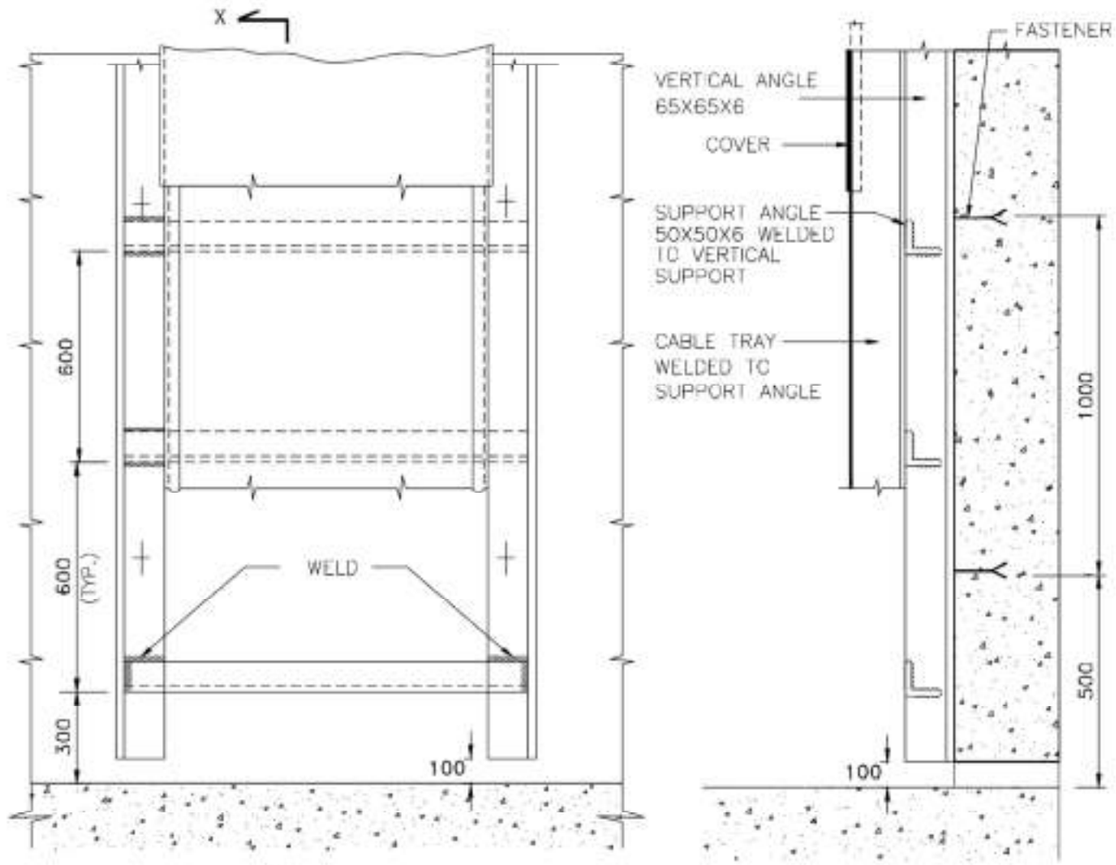
Drawing No. GGNG-E-20714-3010 Rev. 0

0	07.10.16	APPROVED	RKS	PR	KJ	SKH

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PLAN



X ELEVATION

SECTION X–X

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. NUMBER OF TRAYS WILL BE AS PER REQUIREMENT.
3. FOR OUTDOOR USE, THE VERTICAL SUPPORTS TO BE SUITABLY GROUTED IN CONCRETE FOUNDATION OR WELDED TO AVAILABLE STEEL STRUCTURES.
4. STRUCTURAL STEEL SHALL BE AS PER IS 2062: 1992.
5. WELDING SHALL BE DONE AS PER IS 816: 1969.

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SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRAY MOUNTING ARRANGEMENT CTMV (TYPE-C)

TRACTEBEL ENGIE

Size A3 | Scale NTS | Sheet 32 of 62

Drawing No. GGNG-E-20714-3010 | Rev. 0

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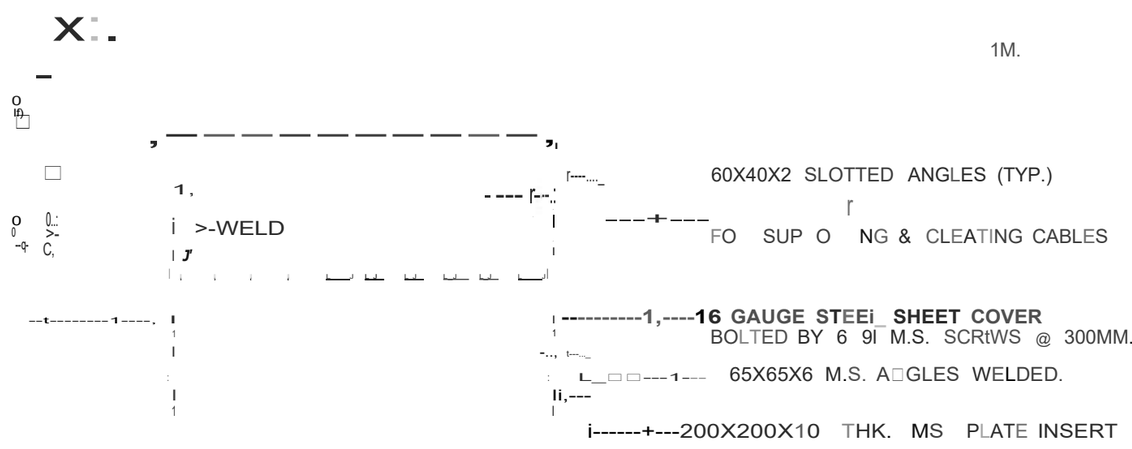
1 2 3 4

A

B

C

D

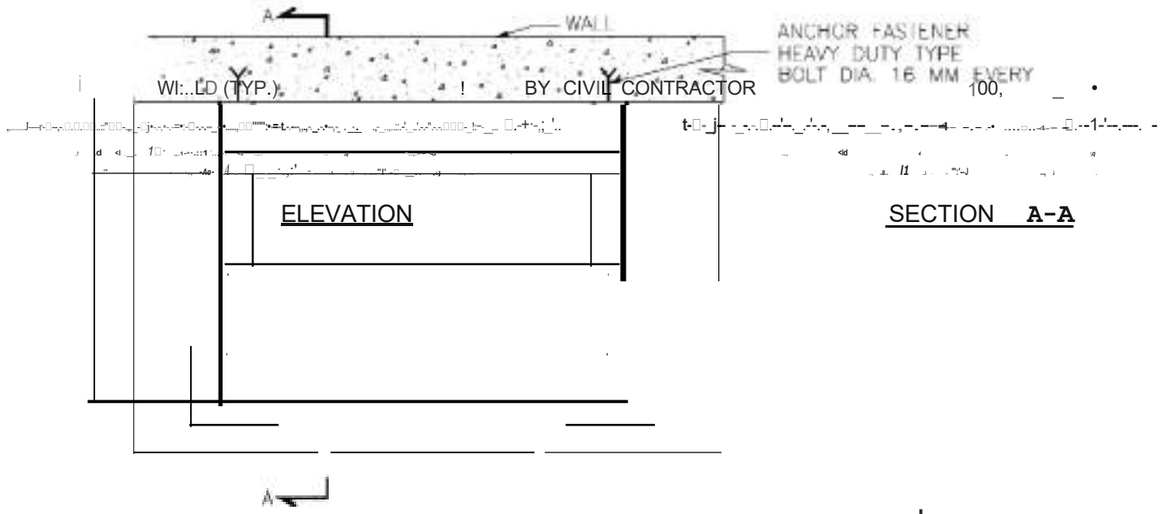


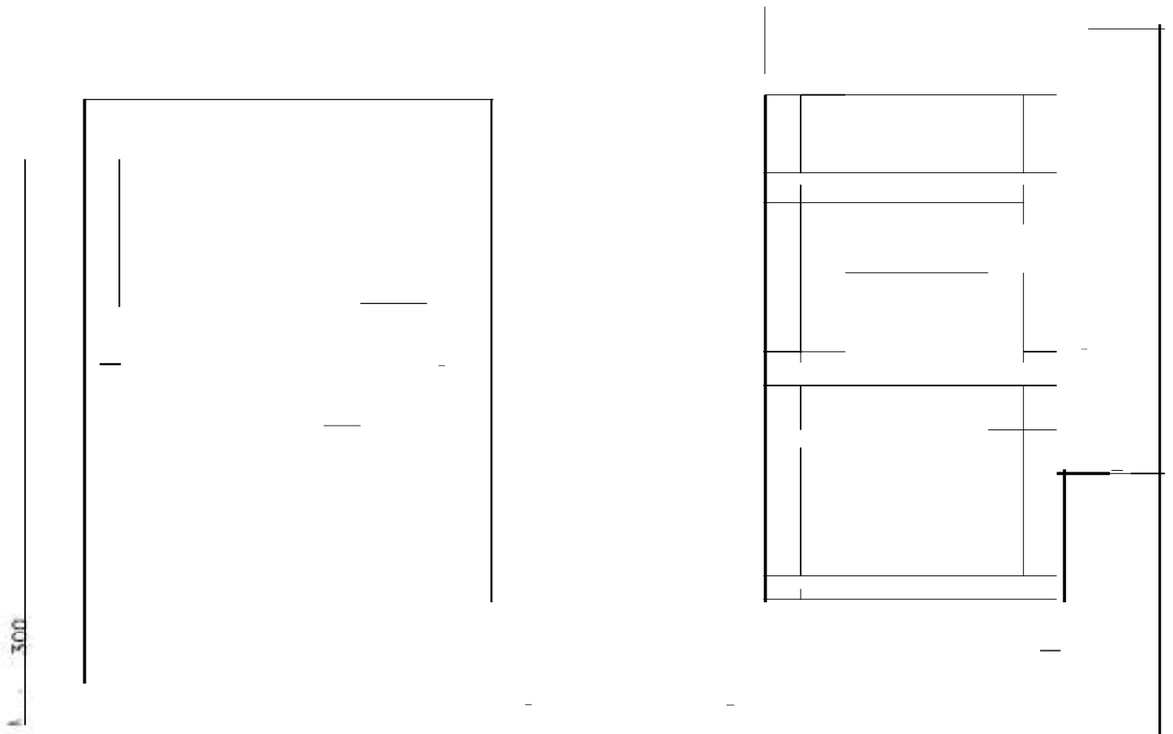
NOTES

1. ALL DIMENSIONS ARE IN MM.
2. NUMBER OF TRAYS WILL BE AS PER RIQUIRIMINI.
3. FOR OUTDOOR USE, THE VERTICAL SUPPORTS TO BE SUITABLY GROUTED IN CONCRETE FOUNDATION OR WELDED TO AVAILABLE STEEL STRUCTURES.
4. STRUCTURAL STEEL SHALL BE AS PER IS 2062: 1992.
5. WELDING SHALL BE DONE AS PER IS 816: 1969.

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SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRAY MOUNTING ARRANGEMENT CTMV (TYPE-D)

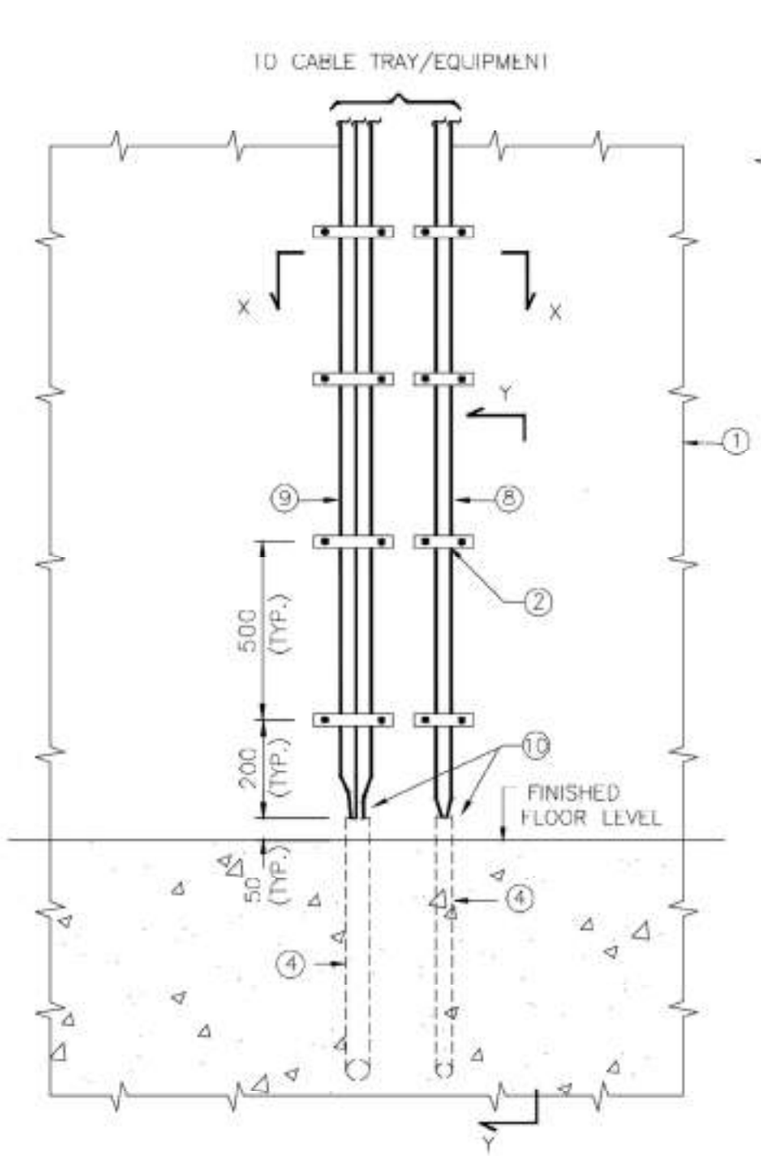
IRACTEBEL

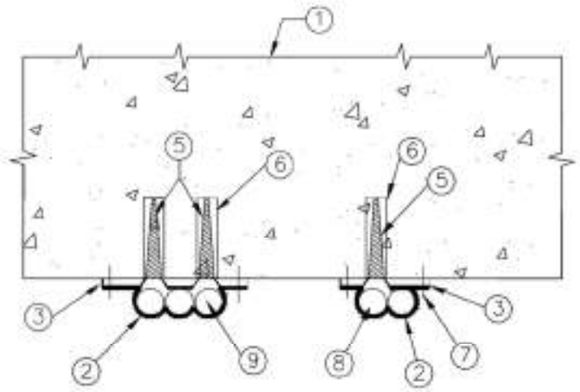
Size	Scale	Sheet
A 3	NTS	33 of 62

C!!NGle

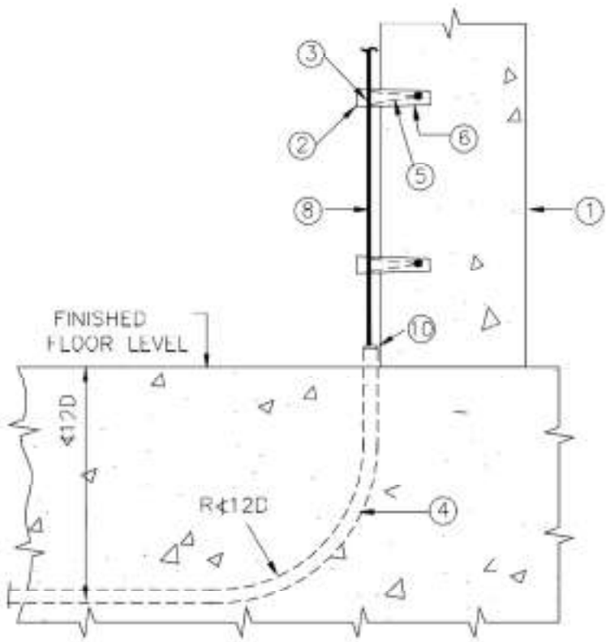
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GGNG-E-20714-3010	0

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SECTION X–X



SECTION Y–Y

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. MAXIMUM 3 No. CABLES SHALL BE CLAMPED WITH ONE SADDLE. SEPARATE SADDLE SHALL BE USED FOR MORE THAN 3 CABLES.
3. POWER AND CONTROL CABLES SHALL BE CLAMPED SEPARATELY.
4. THE CONDUIT SHALL BE EXTENDED UP TO 2500 ABOVE THE FLOOR LEVEL IN CASE OF UNARMORED CABLES.

LEGEND

1. WALL/RCC STRUCTURE
2. G.I. SADDLE
3. G.I. SPACER
4. G.I. CONDUIT
5. 6Φ, 35 LONG G.I. SCREW
6. RAWL PLUG
7. 3Φ, 5 LONG G.I. M/C SCREW
8. CONTROL CABLE
9. POWER CABLE (LESS THAN 3CX70MM²)
10. WATER PROOF SEALING

D – NORMAL DIAMETER OF CONDUIT

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SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE INSTALLATION PRACTICE ALONG WALL/RCC STRUCTURE (CABLE SIZE <3CX70mm)

TRACTEBEL ENGIE

Size A3 | Scale NTS | Sheet 34 of 62

Drawing No. GGNG-E-20714-3010 | Rev. 0

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2 3 4

NOTES

A

B

FINISHED FLOOR LEVEL

ELEVATION VIEW A-A

(ONLY f-01-< INIJUOR & WHI:_N THERE IS NO LIKI:_L HOOD Of ANY LIQUID SPILLAGE)

* ITD/ 7 TC BE WELDED TO COLUMI\ Af\D CAclLE IRAY

ELEVATION □B VI W B-B

CABLt ENIRY

SECTION Y-Y

C

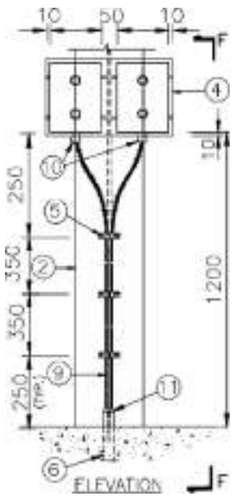
ICI!ON X-X

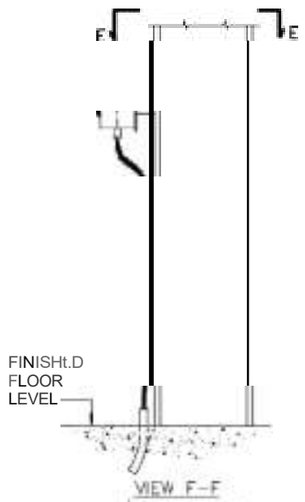
D

FINISrED FLOOR LEVEL

11 6

C



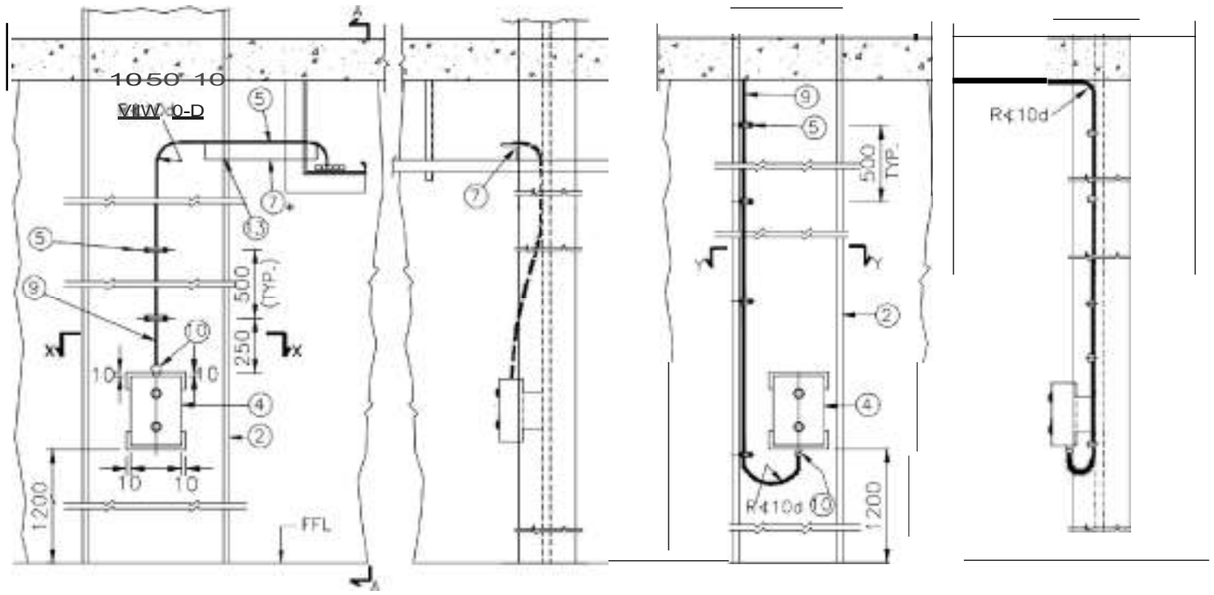


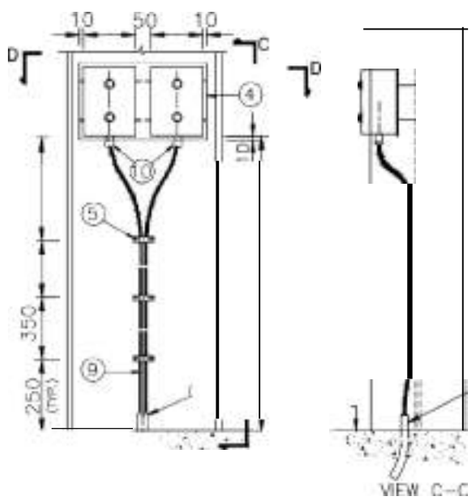
TYPICAL TWO P.B. STATION

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SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
INSTALLATION OF P.B. STATION AND CABLE
(MOUNTED OF STEEL COLUMAN)

Size A3 | Scale NTS | Sheet 35 of 62

IRACTEBE C!!NGIe

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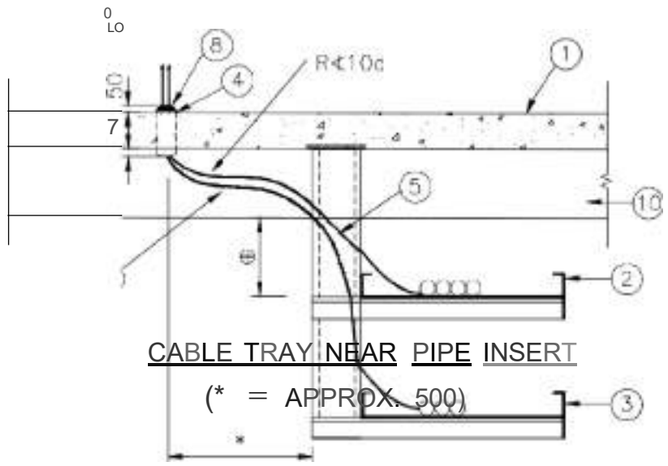
Rev.	D	M	Y	Modifications	Drawn	Checked	Approved	Validated

SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE INSTALLATION PRACTICE TO
EQUIPMENTS INSTALLED ON UPPER FLOOR

Size	Scale	Sheet
A3	NTS	36 of 62

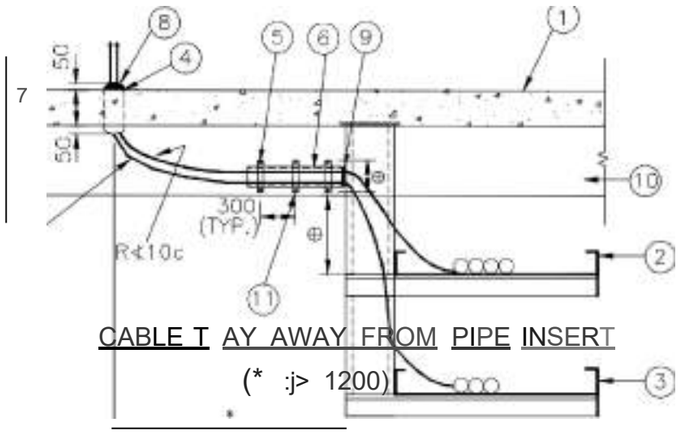
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2 3 4



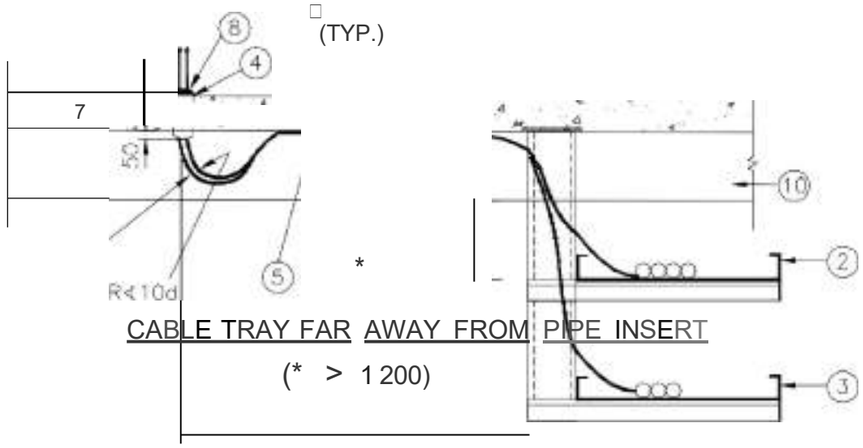
CABLE TRAY NEAR PIPE INSERT

(* = APPROX. 500)



CABLE TRAY AWAY FROM PIPE INSERT

(* :j> 1200)



CABLE TRAY FAR AWAY FROM PIPE INSERT

(* > 1 200)

NOTES

Drawing No. GGNG-E-20714-3010 Rev. 0

1. ALL DIMENSIONS ARE **IN MM.**
2. POWER AND CONTROL CABLES SHALL BE CLAMPED SEPERATELY.
3. G.I. PIPE INSERT SHALL BE INSTALLED NEAR THE EQUIPMINI SUCH THAT THE CABLE COULD BE RAISED STRAIGHT TO THE EQUIPMENT CABLE GLAND /BOX WITHOUT ANT OFFSET.
4. ALL EMBEDDED PIPE INSERTS SHALL HAVE MINIMUM 50 LONG THREADED PROJECTION BEYOND THE EMBEDDED PART.
5. THE DIMENSION MARKED THUS @SHALL BE DECIDED AT SITE. (PREFERABLY
6. THIS SHALL NOT EXCEED 500mm).
7. CABLE SHALL BE CLAMPED SUBJECT TO MINIMUM BENDING RADIUS.
8. STRUCTURAL STEEL SHALL BE AS PER IS 2062:1992.
9. WELDING SHALL BE DONE AS PER IS 816:1969.

LEGEND

CD FLOOR SLAB
G) POWER CABLE T AY
W CONTROL CABLE TRAY
0 G.I. PIPE INSERT
® SADDLE AND SPACER
® 50x50x6 M.S. ANGLE
(D CABLE
® FIRE PROOF/WATER PROOF SEAL NG
@ WcLD
® BEAM
GJ) 25 WICE x 3 THICK M.S. FLAT W LDED IO 1r1:JV-6
d - OVERALL DIA. OF CABLE

0	7.10.1	APPROVED	RKS	PR	KJ	SKH

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SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE INSTALLATION PRACTICE TO MOTOR AND P.B.

Size	Scale	Sheet
A3	NTS	37 of 62

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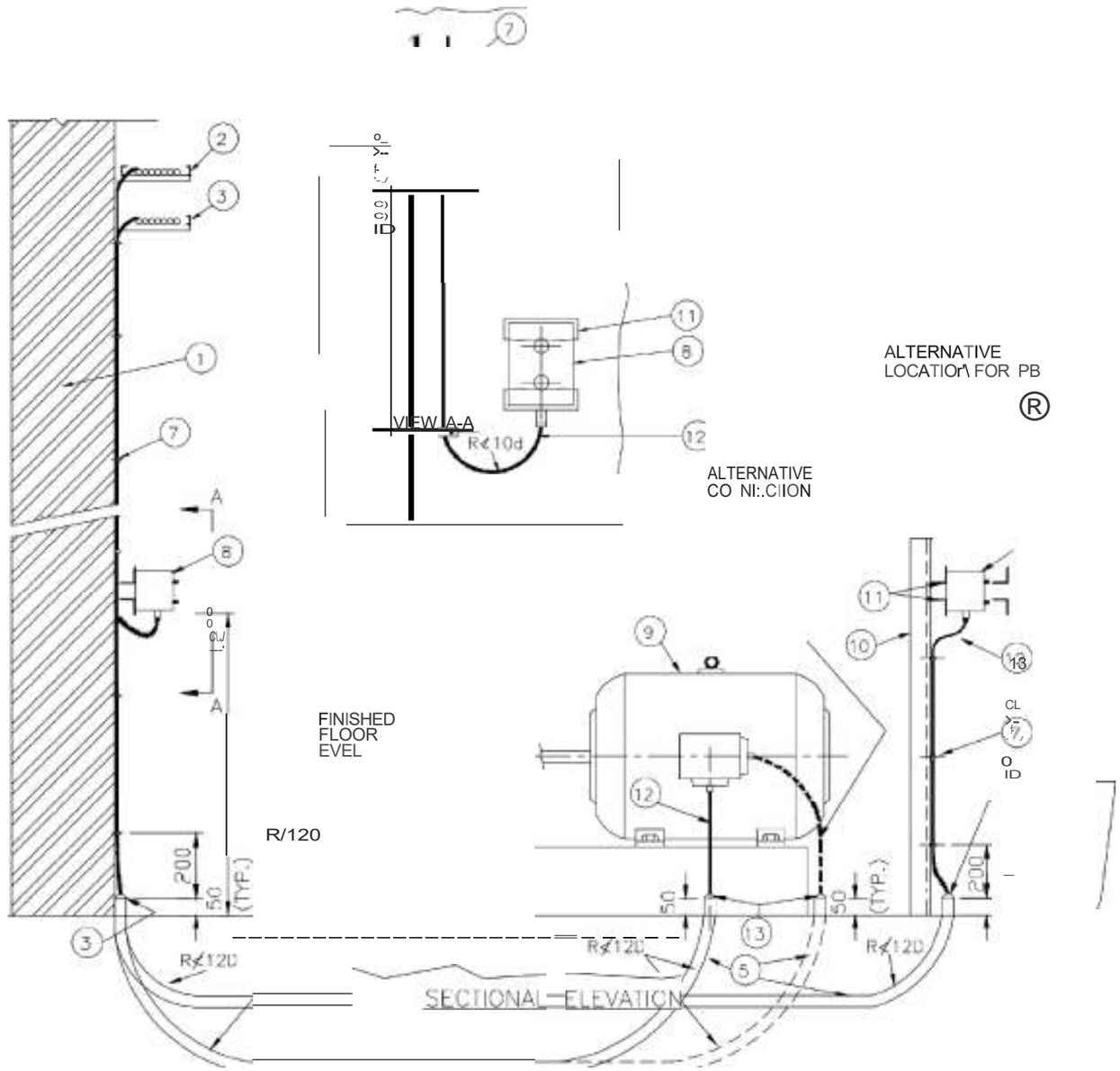
2 3 4

A

B

C

D



NOTES

Drawing No. GGNG-E-20714-3010 Rev. 0

1. ALL DIMENSIONS ARE IN MM.
2. POWER AND CONTROL CABLES SHALL BE CLAMPED SEPARATELY.
3. THE CONDUIT/PIPE INSERT SHALL BE INSTALLED SUCH THAT CABLE CAN BE RAISED STRAIGHT TO THE EQUIPMENT CABLE GLAND/BOX WITHOUT ANY OFFSET.
4. CABLE SHALL BE CLAMPED/BENT SUBJECT TO MINIMUM BENDING RADIUS.
5. SEPARATE SPACE HEATER CABLE WHERE REQUIRED, SHALL BE LAID ALONG WITH THE POWER CABLE IN THE SAME CONDUIT, IF THE VOLTAGE GRADES OF THE TWO CABLES ARE SAME. OTHERWISE SEPARATE CONDUIT SHALL BE PROVIDED.
6. UNARMOURED CABLES SHALL HAVE MECHANICAL PROTECTION UPTO 2500 ABOVE FLOOR LEVEL.
7. STRUCTURAL STEEL SHALL BE AS PER IS 2062:1992.
8. CONDUITS AND ACCESSORIES SHALL CONFORM TO IS 1653:1972/IS 3837:1976.

LEGEN

CD WALL/STEEL COLUMN
@ POWER CABLE TRAY/RACK
G) CONTROL CABLE TRAY/RACK
@ CABLE TRENCr
@ G.I. CONDUIT
@ G.I. PIf-JE INS!:_
(j) SADDLE Ar'\D SPACtR
@ P.B. SIAIION
@ MOIOR
@ ISMC-100
(jj) 50x50x6 M.S. ANGLE
© CABLE IDENTIFICATOf\ TAG
()]) WATER PROOF/FRE PROOF SEALNG
d OVERALL DIA. CF CAt3LE
D NOMINAL DIA. OF CONCUIT

0	7.10.1	APPROVED	RKS	PR	KJ	SKH

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2 3 4

NOTES

1. FOR NOTES AND LEGEND REFER SHEET 37 OF 62.
2. THE ANGLE MARKED THUS @ SHALL BE DECIDED BY SITE ENGINEER/INSTALLATION CONTRACTOR TO SUIT SITE CONDITION.

A

ALTERNATIVE
CONNECTION

FINISHED
rLOOR I:.VI:.L

B

ALTERNATIVE
CONNI:.CIIQN

FINISr' D
FLOOR LEVEL

CABLE FROM TRAY
(BELOW LOOR LEVEL)

(TYP.)'

4 150

C

13

SECTION A-A

D

8

0

CABLE ROUTE

CONDUIT INSTALLATION FROM

CONDUIT INSTALLATION FROM

A

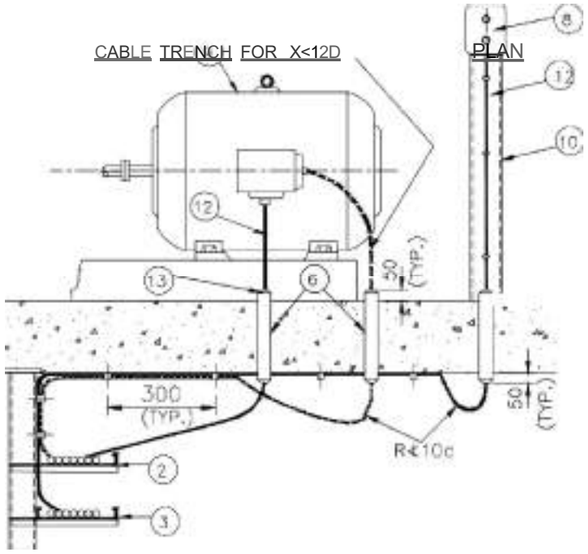
0 7.10.1 APPROVED RKS PR KJ SKH

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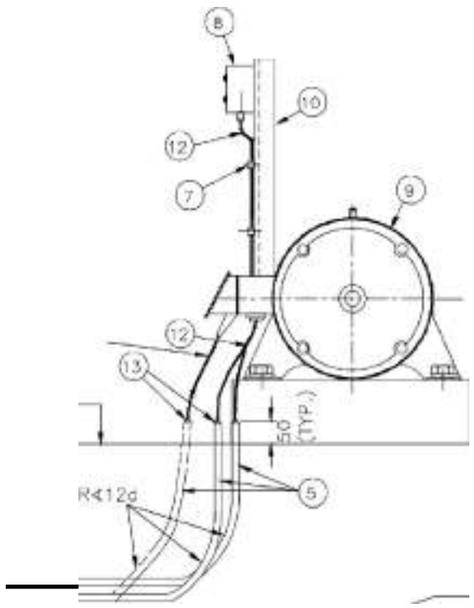
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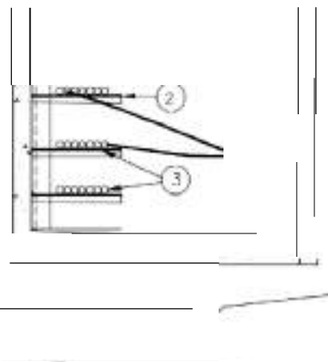
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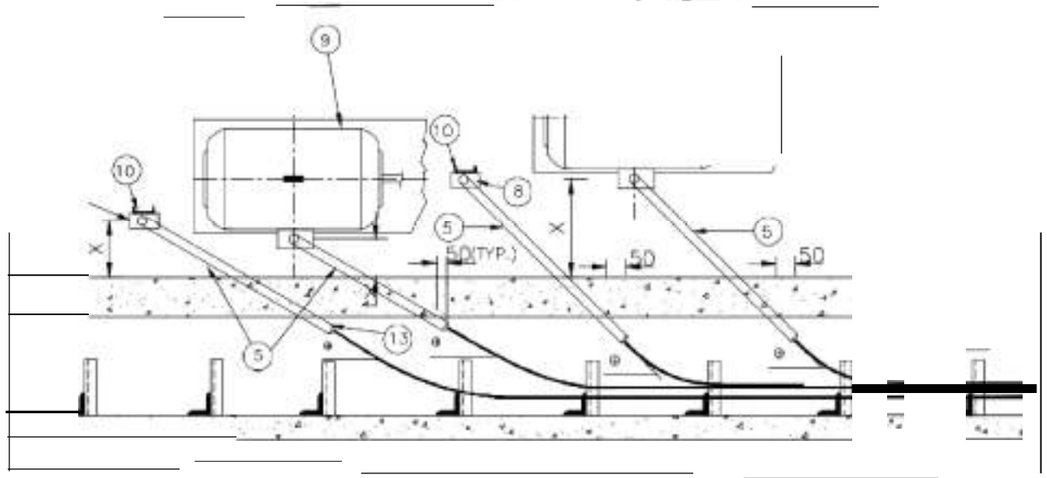
CABLE TRENCH FOR X<12D



CABLE TRENCH FOR X>12D







Rev. D M Y | Modifications | Drawn | Checked | Approved | Validated

SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE INSTALLATION PRACTICE TO MOTOR AND P.B.

IRACTEBE C!!NGIe

Size A3 | Scale NTS | Sheet 38. of 62

Drawing No. | Rev.

2 3 4

NOTES

1. □Of< NOll:.S ANL; Ll:.Gl:.Nl) l:.fl:.f< SHl:.1:.l j7 Of 62.
2. 50x50xo M.S. ANGLE SUPPOFfl FOR CABLE CLAMPING SHALL BE INSTALLED WITHOUT OBSTRUCTING THE PASSAGE AND ACCESSIBILITY, FOR MAINTENANCE OF EQUIPMENT. PREFERABLY THE SUPPORT SHALL BE REMOVABLE TYPE.

A

TYP,

7

ALTI NAI IV
ROUTE

B

EOUI MENT

7

C

13

FINISHED
FLOORLt.Vt.L

R<l:120

R1:12D

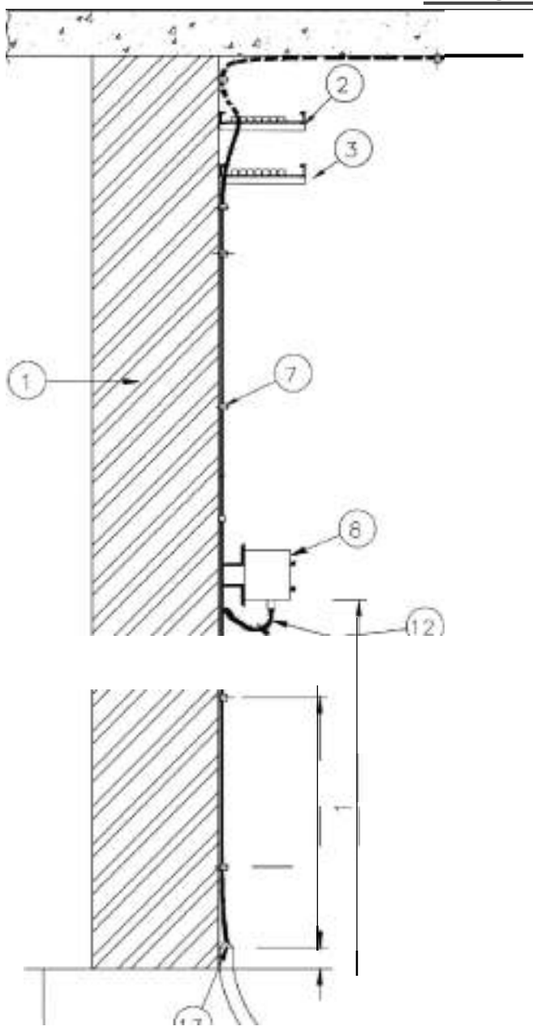
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TYPICAL MOI OR MC□NTED ON EQUIPMENT



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SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE INSTALLATION PRACTICE TO MOTOR AND P.B.

IRACTEBEL

Size A3 Scale NTS Sheet 3 of 62 -1

C!!NGIe

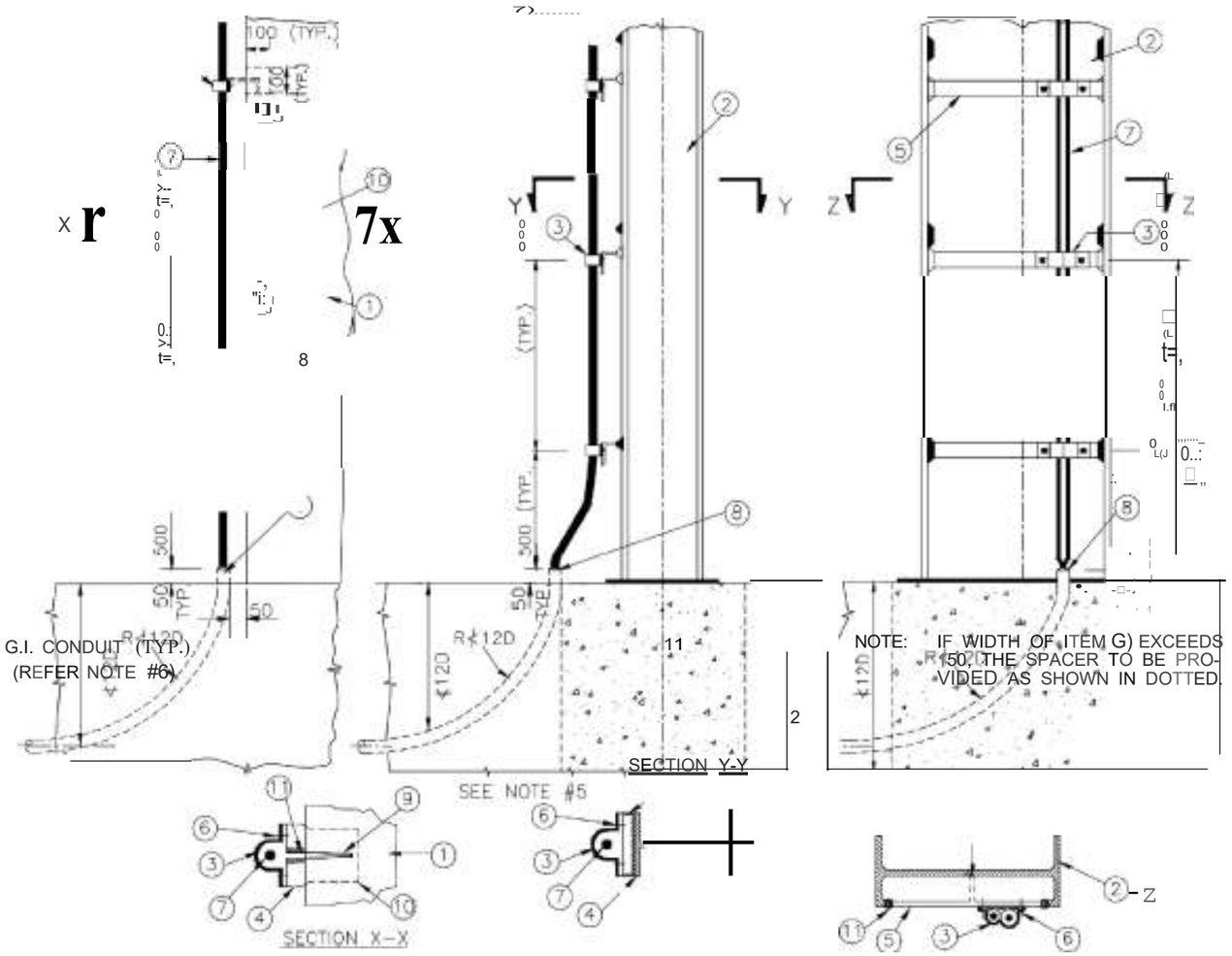
Drawing No. Rev.

Rev.	D M Y	Modifications	Drawn	Checked	Approved	Validated

SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE INSTALLATION PRACTICE FOR
POWER CABLES (3CX70mm AND ABOVE)

Size	Scale	Sheet
A3	NTS	40 of 62

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NOTES

Drawing No.	Rev.
GGNG-E-20714-3010	0

1. ALL DIMENSIONS ARE IN MM.
2. MAXIMUM 3NO. POWER CABLES SHALL BE CLAMPED TOGETHER.
3. CABLES OF DIFFERENT VOLTAGES SHALL BE CLAMPED SEPARATELY.
4. SINGLE CORE POWER CABLES SHALL BE CLAMPED IN TREFOIL FORMATION.
5. 2Nos.ANCHOR BARS SHALL BE USED FOR EACH ANGLE SPACER HAVING LENGTH MORE THAN 100.
6. THE CONDUIT SHALL BE EXTENDED UPTO 2500 ABOVE THE FLOOR LEVEL IN CASE OF UNARMOURED CABLES.
7. STRUCTURAL STEEL SHALL BE AS PER IS 2062:1992.
8. NUTS AND BOLTS SHALL BE AS PER IS 1363(PART-1,2,3):1992/ IS 1367(PART-5);1980.
9. WASHERS SHALL BE AS PER IS 2016:1967.
10. WELDING SHALL BE DONE AS PER IS 816:1969.

LEGEND

CD	WALL
@	SI1:.1:.L COLUMN
Q)	SADDLE FAB ICAT D f-ROM 2:.;ixj G.I. f-LAI (50x50x6 M.S. At\GLE) S ACER
@	SPACER (25x6 M.S. FLAT)
®	8¢,25LONG G.I. BOLT, NUT AND WASHER.
(Z)	POWER CABLE (3Cx70mm AND ABOVE)
®	WATER PR90F SEALING
®	80,150 LONG M.S. ANCHOR BAR
@	M 150 CONCRETE
rjJ)	WELD

d1, dZ... OVERALL IJIAr-/I:.II:.R Or CABLI:.S.
0-NOMINAL DIAMETER OF CONDUI1-.

0	7.10.1	APPROVED	RKS	PR	KJ	SKH

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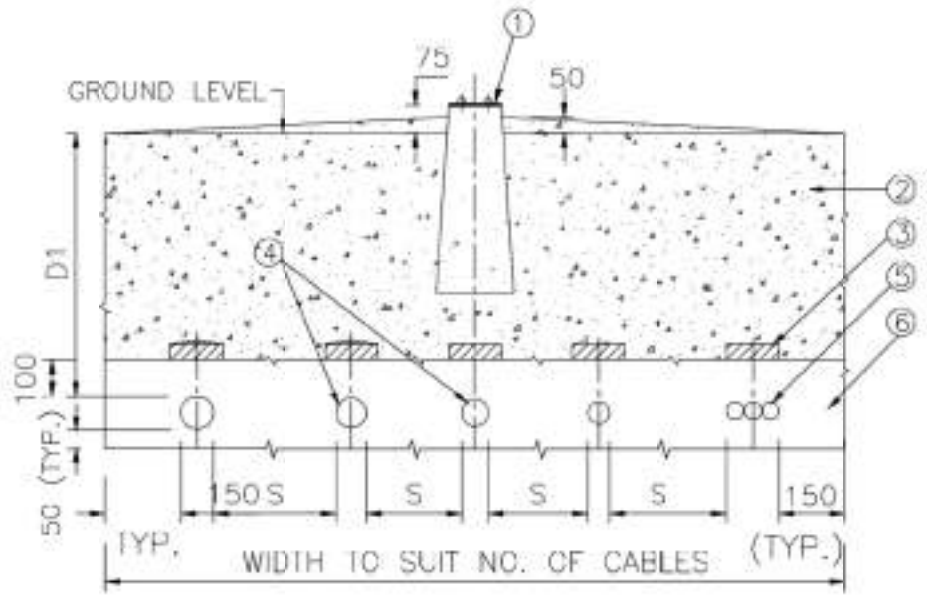
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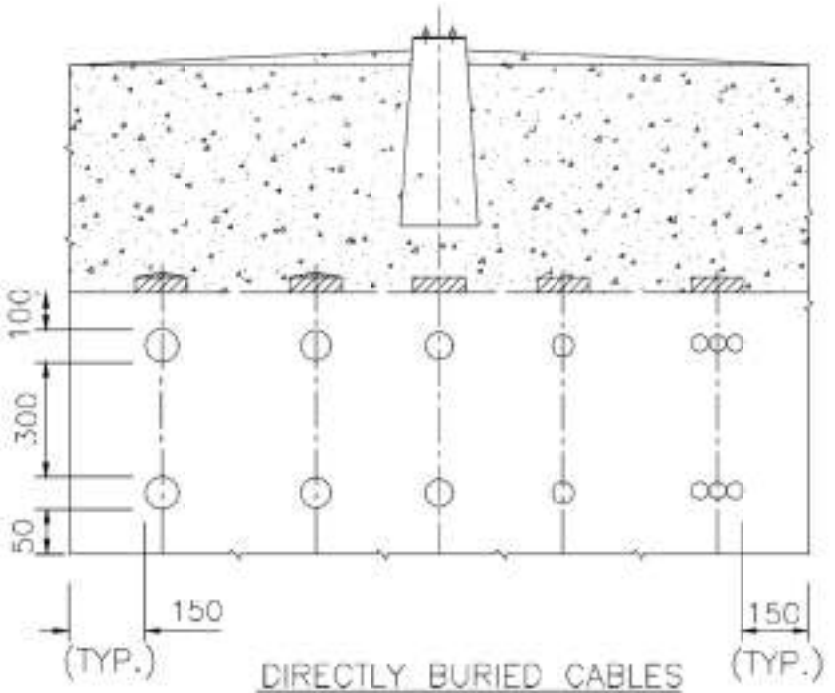
SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
INSTALLATION PRACTICE FOR DIRECTLY BURRIED CABLES

Size	Scale	Sheet
A3	NTS	41 of 62

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DIRECTLY BURIED CABLES
IN SINGLE LAYER



DIRECTLY BURIED CABLES
IN TWO LAYERS

DIMENSIONS (MIN.)	1100V GRADE CABLES	FOR 3.3KV TO 11KV	22KV & 33KV
D1	750	900	1050
S	⊗d —— BETWEEN CABLES OF SAME CLASS *300mm — BETWEEN CABLES OF DIFFERENT CLASS *400mm — BETWEEN 1/C POWER CABLE AND COMMUNICATION CABLE *300mm — BETWEEN MULTICORE POWER CABLE AND COMMUNICATION CABLE		

⊗d — OVERALL DIAMETER OF THE BIGGER OF THE TWO CABLES

* — SPACING SHALL BE KEPT BOTH HORIZONTALLY & VERTICALLY

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. SINGLE CORE CABLES SHALL BE RUN IN TREFOIL FORMATION AND SHALL BE BOUND BY PLASTIC TAPES OR 3 DIA NYLON CORD EVERY 750MM.
3. CABLE IDENTIFICATION TAG SHALL BE TIED AT BOTH ENDS OF THE CABLE AND ALSO AT AN INTERVAL OF 15 METRES.
4. IF THE MINIMUM CLEARANCE AS INDICATED IN THE ABOVE TABLE FOR CABLES OF DIFFERENT CLASSES ARE NOT FEASIBLE, BRICK BARRIERS SHALL BE USED BETWEEN ADJACENT CABLES.
5. G.I./HUME PIPE SHALL BE PROVIDED FOR ROAD CROSSING AT A MINIMUM DEPTH OF 600 FROM THE GRADE LEVEL UNLESS OTHERWISE SPECIFIED.

LEGEND

① CABLE ROUTE MARKER
② EARTH BACK FILLED & RAMMED
③ PROTECTIVE COVERS, AS PER APPENDIX-C OF IS:1255
   a) EARTHENWARE FOR LOW VOLTAGE CABLES.
   b) RCC FOR HIGH VOLTAGE CABLES, WITH HOLE AT EACH END TO TIE THEM TO EACH OTHER WITH G.I. WIRE.
④ POWER CABLE
⑤ CONTROL CABLE
⑥ FINE SAND/RIDDLED SOIL COMPACTED.

0	07.10.15	APPROVED	RKS	PR	KJ	SKH

Drawing No. GGNG-E-20714-3010 Rev. 0

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Civil and Architectural Works for development and construction of CNG Mother Stations in Hyderabad GA
Bid Document No: BGL/780/2026-27
Volume II of II

Bhagyanagar Gas Limited

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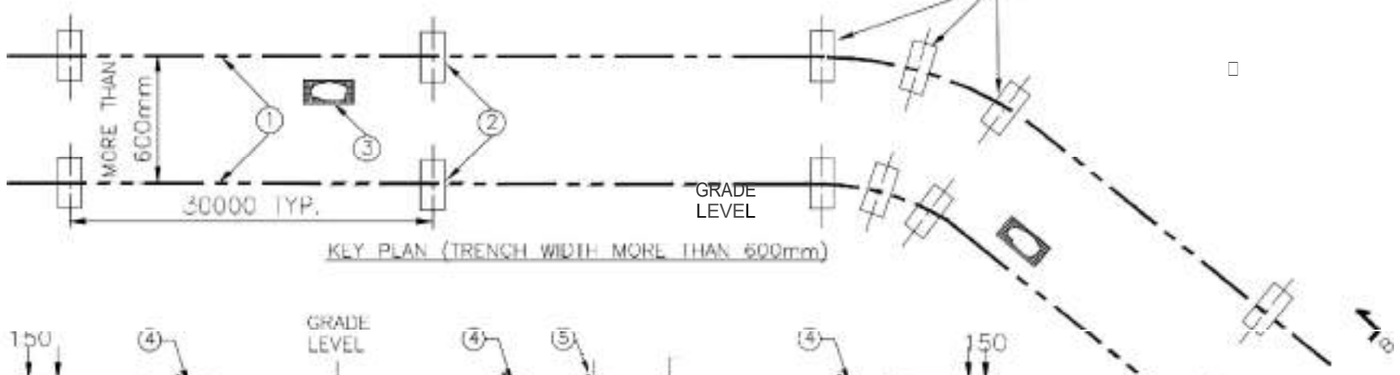
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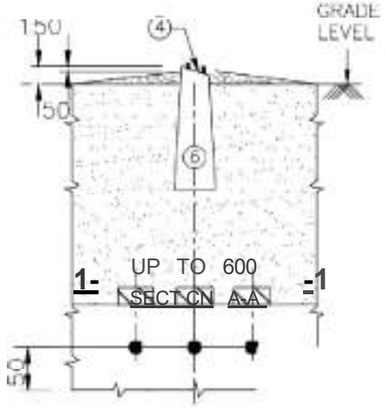
SEE NOTE 6

KEY PLAN (TRENCH WIDTH UPTO 600mm)

SEE NOTE-6

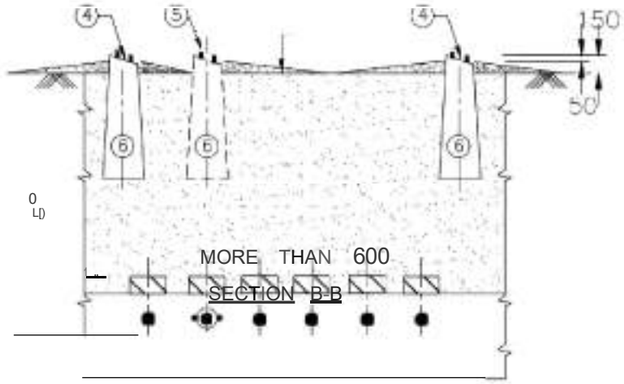


KEY PLAN (TRENCH WIDTH MORE THAN 600mm)



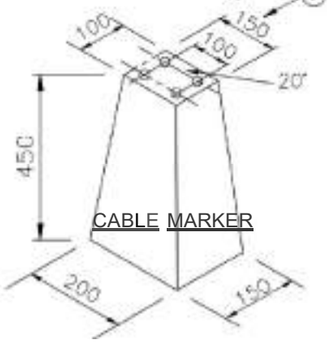
UP TO 600
SECTION A-A

SEE NOTE-3 & 4



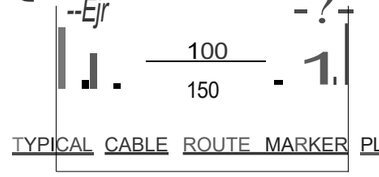
MORE THAN 600
SECTION B-B

SEE NOTE-3 & 4



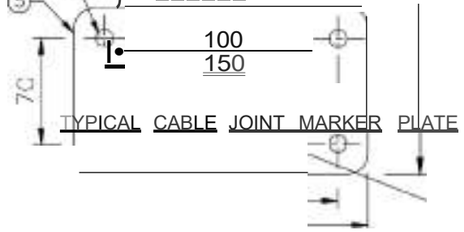
CABLE MARKER

CABLE ROUTE
11000 V



TYPICAL CABLE ROUTE MARKER PLATE

CABLE JOINT
11KV-3C-400mm²



TYPICAL CABLE JOINT MARKER PLATE

SPACING FOR CABLE NUMBER AS PER CABLE SCHEDULE.

NOTES

Drawing No. GGNG-E-20714-3010 Rev. 0

1. ALL DIMENSIONS ARE IN **MM.**
2. FOR NOTES AND OTHER DETAILS REFER SHEET 41 OF 62.
3. a) VOLTAGE OF HIGHEST GRADE CABLE SHALL BE CAST ON THE CABLE ROUTE MARKER PLATE.
   b) VOLTAGE, NUMBER OF CORES, SIZE AND IDENTIFICATION NUMBER OF THE CABLE SHALL BE CAST ON THE CABLE JOINT MARKER PLATE.
4. RAISED LETTERS AND ARROWS SHALL BE CAST ON 10 THICK CAST IRON PLATE (ARROW INDICATES THE ROUTE OF CABLES).
5. CABLE MARKER AS ABOVE SHALL BE AVOIDED ON ROADS. ONLY A TILE SHOWING DETAILS, SHALL BE USED AS MARKER.
6. TYPICAL CABLE ROUTE MARKER AS ABOVE IS SHOWN FOR BEND. ACTUAL PLACEMENT OF ROUTE MARKER SHALL BE DECIDED AT SITE BY SITE ENGINEER/CABLE INSTALLATION CONTRACTOR.
7. THE CABLE MARKER PLATE SHALL BE FIXED BY 4NO. SUITABLE G.I. NUTS.

LEGEND

CD	CABLE ROUTE
Q)	CABLE OUT MARKER
Q)	CABLE JOINT MARKER
(±)	CABLE ROUTE MARKER PLATE (C.I.)
®	CABLE JOINT MARKER PLATE (C.I.)
®	M-150 CONCRETE BLOCK
(J)	100, 25 PROJ. G.I. STUD
®	120 HOLE

0	7.10.1	APPROVED	RKS	PR	KJ	SKH

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2 3 4

400

A

SEE OETAL A OR B

L50x50x6

50

80x80x6.

6□ANCHOR □BARi

ANCHOR PLATE(TYP)

WELDI:.IJ TO PLAII:.

B

50 THK P C C 1:4:8

COVER, PE* 50/36
DET. D FOR

6 SQ. BAR
WI:.LOI:.O IO
ANGLI:. S

6□f□E'p□O;YPE CH LIFTING HOOK

FLOOR LEVEL7

LIFTING IHOOK

300

C:L 75

LAs3

12THK /
PREMOULDED /

10 k- L50x50x6

As4

8¢ 150 LONG ANCHOR BAR JT. FILLER GAP;--,
WELDED TO ANGLE @300

**CH7 = 7 THK. CHQD. PL

C

DETAIL A

EARTH CONDUCTOR
CLAMPED ON WALL

DETAIL B

R C COVER TYPE	THICKN SS mm.	As3	As4
50/36	1:)0	7-6(/J	14-6¢

50/36 MEANS 50mm. THK.x36 Kg. COVER WEIGHT OF 600mm COVER WIDTH. PROVIDE TWO COVERS OF 300mm WIDTH FOR EVERY 10m LENGTH OF TRENCH.

D

IRFNCr

TRENCH

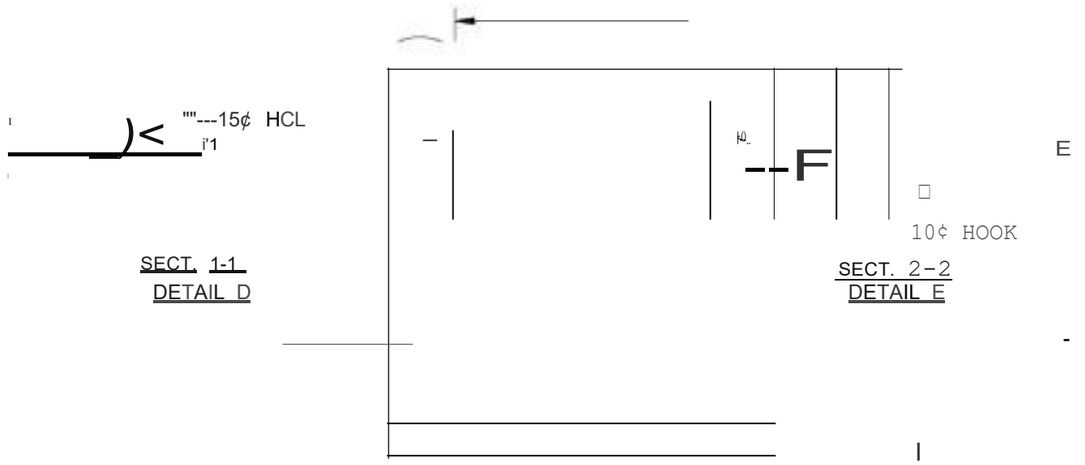
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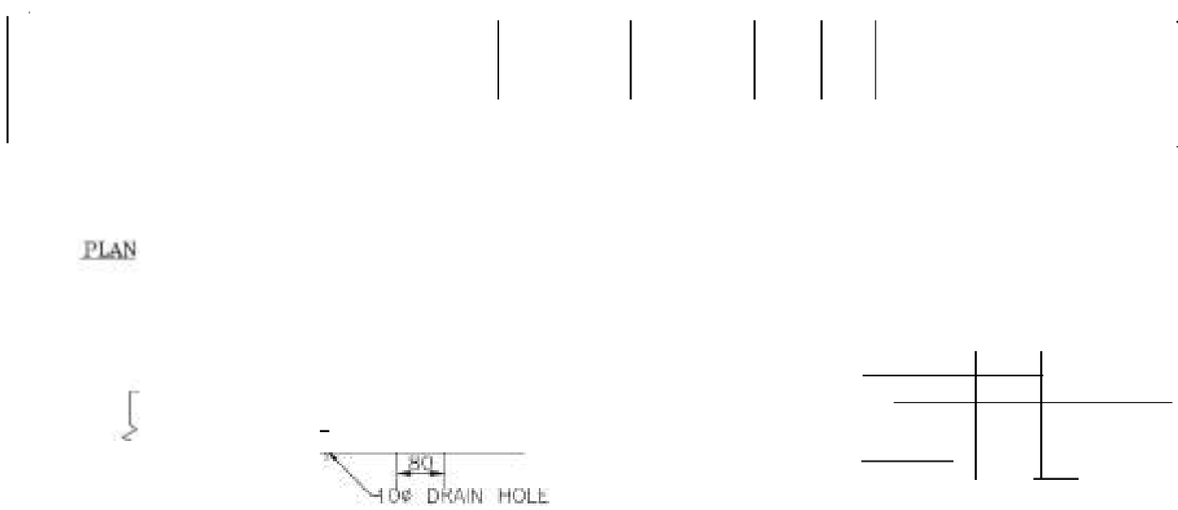
10¢ HOOK

TO RENF.

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SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRENCH TYPE - 0404

IRACTEBEL

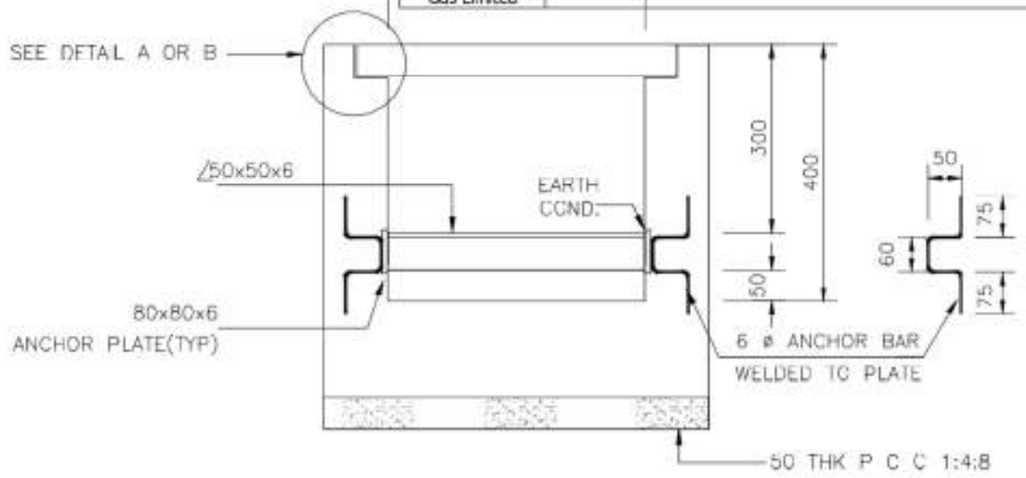
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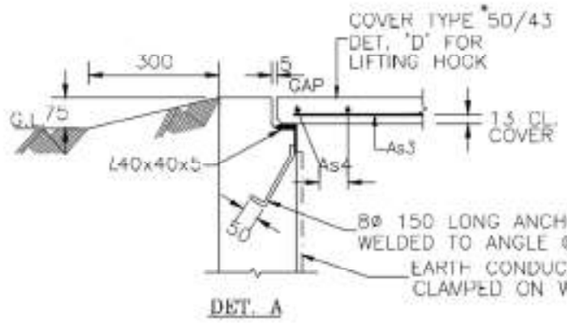
Size	Scale	Sheet
A3	NTS	43 of 62

Drawing No. GGNG-E-20714-3010 Rev. 0

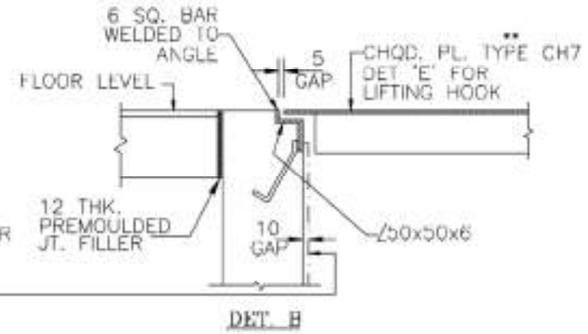
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Bhagyanagar Gas Limited



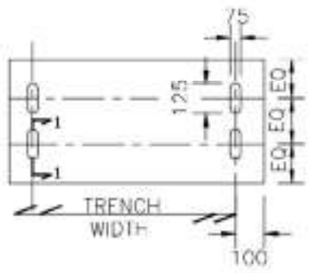


DET. A



DET. B

**CH7 = 7 THK. CHQD. PL

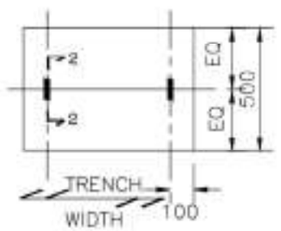


PLAN

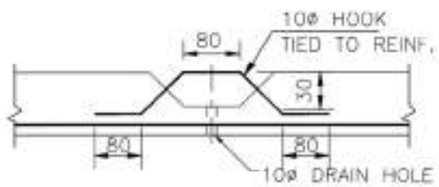
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R C COVER TYPE	THICKNESS mm.	As3	As4
50/72	50	7-6ø	7-6ø
50/36	50	7-6ø	4-6ø

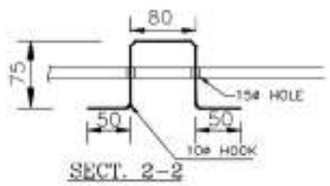
50/36 MEANS 50mm. THK.x36 Kg. COVER WEIGHT OF 600mm COVER WIDTH. PROVIDE TWO COVERS OF 300mm WIDTH FOR EVERY 10m LENGTH OF TRENCH.



PLAN



SECT. 1-1
DET. D



SECT. 2-2
DET. E

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. STRUCTURAL STEEL SHALL BE AS PER IS 2062:1992

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SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRENCH TYPE - 0504

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Size A3 | Scale NTS | Sheet 44 of 62

Drawing No. GGNG-E-20714-3010 | Rev. 0

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NOTES

1. ALL DIMENSIONS ARI:. IN MM
2. STRUCTURAL Sfl:.I:.L SHALL BI:. AS PI:.R IS 2062;1992

700

SEE DETAIL A OR B

L50x::i0x6

EARIH

80x80x6 ANChOR PLATE(TYP)

6 0 ANCHOR WE:LDI:.D IO PLA 11:.

--50 THK P C C 1:4:8

6 SC. BAR WI:.LDI:.D TO AI\GLE

++ CH7 CHQD. PL. IYPI:.-[CH7S ,PET 'E' FOR FO

COVER TYPE*so/58 OET. 'D' FOR

300 --H-a-AP rLIFTING HOOK

FLOOR LEVEL

LIFTING HOOK

L40x40x5

As4

L50x6 THK STFFENER

12THK 1Q.,,Jj-- @240 FOR CH7S ONLY

: A.. 80 150 LONG ANCHOR BAR PREMOULDED GAP • L50x50x6

WELDED TO ANGLE @300 JT. FILLER

EARTH CONDUCTOR CLAMPFD ON WALL

DET. -A

D r; " I'. : B * * JCf--7 = 7 THK. Cf--QD. PL

CH7S = 7 THK CHQD PL. WI1-h ST FFNE

*

R C COVER TYPE	THICKNESS mm.	As3	As4
50/58	50	7-60	7-60

50/58 MEANS 50mm. THK.x58 Kg. COVER WEIGHT OF 600mm COVER WIDTH. PROV OE TWO COVERS OF jQOrnm WIDIH rOR 1:.VI:.RY 1Orr LI:.r-,.,GIH 01- IRt.NCH.

100

PLAN

JREN.5t1:d WIOTh 100

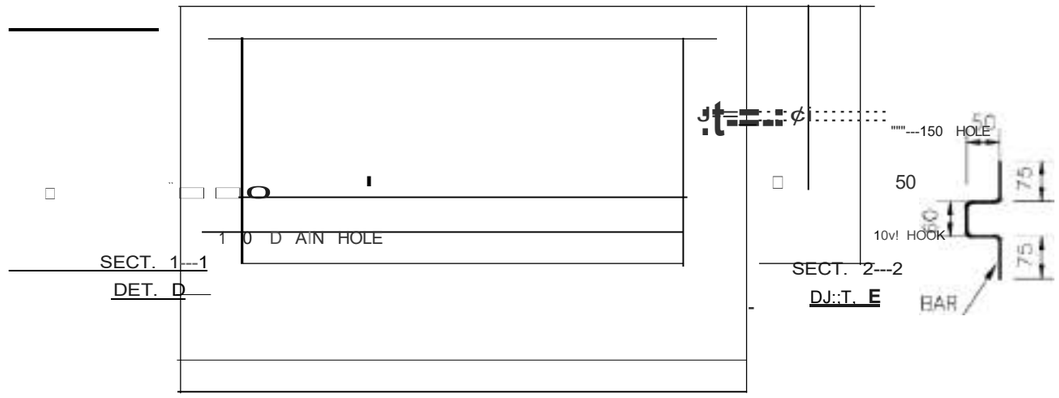
PLAN

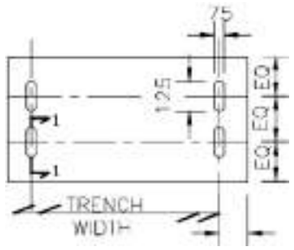
70¢ HOOK

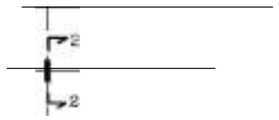
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0 b7.10.1t APPROVED RKS PR KJ SKH

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SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRENCH TYPE - 0704

IRACTEBEL

C!!NGle

Size A3 | Scale NTS | Sheet 45 of 62

Drawing No. GGNG-E-20714-3010 | Rev. 0

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2 | 3 4

A

B

C

D

SEE DET. 'A' OR 'B'

700

350 -550

EARTf-J CONDUCTOR

2 Nos. 150x50x6 THK M.S. FLATS

L50x50x6 (TYP.)

WIIr SPLII 1:.1\DS WI:.LDI:.D 10 PLAII:._

L50x50x6 425 LONG SEE OET.C

475x75x6 THK.

PL. EMBEDDED IN CONC.

L!:>O IHK. PCC 1:4:8

75x6 THK. PL.

6 /ITYP.

L50x50x6

DET. C

NOTES

1. ALL DIMENSIONS ARc. IN MM.
2. STRUCTURAL STEEL SHALL B AS PER IS 2062:1992

COVER TYPE* 50/58 DET. D FOR

300 5 rLIFTING HOOK

6 SQ. BAR WELDED TO ANGLE

FLOOR LEVEL

5

**

CHOO. PL. TYPE{CH? OR DI:.I. E rQR CH?S

rLIFTING HOOK

L40x40x5-)71 s' s

12 THK/

r1--..80 150 LONG ANCHOR BAR PREMOULDED 10 G WITDED TO ANGLE @300 JT. FILLER --.

EARTH COi\D. CLAMPI:._D ON WAL1:----_tJ_-□_,_-□□jT1□1

DET. A

OET. B

Lsox6 THK. STIFFENER @240 FOR CH7 S Oi\LY.

L50x50x6

**CH7=7 THK. CHOO. PL

CH7S=7THK. CHQD. PL. WITH STIFFENERS

R C COVIR TYPE	THICKNESS mm.	AsJ	As4
50/58	50	7-6r/J	6-69'>

50x58 MEANS 50mm. THK.x58 Kg. COVER WEIGHT OF 600mm COVER WIDTH. PROVIDE TWO COVERS OF 300mm WIDTH FOR EVERY 1Om LENGTH OF TRENCH.

TRFNCH WIDTH

PLAN

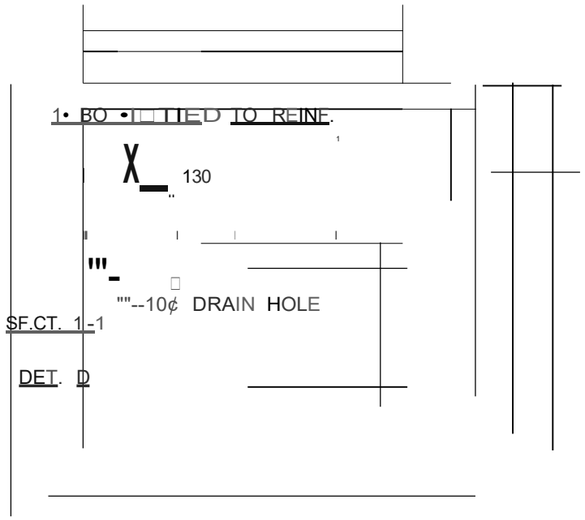
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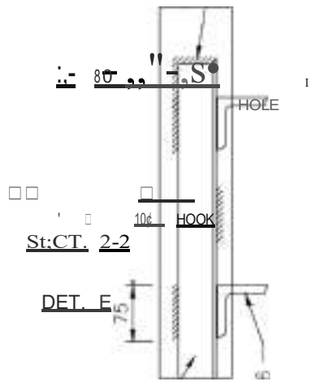
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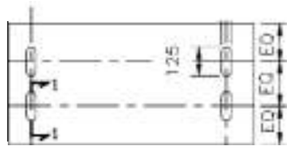
10□ HOOK

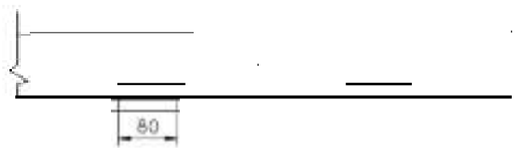
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0 P7.10.1t APPROVED RKS PR KJ SKH

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SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRENCH TYPE - 0707

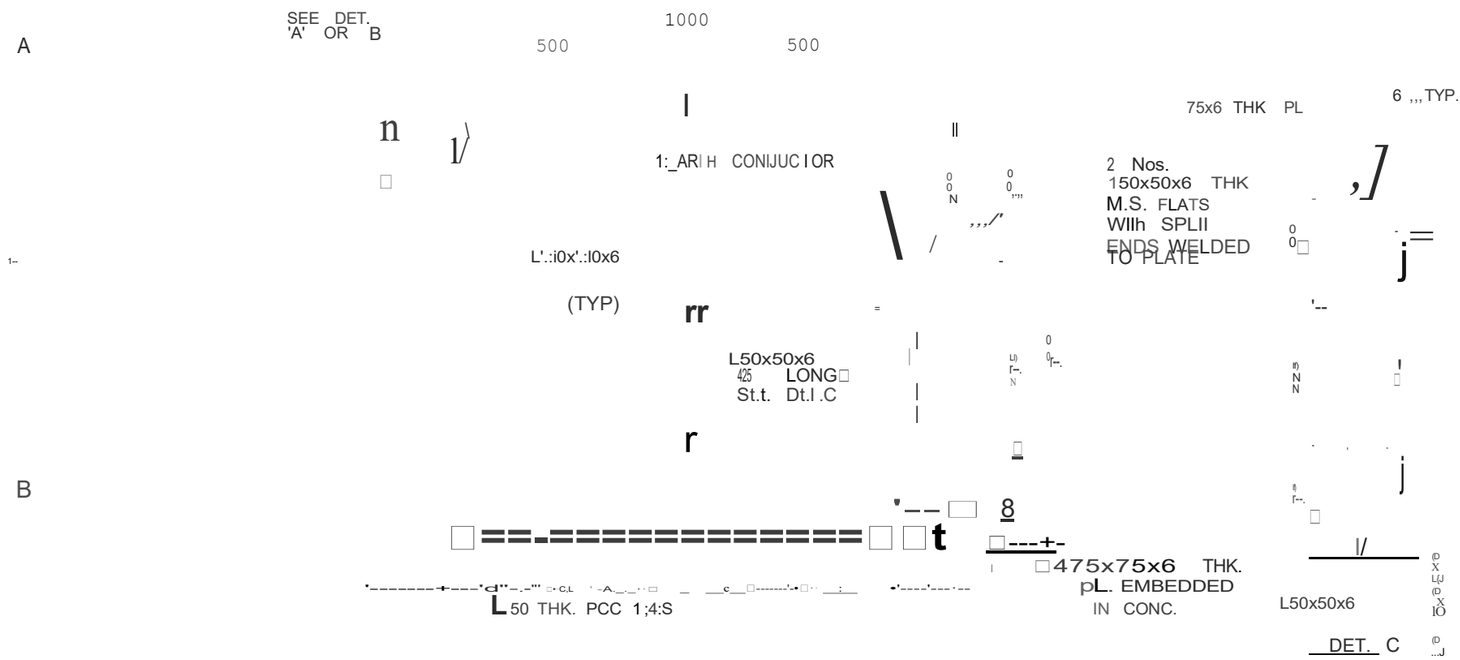
1RACTEBE--1 A3 Size NTS Scale Sheet 46 of 62

C!!NGle Drawing No. GGNG-E-20714-3010 Rev. 0

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NOTES

1. ALL DIMENSIONS ARE IN MM.
2. STRUCTURAL STEEL.HALL B AS PER IS 2062:1992



R C COVER TYPE	THICKN SS mm.	As3	As4
50/80	50	7-6¢	6-6¢
60/95	60	7-8</J	6-8¢

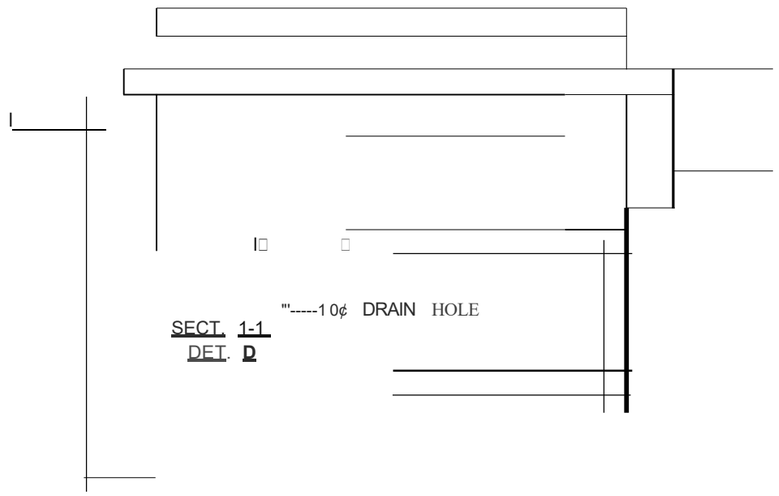
60x95 M ANS 60mm. THK.x95 Kg. COVt.R WEIGHT OF 600mm COVER WIDTt-. PROVIDE TWO COVERS OF 300mm WIDTH FOR EVERY 1Om ENGTH OF TRENCt-.

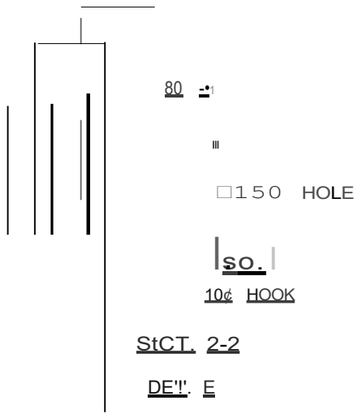
TRFNrH WIDTf-J

L□RENCH J WIDTH 1OO

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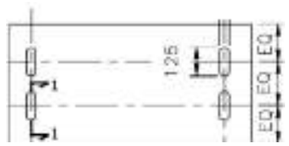
SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRENCH TYPE - 1007

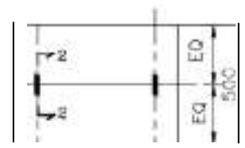
IRACTEBEL

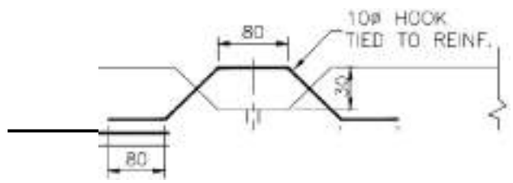
Size	Scale	Sheet
A3	NTS	47 of 62

C!NGIe

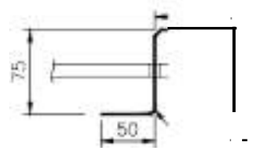
Drawing No.	Rev.
GGNG-E-20714-3010	0







PLAN



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NOTES

THE FOLLOWING TIGHTENING TORQUES SHALL BE USED FOR NUTS AND BOLTS USED FOR SUPPORTS, CABLE TRAY OR ACCESSORIES ASSEMBLY.

Metric size (mm)	Recommended Torque (Nm)
M8	12 Nm.
M10	25 Nm.
M12	45 Nm.
M16	100 Nm.

AS THE ABOVE VALUES CAN SLIGHTLY CHANGE FROM ONE CABLE TRAY MANUFACTURER TO ANOTHER, CABLE TRAY INSTALLATION CONTRACTOR TO CHECK THESE VALUES WITH MANUFACTURER DATA.

TIGHTENING TORQUES

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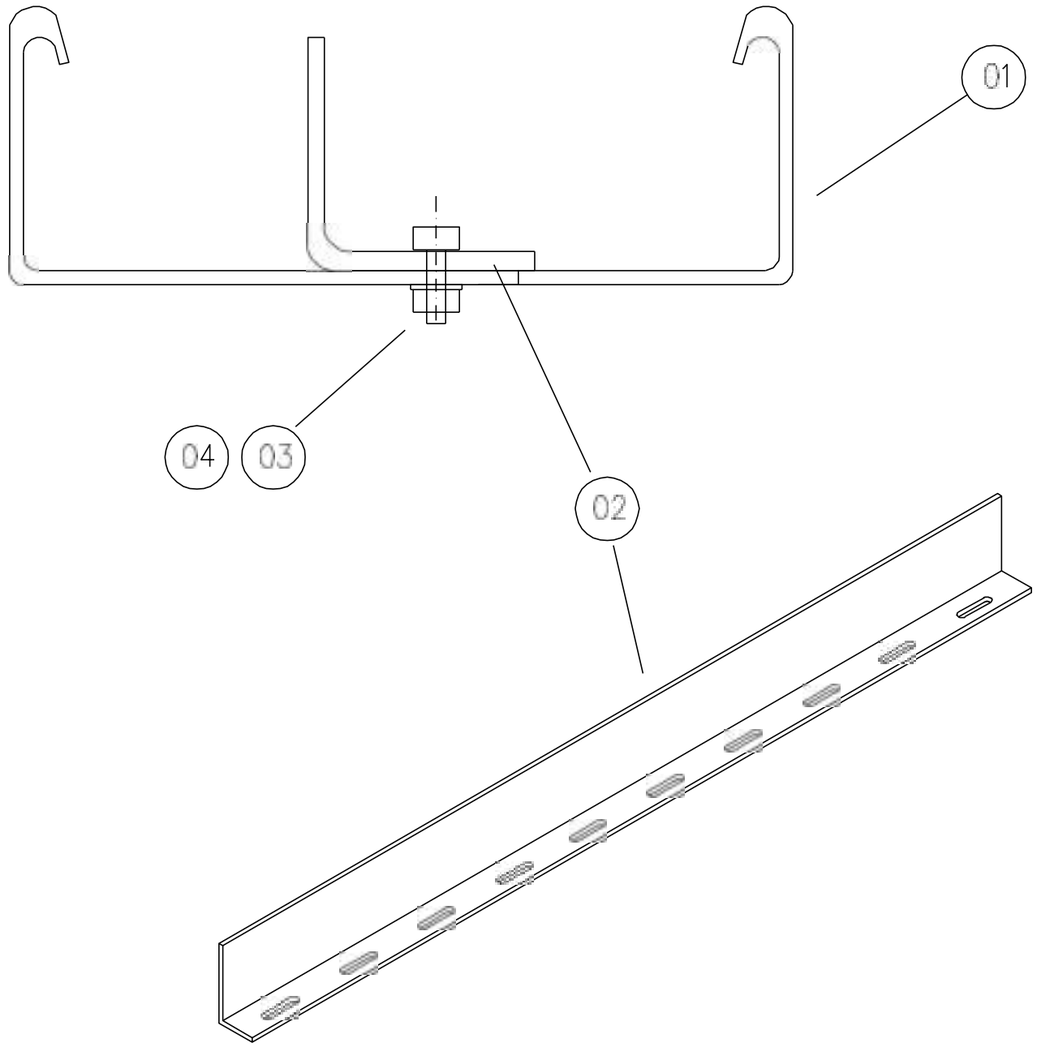
SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
TIGHTENING TORQUES

Size A3 | Scale NTS | Sheet 48 of 62

Drawing No. GGNG-E-20714-3010 | Rev. 0

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CABLE TRAY	W=100mm / H=50mm

04	NUT M6 WITH STOP BASE
03	SCREW M6x16
02	SEPARATOR
01	CABLE LADDER

SEPARATOR FOR CABLE TRAY

NOTES

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E	DESIGNATION	

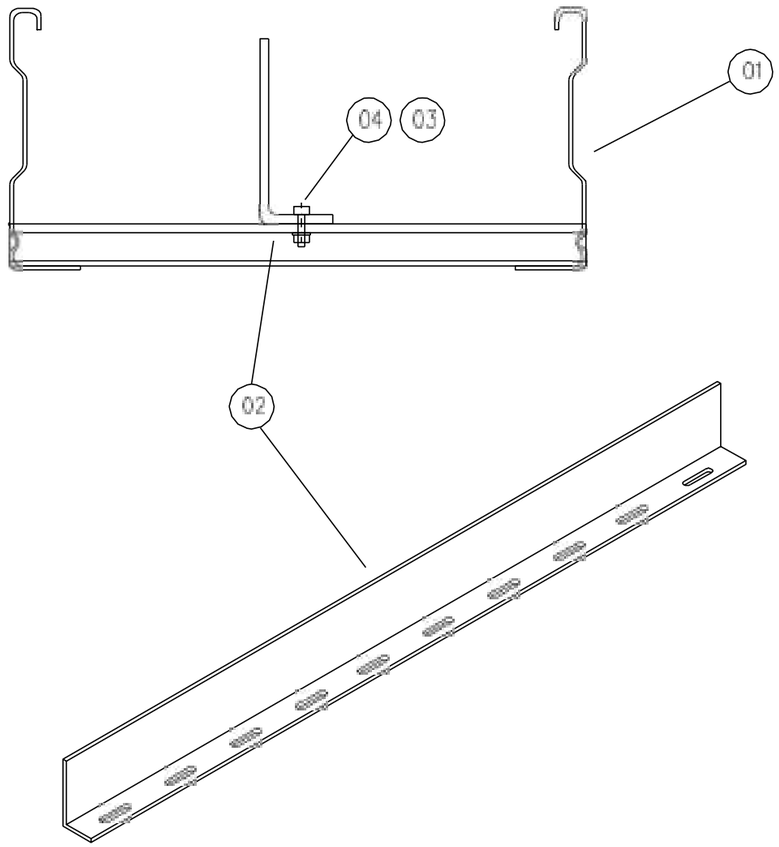
SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
SEPARATOR FOR CABLE TRAY

Size	Scale	Sheet
A3	NTS	49 of 62

Drawing No. GGNG-E-20714-3010 Rev. 0

0	07.10.16	APPROVED	RKS	PR	KJ	SKH

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CABLES LADDER	W=300mm / H=100mm
CABLES LADDER	W=600mm / H=100mm

	DESIGNATION
04	NUT M6 WITH STOP BASE
03	SCREW M6x16
02	SEPARATOR H 68mm
01	CABLE LADDER H 100mm

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CABLES LADDER SEPARATOR

SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLES LADDER SEPARATOR

Size	Scale	Sheet
A3	NTS	50 of 62

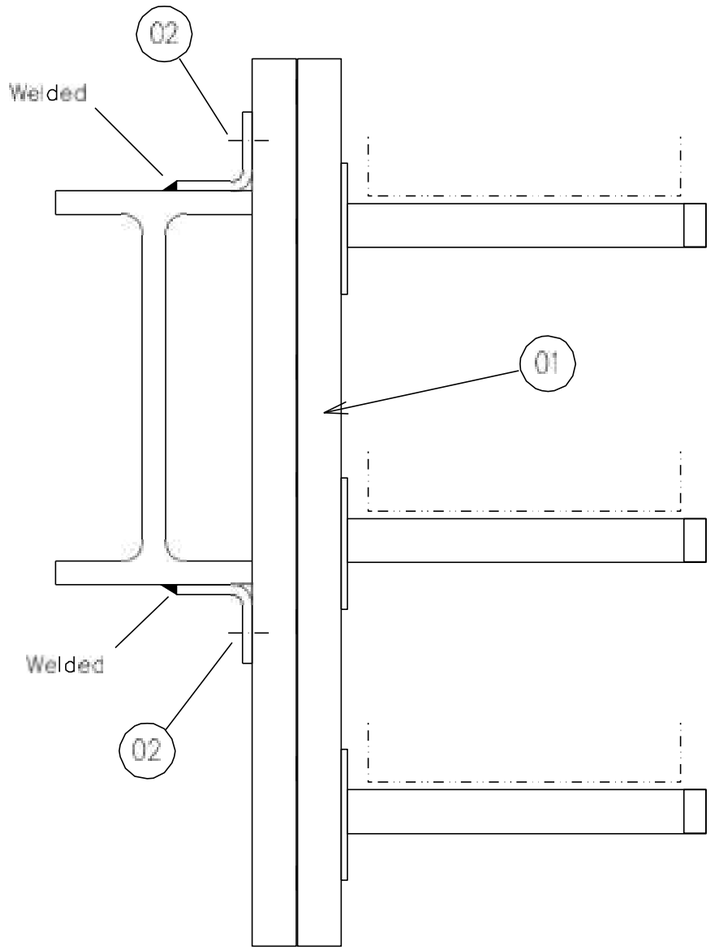
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0	07.10.16	APPROVED	RKS	PR	KJ SKH

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1 2 3 4

A B C D



NOTES

02	BOLT M10x30
01	DOUBLE CHANNEL 82x41
	DESIGNATION

SUPPORT TYPE FIXING ON

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GROUND AND CEILING

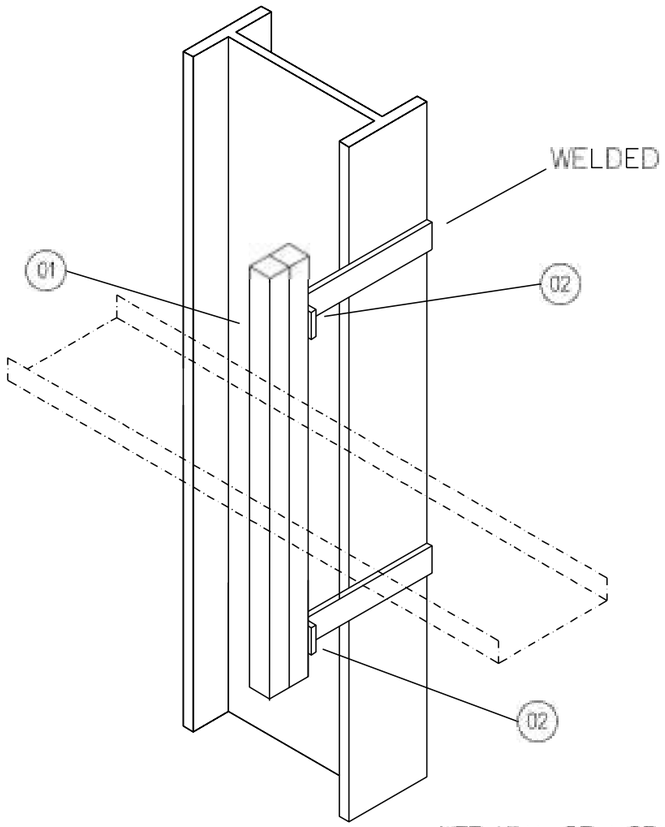
SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
SUPPORT TYPE FIXING ON GROUND AND CEILING

Size	Scale	Sheet
A3	NTS	51 of 62

Drawing No. GGNG-E-20714-3010 Rev. 0

0	07.10.16	APPROVED	RKS	PR	KJ	SKH

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VERTICAL OR HORIZONTAL MOUNTING
ACCORDING TO DRAWING.

NOTES

02	BOLT M10x30
01	DOUBLE CHANEL 82x41
	DESIGNATION

SUPPORT TYPE FIXING ON GROUND AND CEILING

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SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
SUPPORT TYPE FIXING ON GROUND AND CEILING

Size A3 | Scale NTS | Sheet 52 of 62

Drawing No. GGNG-E-20714-3010 | Rev. 0

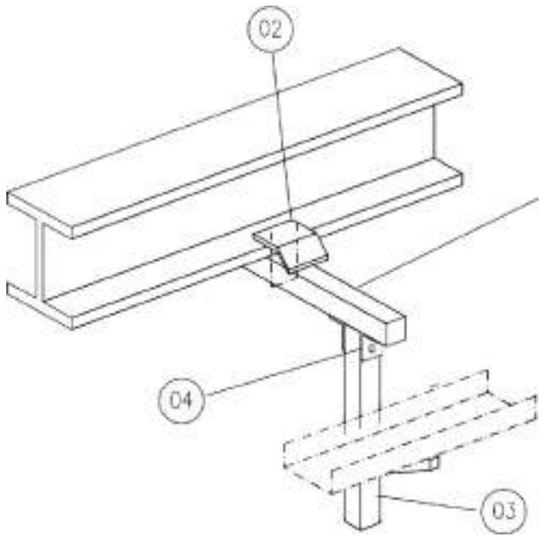
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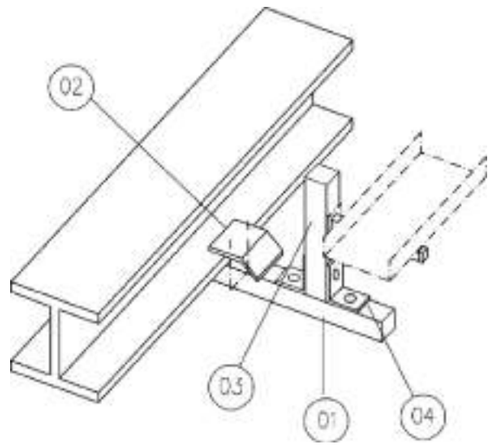
2 3 4

NOTES

A



B



C

0	TWO HOLE CORNER ANGLE	
®	SIMPLE CHANNEL U 41x4'	
®	B AM CLA□PS FO U 41x41	SUPPLIED WITH 1 U OU
®	SIMPLE CH ANNEL U 41x4'	
	DESIGNATION	REMARKS

D

SUPPORT TYPE
MOUNTING UNDER BEAM

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E

SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
SUPPORT TYPE MOUNTING UNDER BEAM

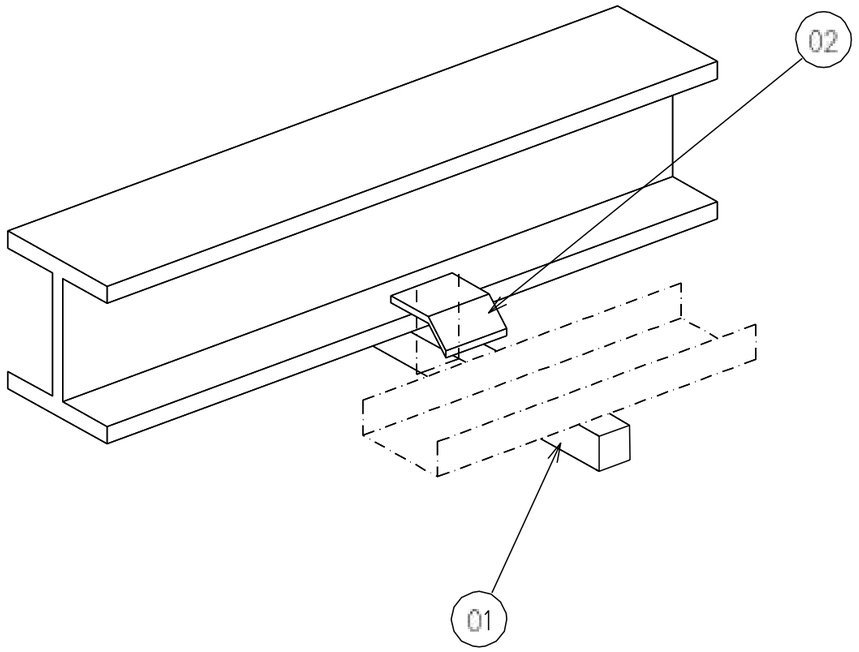
IRACTEBEL

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Size	Scale	Sheet
A3	NTS	53 of 62

Drawing No. GGNG-E-20714-3010 Rev. 0

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VERTICAL OR HORIZONTAL MOUNTING
ACCORDING TO DRAWING.

02	BEAM CLAMPS FOR U 41x41	SUPPLIED WITH 1 U BOLT
01	SIMPLE CHANNEL U 41x41	
	DESIGNATION	REMARKS

SUPPORT TYPE MOUNTING ON BEAM

NOTES

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SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
SUPPORT TYPE MOUNTING ON BEAM

Size	Scale	Sheet
A3	NTS	54 of 62

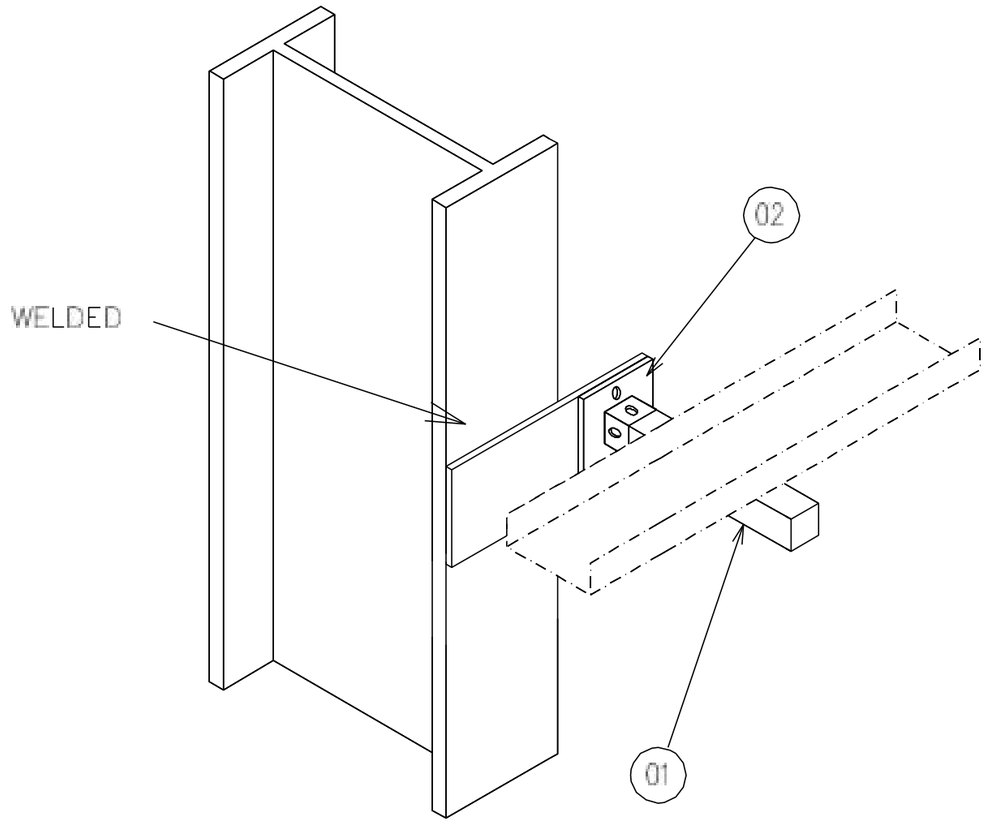
Drawing No. GGNG-E-20714-3010 Rev. 0

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1 2 3 4

A B C D



VERTICAL OR HORIZONTAL MOUNTING
ACCORDING TO DRAWING.

02	HEAD POST BASE	WELDED
01	SINGLE CHANNEL U 41x41	
	DESIGNATION	

NOTES

SUPPORT TYPE

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MOUNTING ON BEAM

SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
SUPPORT TYPE MOUNTING ON BEAM

Size	Scale	Sheet
A3	NTS	55 of 62

Drawing No. GGNG-E-20714-3010 Rev. 0

0	07.10.16	APPROVED	RKS	PR	KJ SKH

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2 | 3 | 4

NOTES

A

B

C

D

I/

VERTICAL OR HORIZONTAL MOuNTING
ACCORDING TO DRAW NG.

@	BOLT M10x30
®	DOLBLE CHANEL 82x41
	DESIGNATION

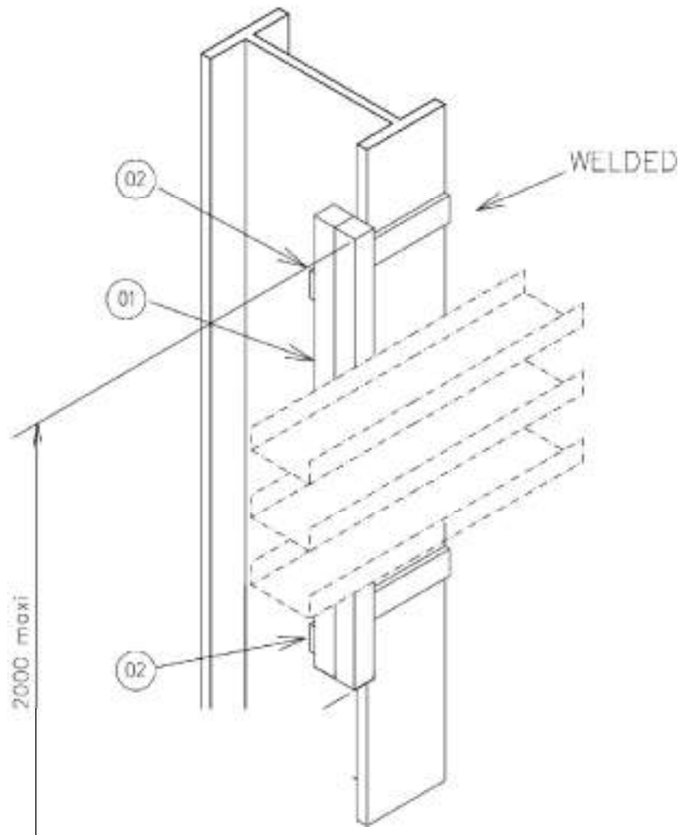
SUPPORT TYPE FIXING ON GROUND AND CEILING

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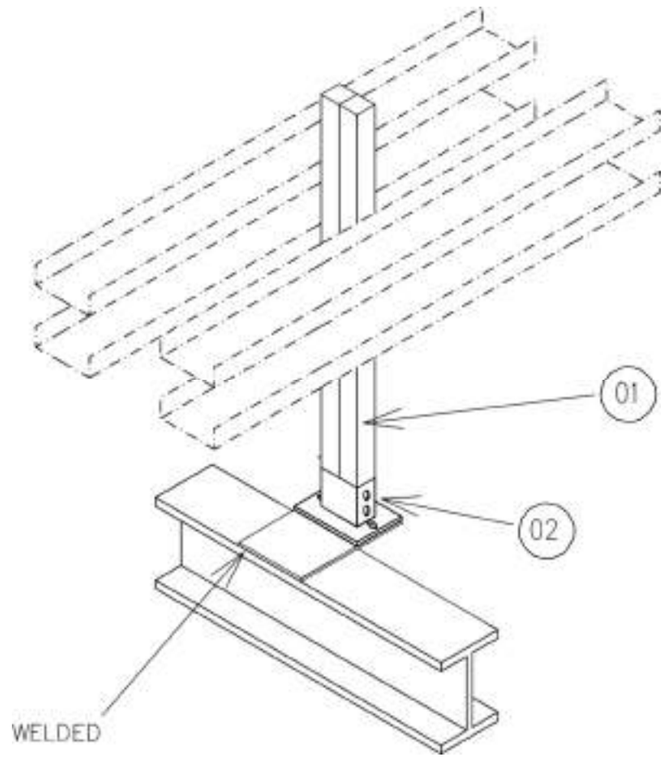


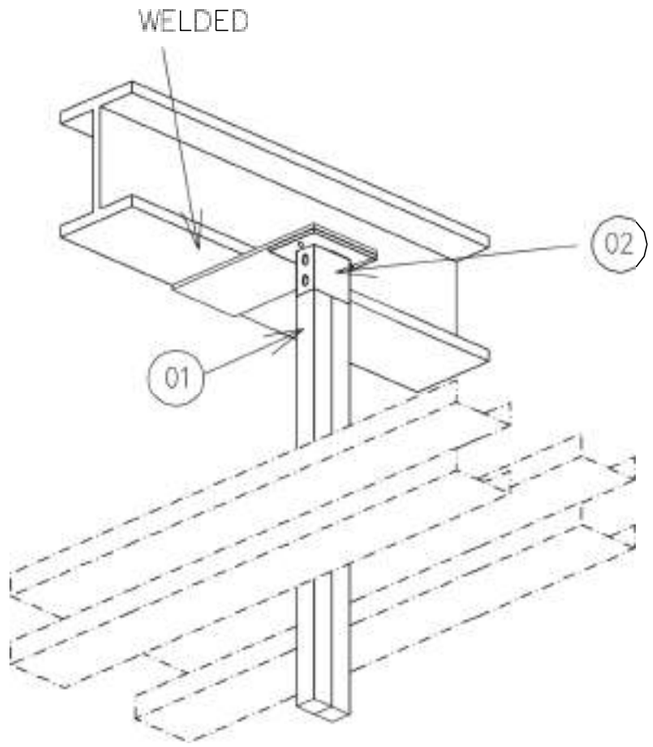
SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
SUPPORT TYPE FIXING ON GROUND AND CEILING

IRACTEBE I- Size A3 1 Scale NTS Sheet 56 of 62

C!!NGle Drawing No. GGNG-E-20714-3010 Rev. 0

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02	DOUBLE HEAD POST BASE	BOLTED
01	DOUBLE CHANNEL U 82x41	
	DESIGNATION	

SUPPORT TYPE FIXING ON GROUND AND CEILING

NOTES

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SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
SUPPORT TYPE FIXING ON GROUND AND CEILING

Size A3 | Scale NTS | Sheet 57 of 62

Drawing No. GGNG-E-20714-3010 | Rev. 0

0	07.10.16	APPROVED	RKS	PR	KJ	SKH

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1 | 2 | 3 | 4

NOTES

A

B

C

D

02

®	DOUBLE HEAD POST BAS BOL ID
®	DOUBLE CHANNEL L 82x4'
	ESIGNATION

SUPPORT TYPE 65 FIXING ON GROUND AND CEILING

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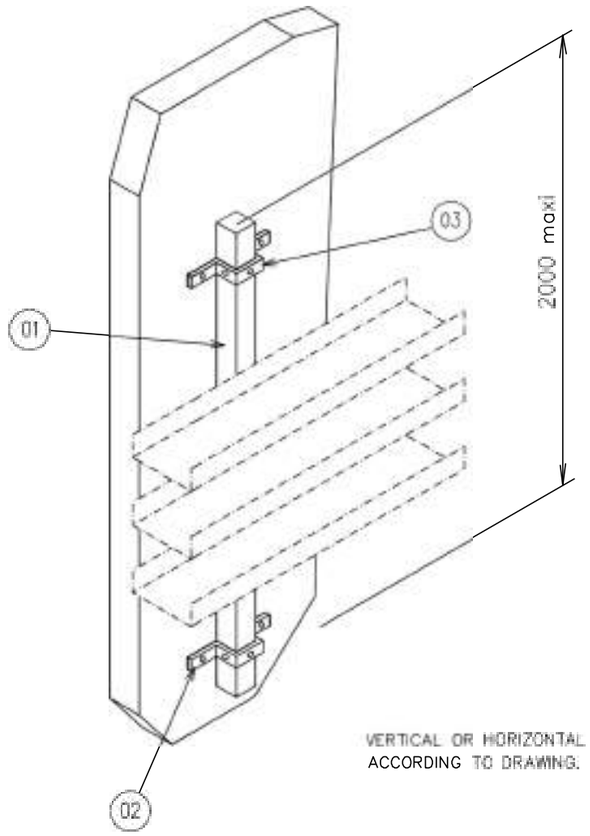
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SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
SUPPORT TYPE 65 FIXING ON GROUND AND CEILING

lRACTEBEL | Size A3 | Scale NTS | Sheet 58 of 62

C!!NGle | Drawing No. GGNG-E-20714-3010 | Rev. 0

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VERTICAL OR HORIZONTAL MOUNTING
ACCORDING TO DRAWING.

NOTES

03	OMEGA SHAPE FITTING FOR U 42 x41
02	EXPANSION STUD ANCHOR
01	SINGLE CHANNEL U 41x41
	DESIGNATION

SUPPORT TYPE FIXING ON SINGLE CHANNEL U 41x41 ON CONCRETE

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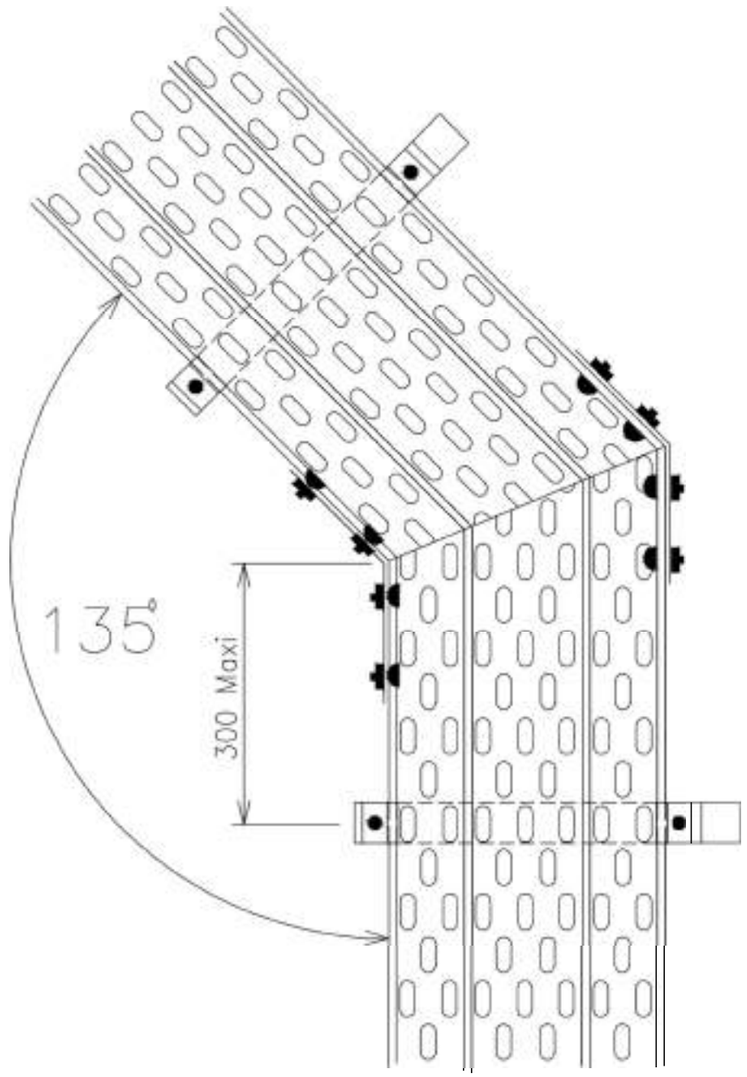
SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
SUPPORT TYPE FIXING ON SINGLE CHANNEL U41x41 ON CONCRETE

Size	Scale	Sheet
A3	NTS	59 of 62

Drawing No. GGNG-E-20714-3010 Rev. 0

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CABLE TRAYS 135° ANGLE

NOTES

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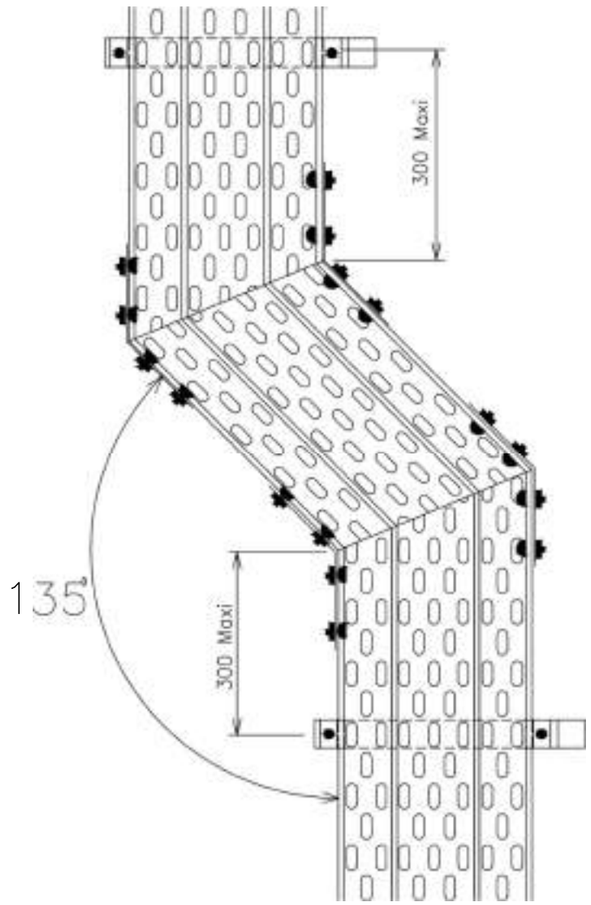
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SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRAYS 135 ANGLE

Size	Scale	Sheet
A3	NTS	60 of 62

Drawing No. GGNG-E-20714-3010 Rev. 0

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CABLE TRAYS 135° ANGLE

NOTES

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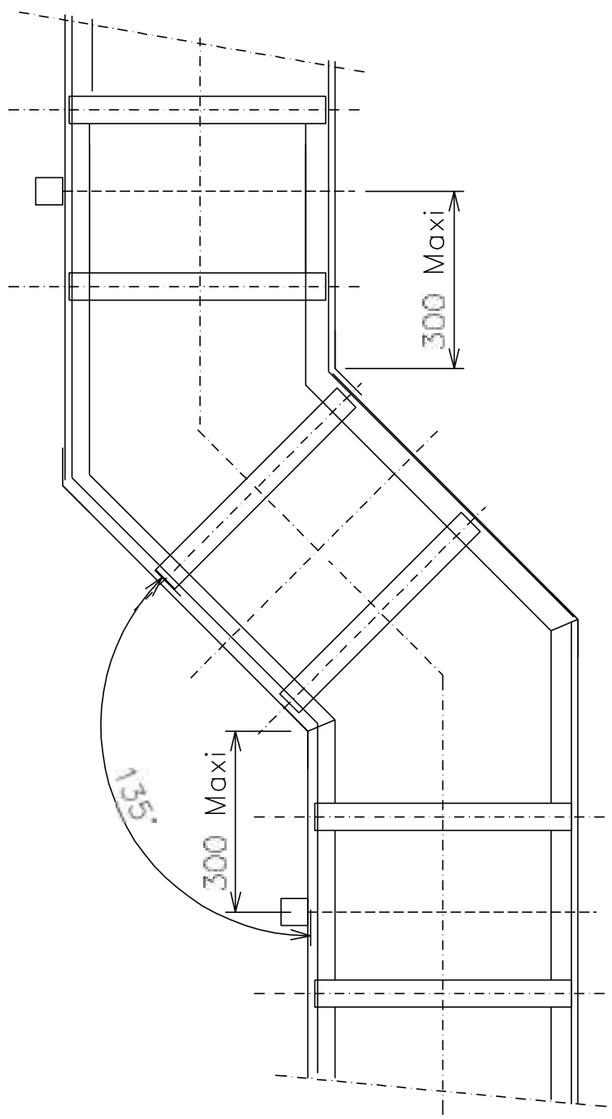
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SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE TRAYS 135 ANGLE

Size	Scale	Sheet
A3	NTS	61 of 62

Drawing No. GGNG-E-20714-3010 Rev. 0

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CABLE LADDER 135° ANGLE

NOTES

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SUBJECT TYPICAL CABLE TRAY INSTALLATION DETAILS
CABLE LADDER 135 ANGLE

Size	Scale	Sheet
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TYPICAL EARTHING INSTALLATION DETAILS

NOTES

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SUBJECT TYPICAL EARTHING INSTALLATION DETAILS

TRACTEBEL ENGIE

Size A3 | Scale NTS | Sheet 01 of 23

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Bhagyanagar Gas Limited

!GENERAi NOTEsl

NOTES

1. ALL DIMENSIONS ARE GIVEN IN MM.(LJNLESS on- W SE SPECIFIED).
2. ALL GROLNOING CONOUC I ORS SLRROLNOING THE BUILDINGS SHALL BE LOCATED ABOU I 1.'.JM(1 '.JOOMM) f-ROM WALLS, COLUMN PEDES-IALS AND FI CIS.
3. ALL JOINTS LNDERGROUND SHALL BE PROTECTED AGA NST CORROSION BY OEI\SO TAPE(OR EQUIVALENT).
4. TIGHII_NING rQRQLIS A E GIVc.I\ IN THE f-CLLOWNG I'ABLE:

Tigrtening torques (in rr.kg)

Dicrreter of screw	Class 5.8 stee screw
M 10	2.86
M 12	4.94
M 14	7.8
M 16	11.83
M 20	26

'.J. METALLIC FEI\CES AROuND TRANSFORMER AREA AI\D LONG METALLIC OBJECTS SHALL EE CONNECTED TO THE GROUNDING SYSTEM IN AT LEAST TWO INTERVALS NOT EXCEEDING 50 METERS.

PLAST C COVERE CHAIN LINK FEI\CES SHALL EE CONSIDERED IN THE SAf./E WAY AS BARE METALLIC FEI\CES, SO THAT SUPPORT POSTS, STAYS AI'\O ANT-CLIMBING FITTINGS SHALL BE BAI\OED ACCCRDING TO ABOVE TWO METHODS.

6. vc PIPES SHALL BE SET IN CONCRETE CASING uNLESS on-ERW SE SPECIFIED.
7. PVC PIPES ARE HEAVY DUTY TYPE.
8. ALL ARC WELDS SHALL EE ROTECTED AGAINST CORROSION.
9. ELECTRICAL EQLIPMENT LIKE MV/LV SWITCHGEAR, OB, CONTROL PAI\EL WILL BE EARTHED TO THE EARTHING CONOLCTOR RLNNING ALONG THE EDGE OF THE NEARBY CABLE TRAY, WHETHER AVAILABLE.
10. ALL NON CLRRENT CARRY NG METAL C EQUIPM NT SUCH AS TANKS, M TAL STRLCTuRE SUCH HAS HAI\D RA L, STRUCTURAL COLUMNS SHALL E GROUNDED WITH MIN ON GROUND CONDUCTOR. AND TWO NUMBERS IN CASE LOCATED IN HAZARDOLS AREA
11. A IESI LINK SHALL EE PROVICEL; IN EACH EARI H Fir.
12. IARIh PIT f-OR LIGHINING PROI CI ON OOWI\ CONOUCIOR SHALL BE SEPARATE OOWI\ CONOUCIORS f-ROM LIGHINING ARRISIOR 10 c.ARIH FIT SHALL BE RUN BY SHOR I c.SI ROUII Lc.I\G Ir.
13. AL ILICI RICAL EQLIPMENT WI-iH J-PHASE '.,:;UPPLY EG. SWIICHGEAR, POWER ANO MO I OR CONI ROL CEN-1c.RS, INVERTER PAI\IL, POWER LIGHTING D , MOTOR WELDING RECEPTACLES. ETC SHALL BE GROUNCED BY TWO SEPARATE GROUND CONNECTONS.
14. NEUTRAL POINT OF TRAI\SFORMER SECONDARY SHALL BE GROUNDED wm- TWO SEPARATE AI\O DISTNCT EARTH Fil TRAI\SFORMER BODY SHALL BE GROUNDED BY TWO SEPARATE AND OIAGONALLY OPPOSITE CONNECTIONS TO MAIN GROUND GRID.
15. STATC G OUNC CONNECTIONS SHALL BE MADE AC OSS FLANGED JOINTS OF PIPELINES IDENTFIED FOR STATC CHARGE IN ALL AREAS.
16. DCS/PLC GROLND ELS BAR SHALL BE CONNECTED TC DCS GROUNCING ELECTRODE BY TWO SEPARATE PVC INSULATED COPPER CONDUCTORS.
17. ALL FLAME PROOF ELECTRICAL EQUIPMENT INCLUDING LIGHTING FIXTURES AI\D LSH BUTTON STATION SHALL EE GROUNDED AT TWO POINTS.

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SUBJECT TYPICAL EARTHING INSTALLATION DETAILS

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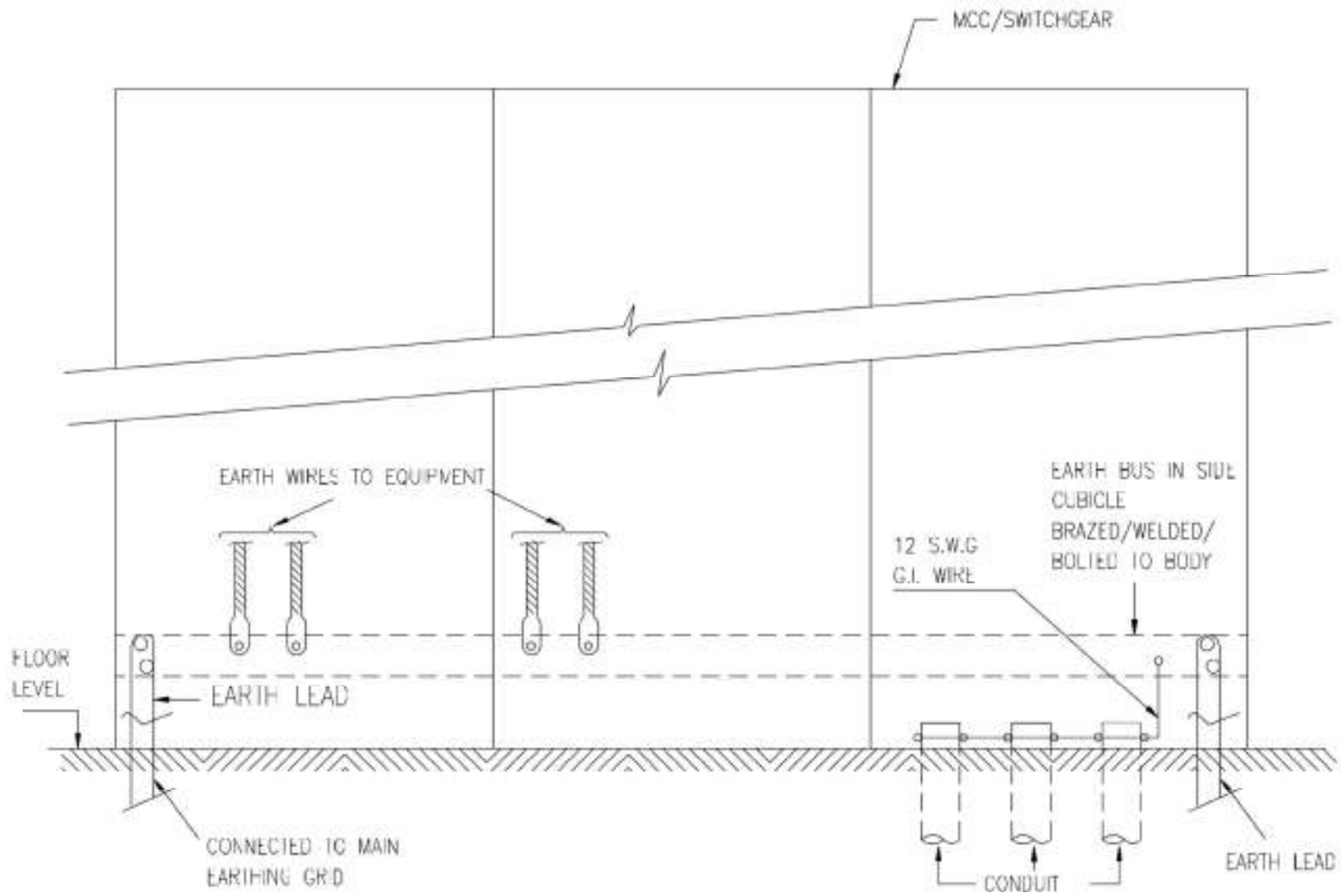
Size A3 Scale NTS Sheet 02 of 213

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ELEVATION

NOTES

NOTES

1. CONNECTION BETWEEN EARTH BUS IN MCC/SWITCHGEAR AND EARTH LEAD SHALL BE WITH MINIMUM TWO BOLTS.

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SUBJECT TYPICAL EARTHING INSTALLATION DETAILS M.C.C. & METAL CLAD SWITCHGEAR

TRACTEBEL ENGIE

Size A3 | Scale NTS | Sheet 03 of 23

Drawing No. | Rev.

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1 2 3 4

A

B

C

D

CONCRETE INSPECTION PIT PLACED INTC 12:i

CASI IRON COVI:_R HINGI:_D
IO CASI IR O\I_FRAME

PO ITIOI\ A TE INSTALLATION O EA TI-- ----------+----------
ELECTRODE AND EART CONDUCTOR
CONNECTIONS HAVE B EN MADE & TESTED

GALVANISED SI I:_I:_L IARIH
SIRAP WILDIO IC PIPI (SEE DI IAIL 'B')

100 DIA. PVC

IMBIDDID CONDUCTOR

(01\ 2 SID S)

REMOVABLE CAP

(SEE DI IAIL 'A'\\

75'

14 DIA. HOLI

1:i.8219

EARTH CONDUCTOR

GALVANISED SI I:_I:_L FLAI
SHAPED TO FIT

300

DETAIL 'B'

ELEVAT ON

12 DIA. HOLIS (TYP)

25,5109

PLAN

r6MS FILLET WI:.LD

LEGEND

Ci) 1oomm DIAMETER MEDIUM DUTY GALVANISED STEEL PIPE (CLASS '8')

®GALVANISEC MS FLAT (DETAIL "8')

0)coNCRtIt INSPtCIION <.:OVtR

0 90x50x6 GALVANISED MS ANGLE (DETAIL 'A')

® 1Jax· JOx6 GALVANISED MS PLATE (DETAIL 'A'

NOTES

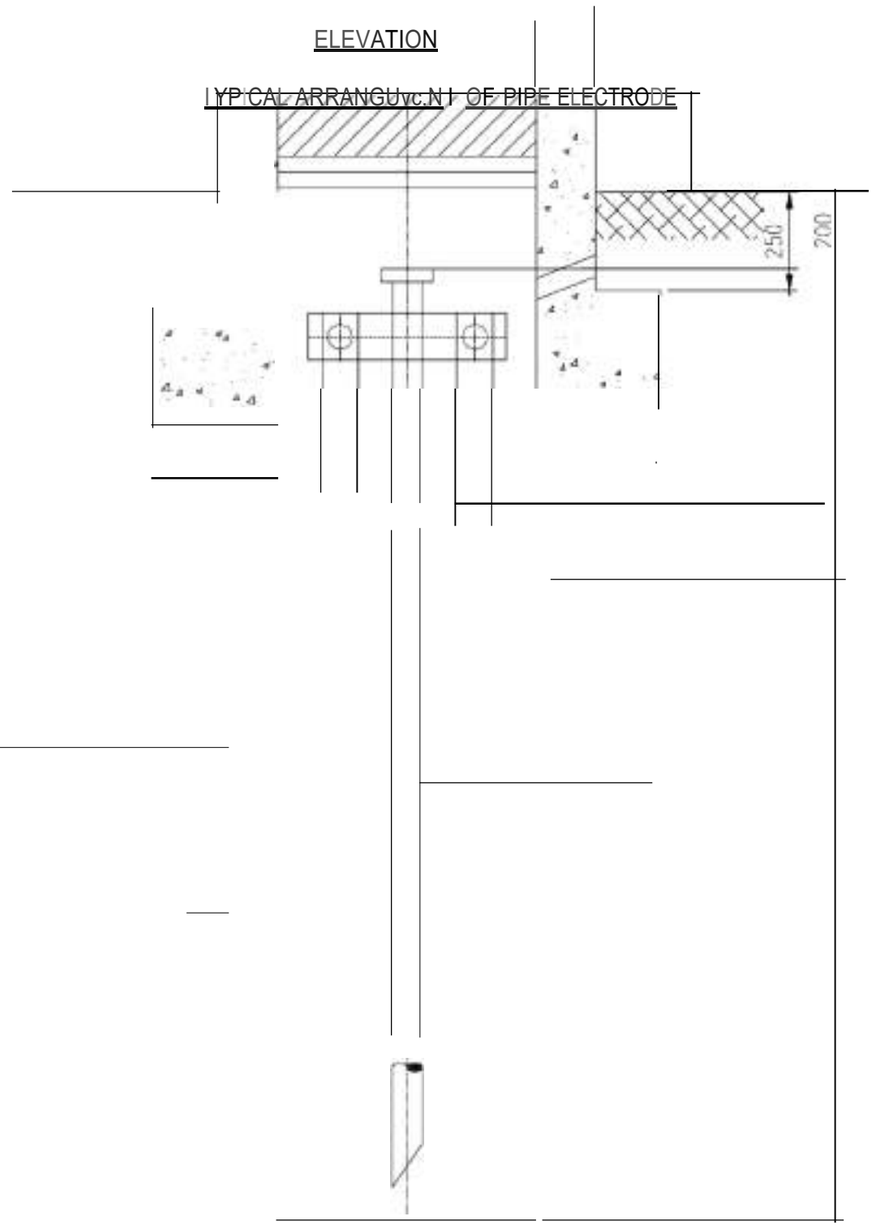
1. ALL DIMENSION AREA IN MILLIMETER (mm).
2. ALL STEEL WORK SHALL BE HOT DIP GALVANISED.
3. INSPECTION PITS SHALL BE INSTALLEDFIASH WITH SURROUNDING GRADE WITHIN PAVED AREAS.
4. UNLESS OTHERWISE SPECIFIED, ALL THE MATERIALS ARE IN CONTRACTORS SCOPE OF SUPPLY.

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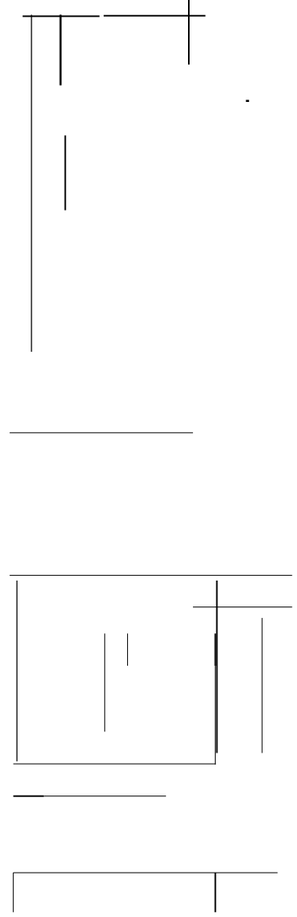
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TYPICAL ARRANGEMENT OF PIPE ELECTRODE



112.7555 r,0

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SUBJECT TYPICAL EARTHING INSTALLATION DETAILS

PIPE/ROD ELECTRODE

IRACTEBEL

Size A3 | Scale NTS | Sheet 04 of 23

Drawing No. GGNG-E-20715-0812 | Rev. 0

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2 3 4

NOTES

1. NUIS AND BOLiS SHALL Bl:. AS f't:.f< IS; 1363(PART- 1,2,3):1992/ IS 1367(PART-5):1980.
2. WASHE S SHALL B AS PER IS 2016;196/.

A

MOTOR FRAME

EARTf-ING PAD
LOCK WASHER
BOLT OR TAPERED STUD & NUT

EARTH LEAD

MOTOR FRAME

WELDED/BRAZE

I:.AR IHING PAD
LUG
LOCK WASHER
BOLT OR TAPERED STUD & NUT

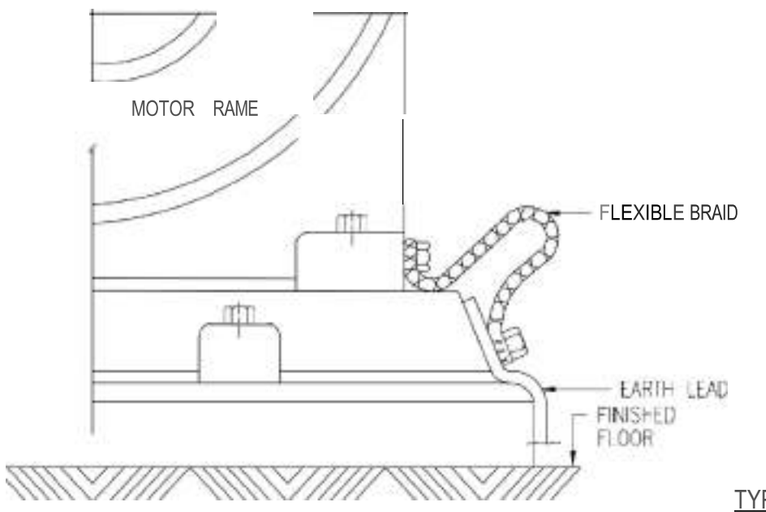
STRANDED CONDUCIOR

B

TYPE I CONNICIION FOR rLAr CONL":LCIOR

TYPE II CONNECTON FO STRAN ED CON uCTOR

C



MOTOR FRAME

D

SOLID CONDUCTOR

FINISHED LOOR

TYPE]I CONN C110N rOR FLAT/STRAND ll CONDUCI OR FOR MOTORS IN SLIDING BASE

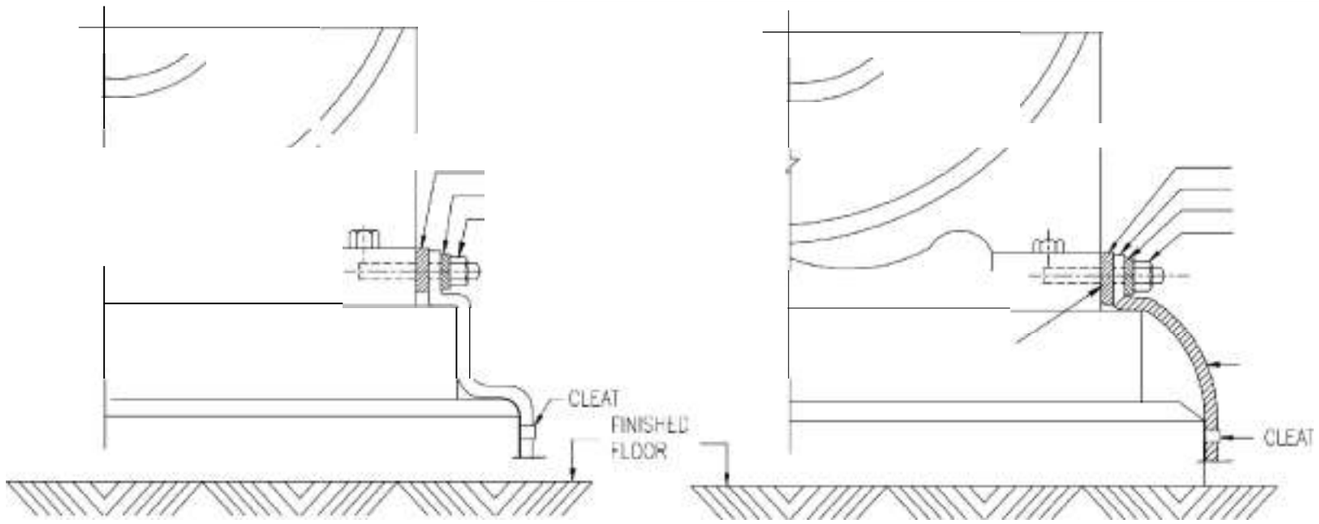
TYPE IV CCNN CI ION FOR SMALL MOTO S WHEN STRANO D CONOUCTO S IS NOT AVA ABLE

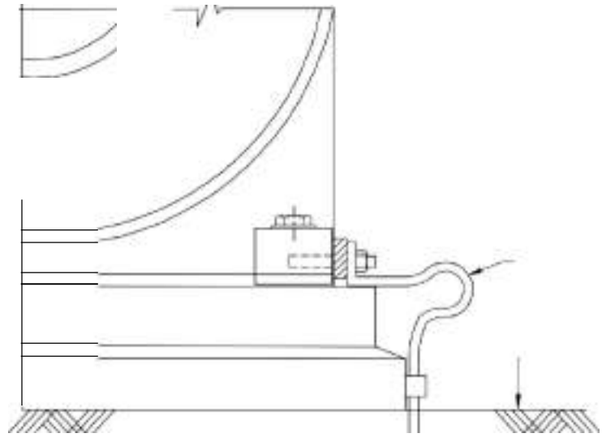
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SUBJECT
TYPICAL EARTHING INSTALLATION DETAILS
MOTOR FRAME EARTHING

IRACTEBEL C!!NGIe

Size	Scale	Sheet	Rev.
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1 2 3 4

A

B

C

D

/PIPt.

DETAIL-'c'

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. THE PIPI:. LINI:.S SHALL 61:. 60NDI:.D AND 1:.AR rHI:.D AT THE ENTRY AND EXIT POINTS OF BAITERY LIMIT UNLESS OTHERWISE SPECIFIED.
3. NUTS/BOLTS SHALL BE AS PER IS 1363(PART-1,2,3):1992/ IS 1367(PART5):1980.
4. WASHERS SHALL BE AS PER IS 2016:1967.

□LEXIBLE CONNECTION

SEE DETAIL-'B' @/FOR LUG

G.L.

G.L.

/MAI EARTr STR P

SIDE VIEW

WELD

FRONT VIEW

G,I. LUG

25mm² FLEXIBLE

10¢ G.I. BOLT. NUI & WASHERS.

COPPER CABLE

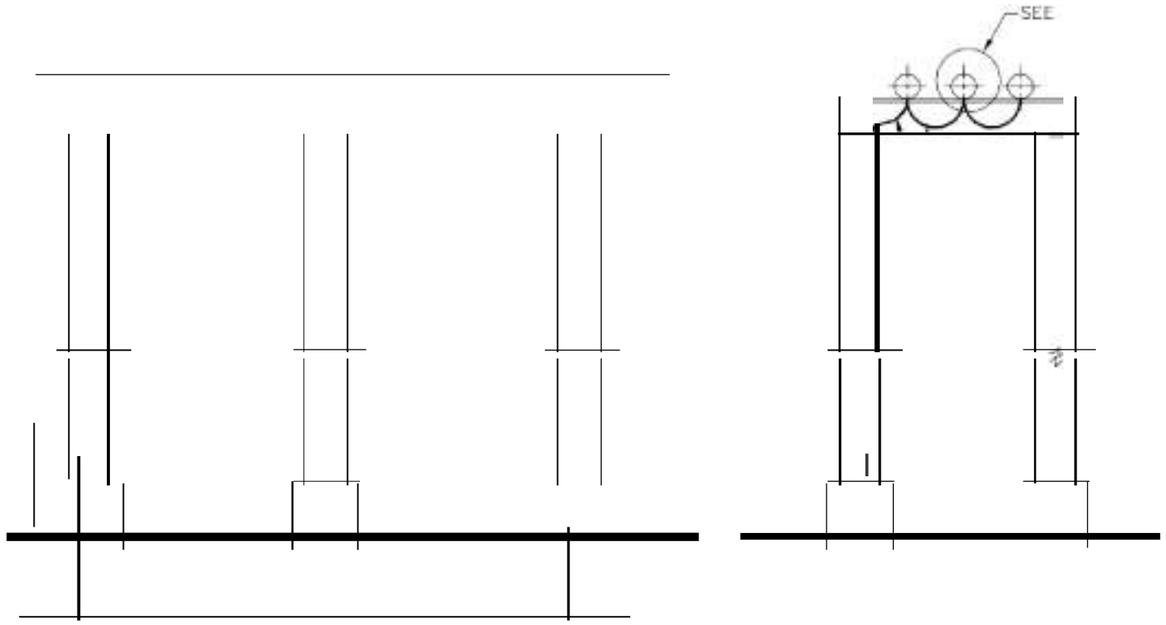
DETAIL - 'C'

DEML - 'A'

Dt.IAIL - 'B'

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SUBJECT TYPICAL EARTHING INSTALLATION DETAILS
EARTHING OF PIPES ON RACK

IRACTEBEL
C!!NGle

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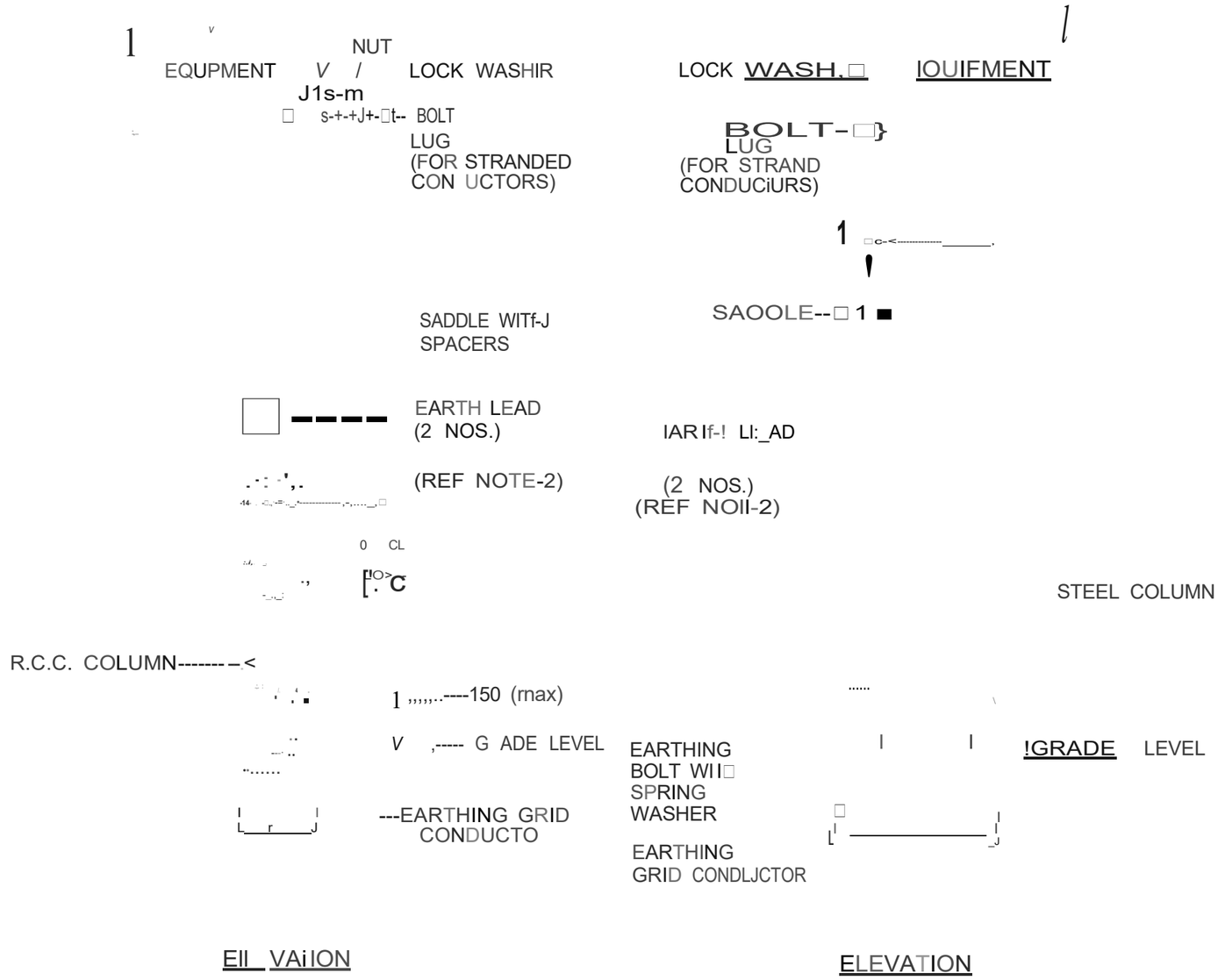
B

C

D

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. 11-IE EARTI-1LEADS FOR THE SAME EQUIPMENT SHALL BE LAID ON TWO DIFFERENT COLUMNS, HOWEVER, IF THE EQUIPMENT IS SUPPORTED ON ONLY ONE COLUMN THE LEADS TO BE RUN ON OPPOSITE FACES OF THE SAME.
3. IF FLAT CONDUCTOR IS USED THE SAME TO BE SUITABLY DRILLED FOR CONNECTION TO THE EQUIPMENT EARTHING TERMINAL STUD.
4. THE CONDUCTOR CAN ALTERNATIVELY BE WELDED TO STEEL STRUCTURE AT 1000MM INTERVAL.
5. THE CONNECTION BETWEEN CONDUCTOR AND LUG SHALL BE CRIMPED TYPE,
6. NUTS AND BOLTS SHALL BE AS PER IS: 1J63(PART-1,2.3):1992/ IS 1367(PART-5):1980.
7. WASHERS SHALL BE AS PER IS 2016:1967.



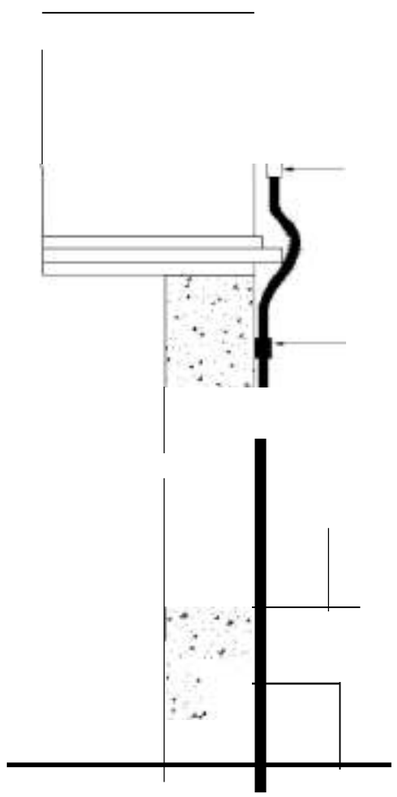
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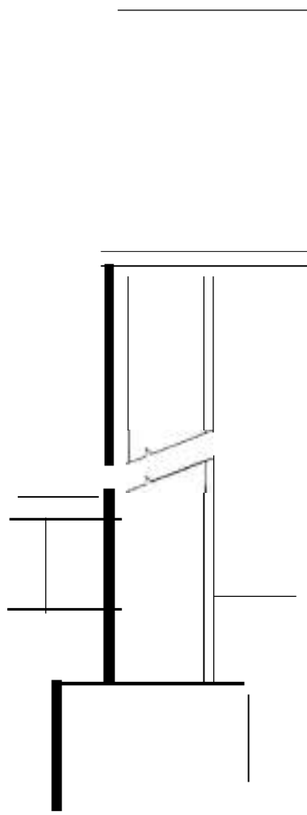
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SUBJECT TYPICAL EARTHING INSTALLATION DETAILS
EQUIPMENT ON R C C / STEEL COLUMN

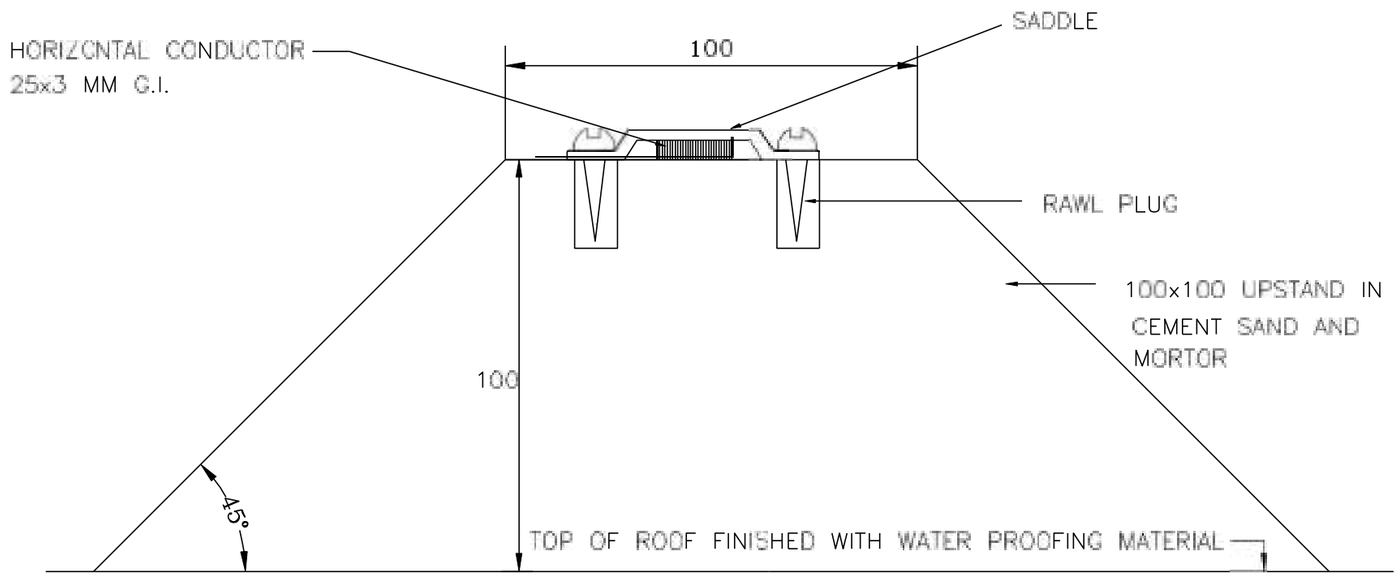
IRACTEBEL .... C!!NGle

Size	Scale	Sheet
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TYPICAL DETAILS OF CLEATING HORIZONTAL CONDUCTOR

OVER WATER PROOFING

NOTES

1. ALL DIMENSIONS ARE IN MM.

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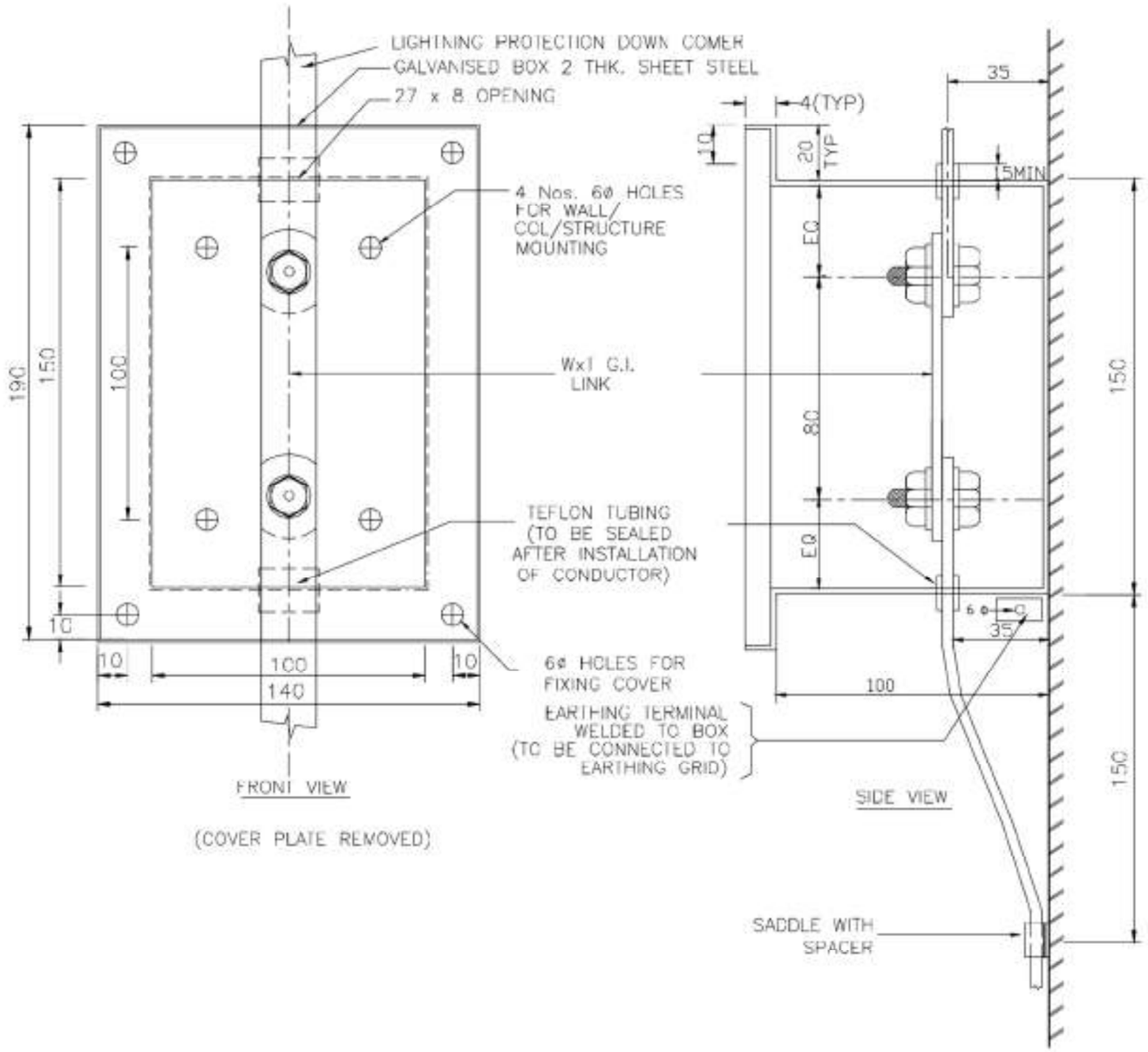
SUBJECT TYPICAL EARTHING INSTALLATION DETAILS
CLEATING EARTHING / LIGHTNING CONDUCTOR

Size	Scale	Sheet
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NOTES

1. ALL DIMENSIONS ARE IN MM.
2. THE DOWN COMER ENTRY AND EXIT POINTS IN THE BOX TO BE MADE WATER TIGHT AFTER LAYING OF CONDUCTOR.
3. THE TEST LINK SHALL BE OF SAME WIDTH AND THICKNESS AS THE DOWN COMER. THE NUTS BOLTS AND WASHERS TO BE OF G.I.
4. NUTS AND BOLTS SHALL BE AS PER IS: 1363(PART-1,2,3):1992/ IS 1367(PART-5):1980.
5. WASHERS SHALL BE AS PER IS 2016:1967.

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SUBJECT: TYPICAL EARTHING INSTALLATION DETAILS
LIGHTNING PROTECTION DOWN COMER TEST LINK

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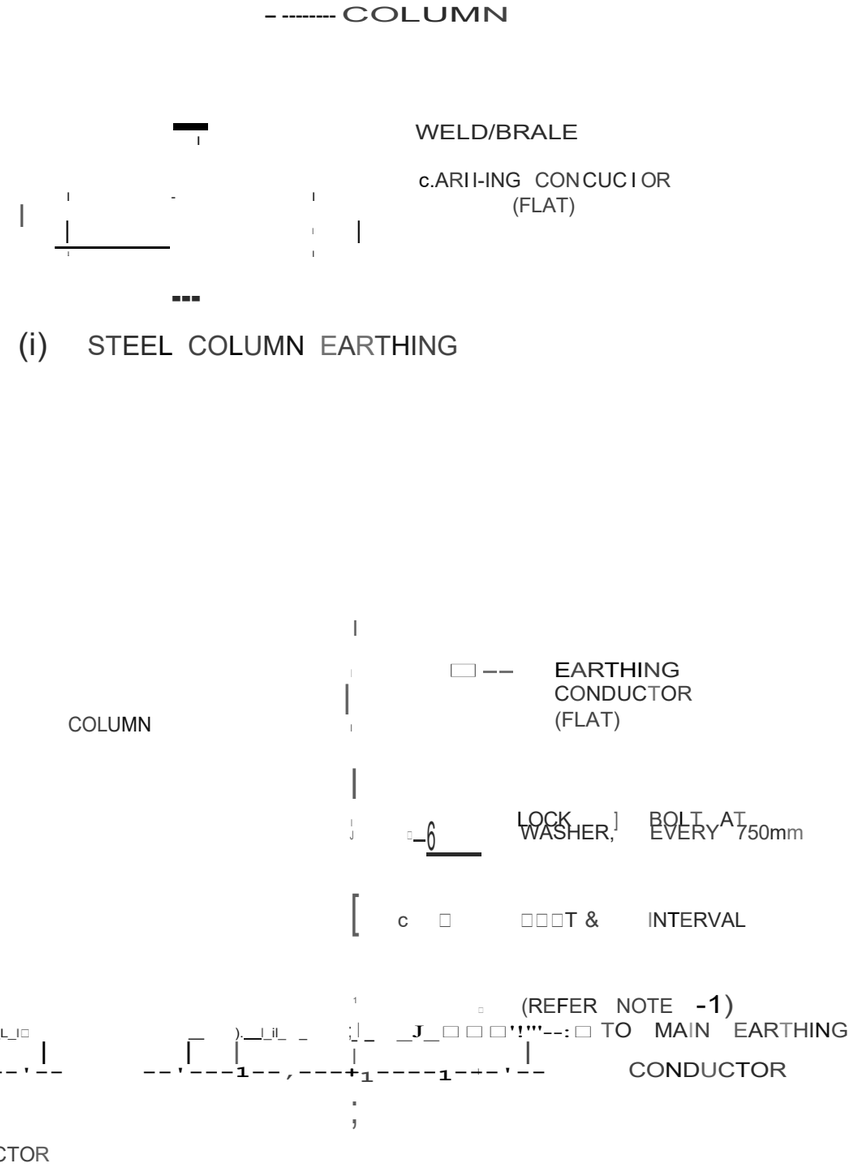
B

C

D

NOTES

1. IT IS PREFERABLE TO HAVE A RUN ON WEB SO TI-1AT PROJECTIONS OF NUT/BOLTS ARE AVOIDED
2. NUTS AND BOLTS SHALL 8£ AS PER IS: I363(PART-1.2,3):7992/ IS 1367(PART-5):1980.
3. WASHERS SHALL BE AS PER IS 2016:1967.

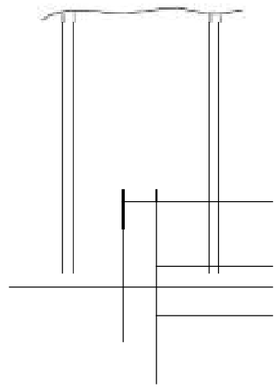


(i) STEEL COLUMN EARTHING

(ii) FLAT EARTHING CONDUCTOR RUNNINGALONG STEEL COLUMN

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TYPICAL EARTHING INSTALLATION DETAILS
EARTHING DETAILS STEEL COLUMNS

IRACTEBEL.. | Size | Scale | Sheet

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2 3 4

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. LUG DIMENSIONS TO SUIT VARIOUS CONDUCTOR SIZES USED.
3. FIELD TO ENCASE BUS IN BOX WHEN IN CORROSIVE ATMOSPHERE.
4. NUTS AND BOLTS SHALL BE AS PER IS: 1363(PART-I ,2,3):1992/ IS 1367(PART-5): 1980.
5. WASHERS SHALL BE AS PER IS 2016:1967.

A

ALUMINIUM BAR HANGING BISBAR 50x10MM THICK LENGTH TO SUIT. (THE CUSTOMER SHALL NOT BE EASILY ACCESSIBLE)

25 65 65 50 50 65 25

B

LUG

PVC INSULATED STRANDED ALUMINIUM CONDUCTOR EARTHING LEAD

MAIN BARE EARTHING CONDUCTOR PVC INSULATED STRANDED ALUMINIUM

C

SPACER OF SMALL PERSPEX BLOCK

SECURE TO STEEL WORK WITH BRACKET OF 50x6MM THICK

WALL MOUNTED EARTHING BUSBAR COLUMN MOUNTED

D

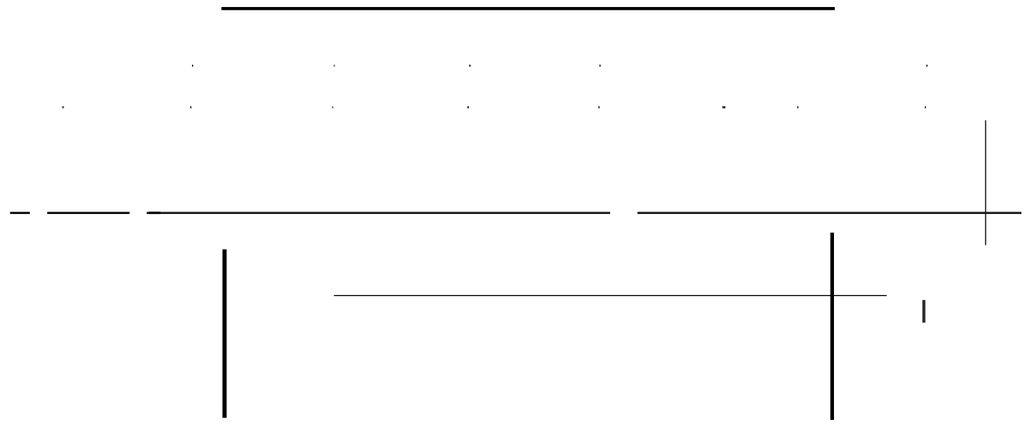
MATERIALS

1. LUGS ALUMINIUM (REFER NOTE # ?)

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2. NU S, OLTS & WASHERS ..... G.I.



E

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SUBJECT TYPICAL EARTHING INSTALLATION DETAILS
BUSBARS WALL/COLUMN MOUNTED

IRACTEBEL

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1 2 3 4

A

B

C

D

ROD & PIT

110 70 45 10

15 130 80

120 HOLt OR
100 OU

BRAZE

MAN EARTHING COI\DUCTOR
COPPER FLAT, W=WDE T=THICK

130 LONG TEST LINK
COPPER LAT
(WxT SAME AS MAIN
EARTHING CONDUCTOR)

1----1----20¢ COPPER ROD

IIOWxISOL COPPE
PLATE BRAZED TO ROD
(TI-ICKt\ESS SAME AS MAIN CON0.)

EARTf- PIT

ELEVATON

OD & PIT

70 90 70

i150

30 101 0 15 15 JO 110 30

MAN tARIHING COf\DUCIOR

oPPtR FLAI

TE BRAZ D

ROD

BRAZE

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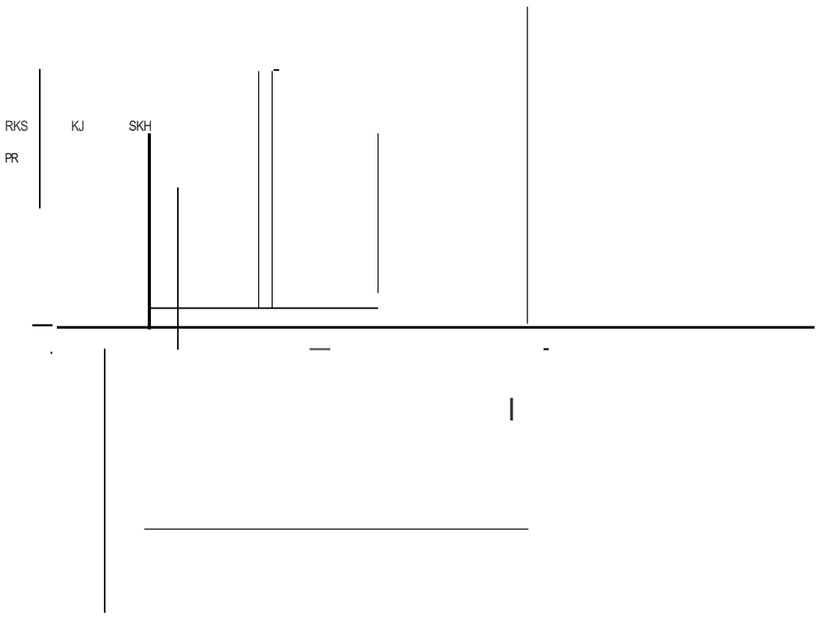
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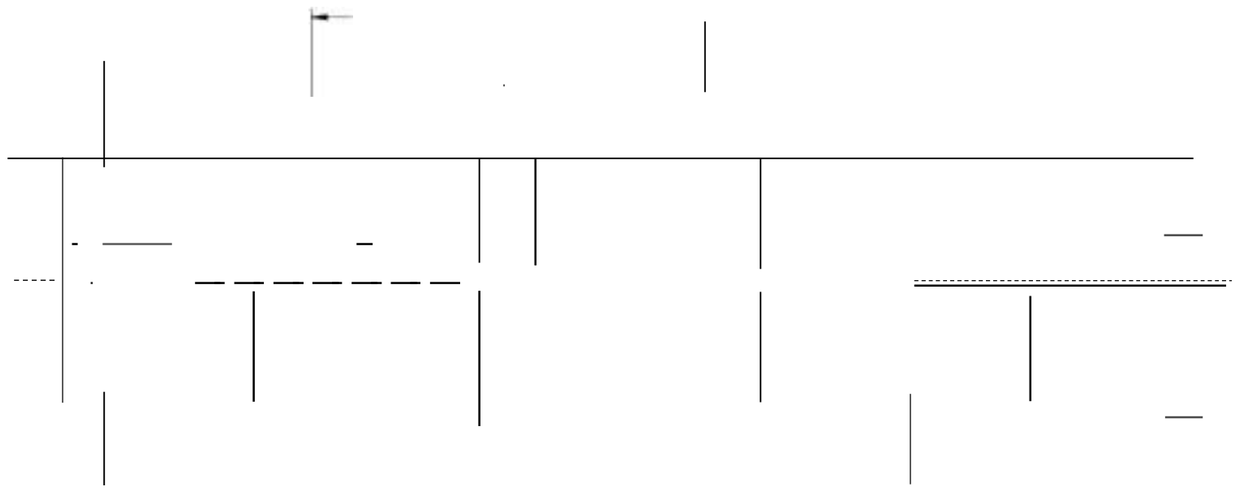
0 13.10.16 APPROVED

RKS KJ SKH

PR

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SUBJECT TYPICAL EARTHING INSTALLATION DETAILS

ROD ELECTRODE CONNECTION DETAILS (FLAT CONDUCTOR)

IRACTEBEL

C!!NGle

Size A3 Scale NTS Sheet 12 of 23

Drawing No. GGNG-E-20715-0812 Rev. 0

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2 | 3 | 4

A

TO TRANSF. NEUTRAL BUSHING

INSULATOR

WELDED

SUITABLE G.I. FLAT (THICKNISS SAME AS EARTHING CONDUCTOR)

B

ALL IARIrING CO DUCTORS TO BI:. OF SAME WIDTH & THICKNESS.

VIEW 'A'

C

NEUTRAL BUSHING

EARTHING TERMINAL OF RADIATOR TANK

EARTHING CONDUCTOR

VIEW 'A'

EARTHINGI TERMINAL

(GRADE LEVEL

WILD t..>

TO EARTHING GRID

D

MARSHALLING BOX

EARTH ELECTRODE (TO BE CONNECTED TO EARTHING GRID)

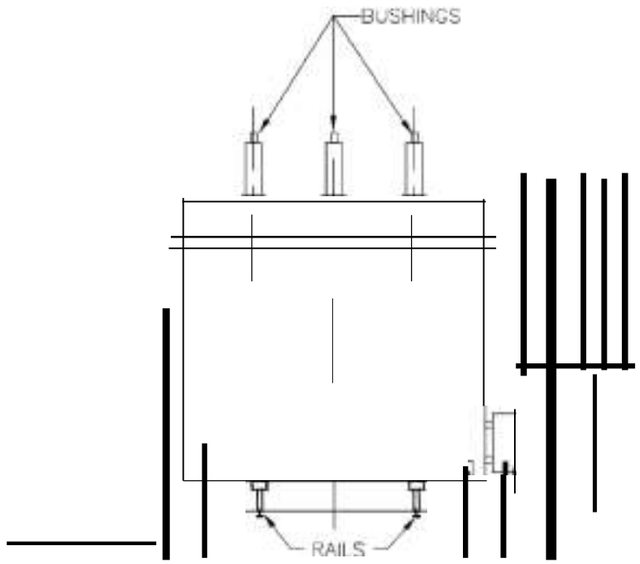
NOTES

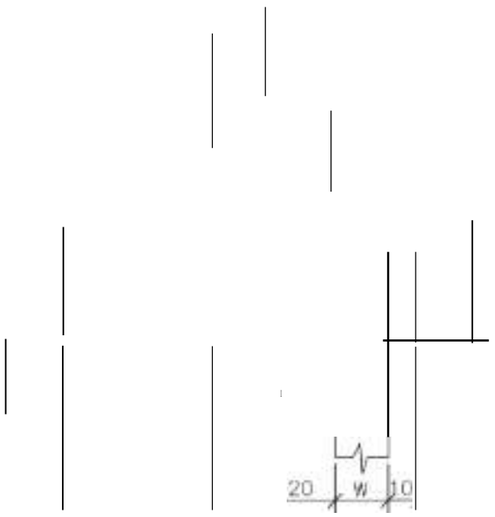
1. ALL DIMENSIONS ARE IN MM,
2. WELDING SHALL BE DONE AS PER IS 816:1969.
3. THE TRANSFORMER NEUTRAL SHALL BE CONNECTED TO TWO ELECTRODES LOCATED APPROX 6m APART IN EARTH TEST PIT. THE CONNECTION BETWEEN TRANSFORMER NEUTRAL AND EACH ELECTRODE SHALL BE MADE BY SEPARATE CONDUCTORS.

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SUBJECT

TYPICAL EARTHING INSTALLATION DETAILS
TRANSFORMER EARTHING

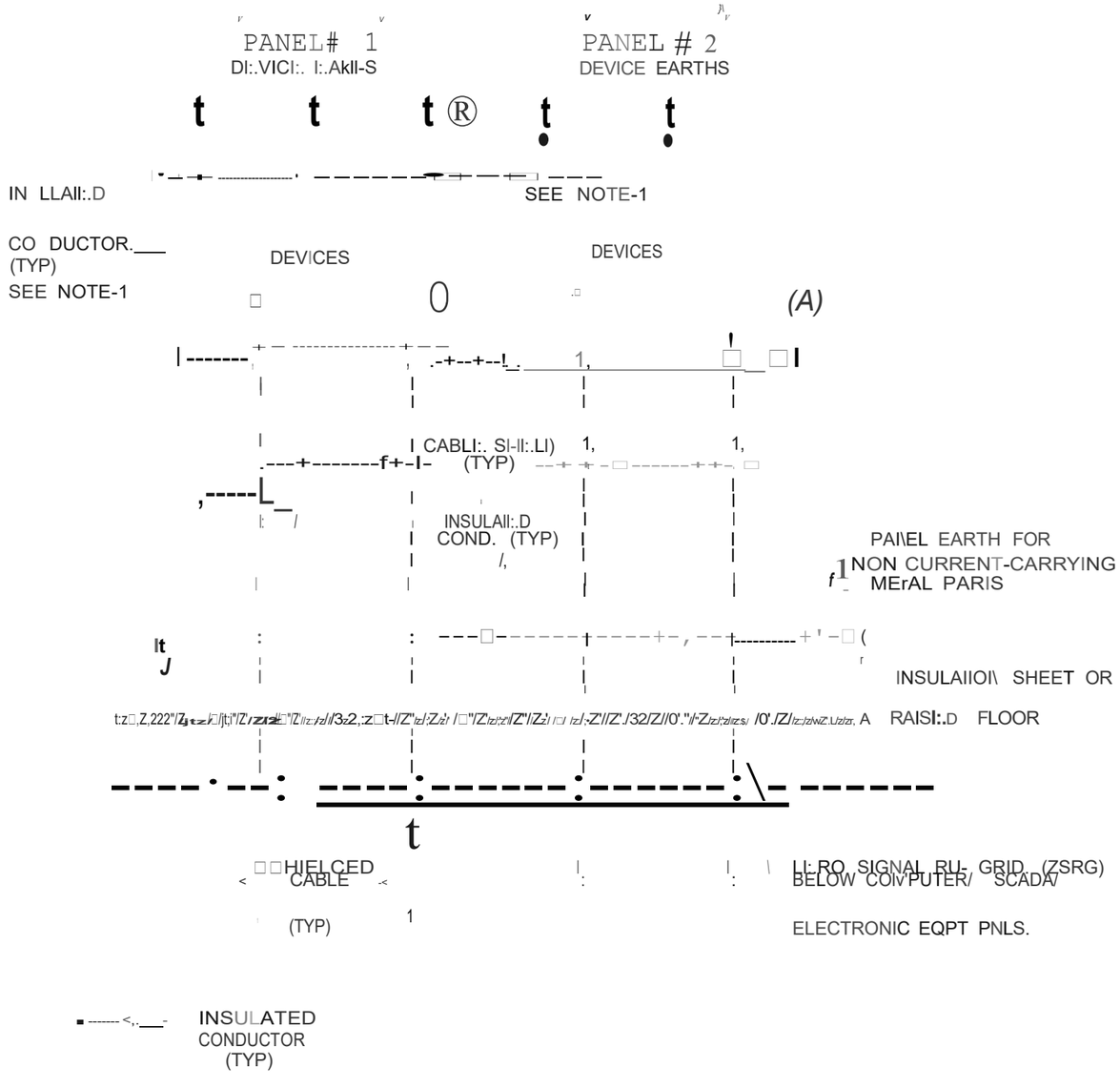
IRACTEBE I- Size 1 Scale Sheet -

C!!NGle A3 NTS 13 of 23

Drawing No. Rev.

GGNG-E-20715-0812 0

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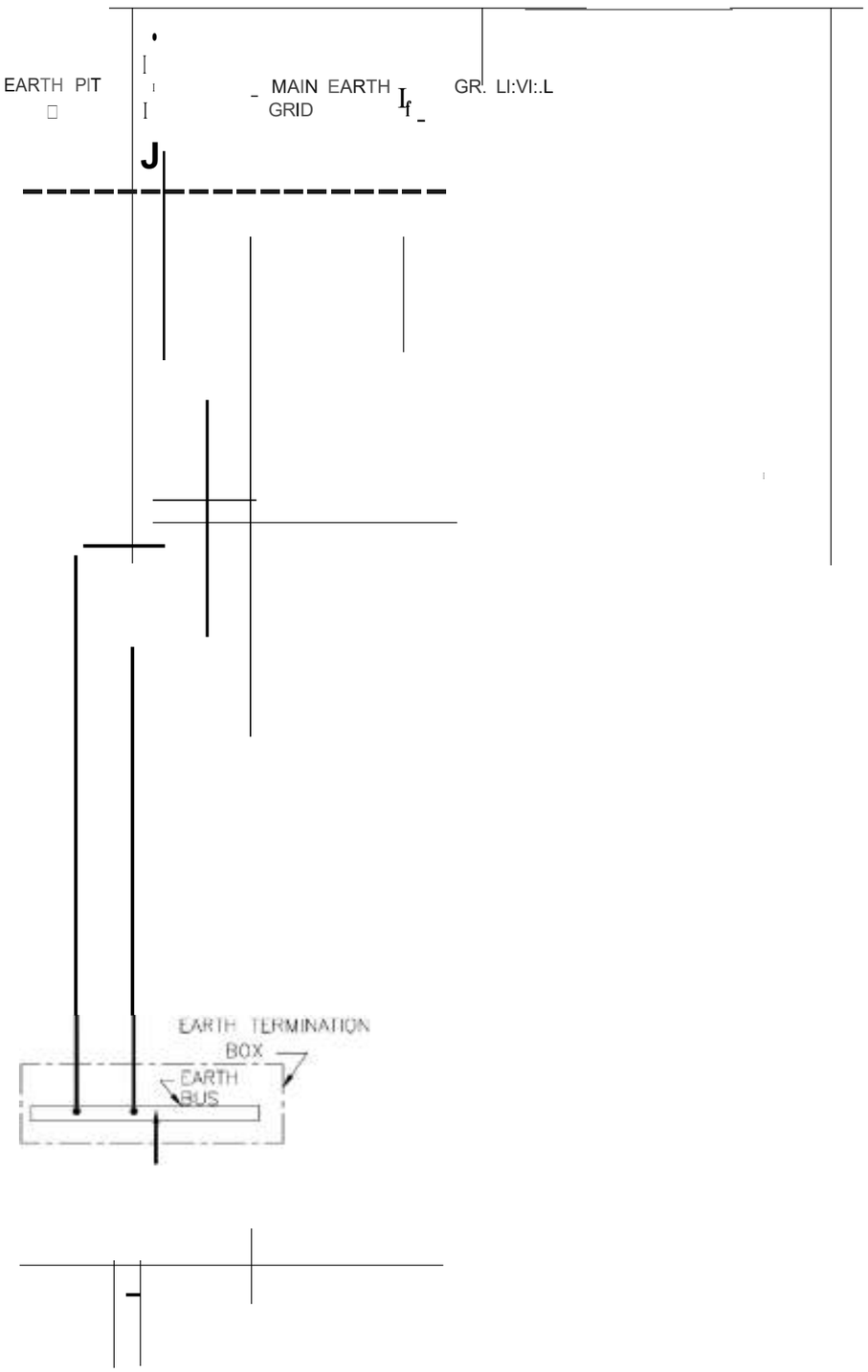
NOTES

1 EARTH BUSES® & i&}) MAY BE COMBINED INTC ONE BUS IF TWO SEPARATE BUSES ARE NOT SPECIFIED BY VENDORS

2 IF ZSRG IS NOT PROVIDED THE ® & □ BUSES ARE BROUGHI BY INSULAIED CONDUCTORS ГО THE EAf-IIHBUS IN THE ARTI- TERMINATION BOX ONLY ONE ARTHING CONNECTION SHOULD BI Pf-IOVIDID □RO!v' I HIS IARIh BUS IO IARTH PIT PROVIDI:_D IN THE MAI□ ARTHING GRID.

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SUBJECT: TYPICAL EARTHING INSTALLATION DETAILS
COMPUTER/INSTRUMENTATION EQUIPMENT

IRACTEBEL

Size	Scale	Sheet
A3	NTS	14 of 23

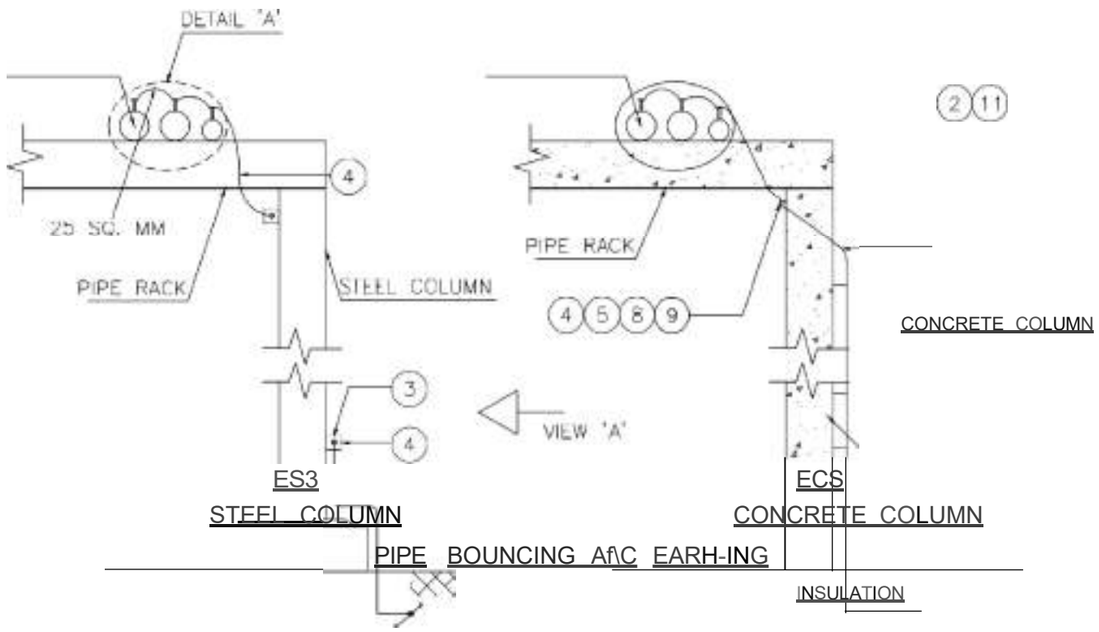
Drawing No.	Rev.
GGNG-E-20715-0812	0

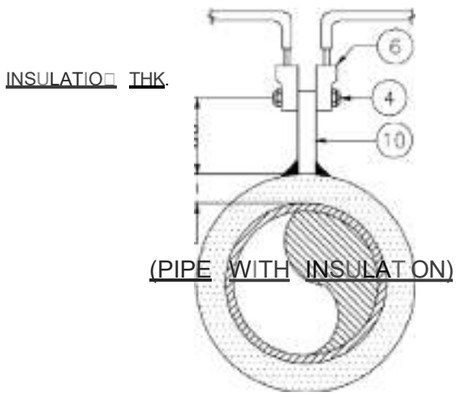
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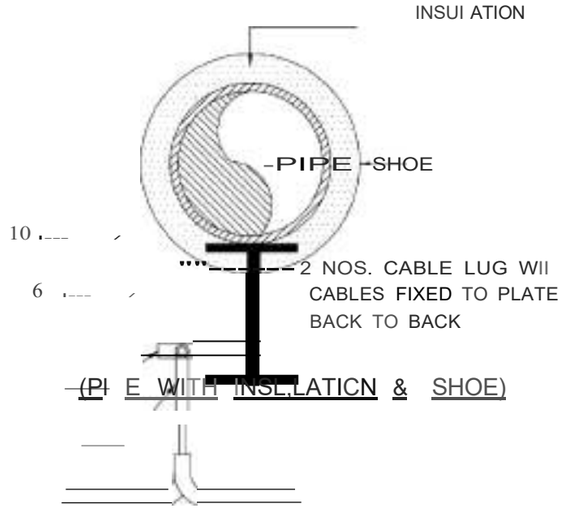
2 3 4

PROCESS PIPE

PROCESS PIPE







NOTES

1. ALL DIMENSION INDICATED ARE IN MM UNLESS OTHERWISE SPECIFIED

LEGE D

(i) EARTHING SIRIP GI

0 SADDLE WITI- CLAMP (HOT DIP GALV.)

0 EARTHING LUG (100x75x5mm THK.)

0 NUT, BOLT &: SPRING WASHER

0 EARTH BUS 75x10mm, 400mrr LONG @TERMINAL LUG (25 SQ.MM)

0 EARTHING CONDUCTOR (25AQ.MM)

® 12mm DIA. SPACING PIPE(50mm LONG)

®ANCHOR BOLi MBx'OOmm LONG WIIH NUI WASHER & SPRING WASHER

@SO X 8 G.I STRIP WITI· 1 NO. 10 DIA HOLE, L NGHT TC SUIT INSULATION

@EXPANSION ANCHOR BOLT WITh FLATE WASHER (M6x40mm)

Rev.	D M Y	Modifications	Drawn	Checked	Approved	Validated
0	13.10.16	APPROVED	RKS	PR	KJ	SKH

SUBJECT: TYPICAL EARTHING INSTALLATION DETAILS
EQUIPMENT ON R C C / STEEL COLUMN

TRACTEBEL ENGINEERING

Size A3 Scale NTS Sheet 15 of 23 1

Drawing No. Rev.

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2 3 4

A

6 6

VIEW 'A'

4 }---------

B

FOUNDATION
(BY PASS)

GL.

FOUNDATION

'"(BY Olf-ERS)

GL.

EM1A

IAR I HING OF HORIZON-IAL MO rGR

VIEW A

VIEW '80

C

6 ,_____,

,___ _, 2

4

D

2

GL. JO NT (TYPE)

GL.

VIEW B

NOTES

1. ALL DIMENSIO□ INDICATED ARE IN MI/ UNLESS OTHERWISE SPECIFIED.

8 I:.GI:.ND

EARTHING CONDUCTOR

EARTHING STRIP

G)EARTH BUS

0TERMINAL LUG WITH NUT , BOLT & SPRING WASHER

(BsADDLEWm- CLAMP

®MOTOR

0 12mm DIA. SPACING PIPE (50mm LONG)

@ANCHOR BOLT DIA 8mm, 100mm LONG WITh NUT,SPRING WASHER & PLAIN WASHER

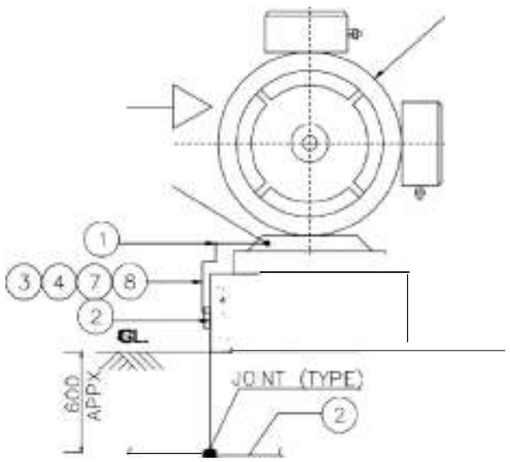
®EXPANSION ANCHOR NBOLT WITH FLATWASHER (M6x40mm)

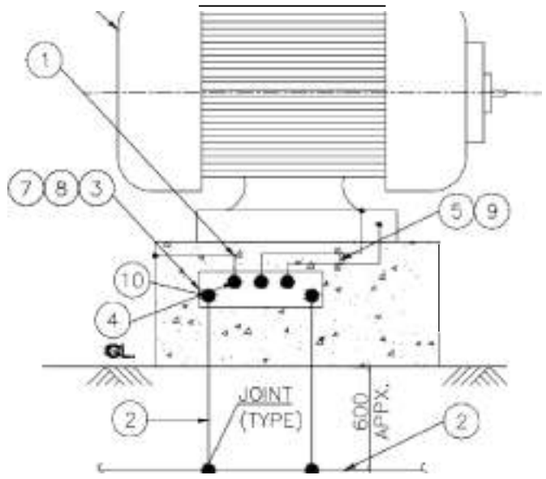
@NUT, BOLT & SPRING WASHER (MB)

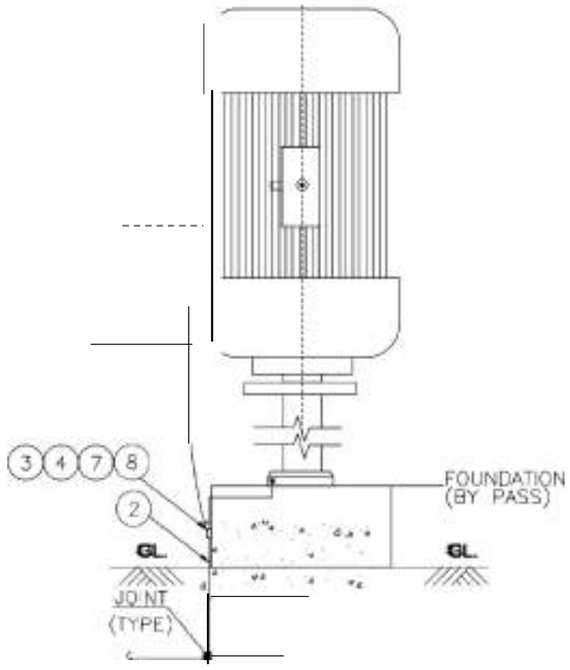
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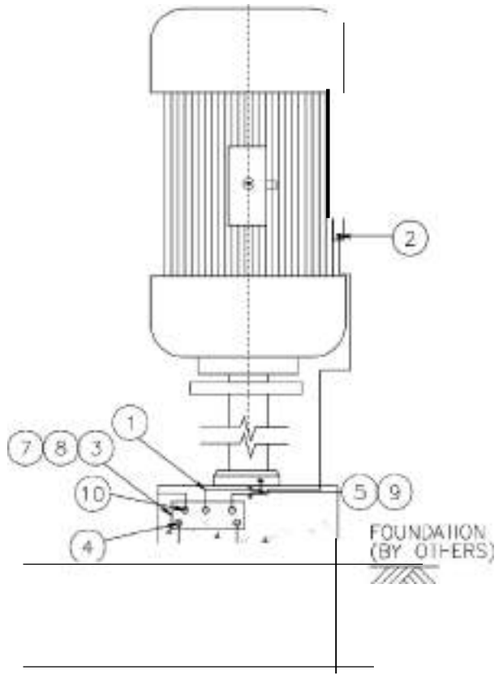
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SUBJECT

TYPICAL EARTHING INSTALLATION DETAILS
EARTHING OF HORIZONTAL MOTOR

IRACTEBEL
C!!NGIe

Size A3 | Scale NTS | Sheet 16 of 23

Drawing No. GGNG-E-20715-0812 | Rev. 0

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1 2 3 4

A

B

C

D

C)

LIGHTING f-IOLr.
(TYPICAL)

LIGHTNG POLE
(TYPICAL)

R10

DErAIL 'A'

TO EARTHING NETWORK

CETAL 'A'

Gt..

150

EARTHING NETWORK

600 APP□/

(G.I. STRIP)

JOINT

(TYP CAL)

EARTHING OF LIGHTING POLE

NOTES

1. ALL DIMt:.NSIOt\ INDICAlt:.D AI IN MI/ UNL SS OIHI WIS SP mIt:.D,

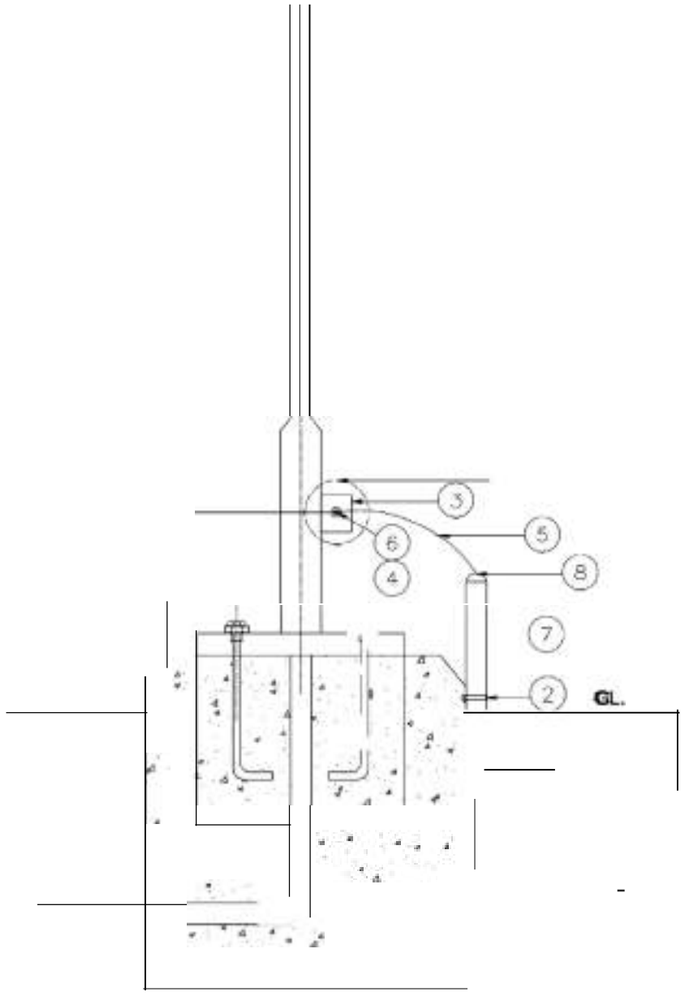
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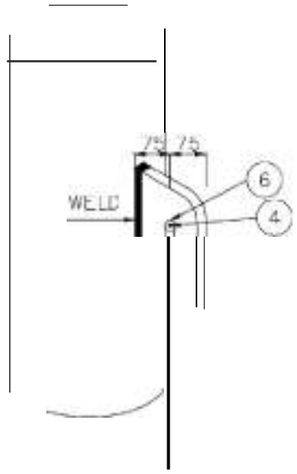
0 CONDUIT (GI)
0 CONDUIT CLAMP (HOT DIP GALV)
0 EARTHING LUG (100x75x5mm THK)
0 NUT, BOLT & SPRING WASHER (M8)
® EARTHING CONDUCTOR (25 sq.mm)
®T RMINAL LUG (25 sq.mm)
0 EXPANSIOt\ ANCHOR BOLT WITH FLATEWASHER (M6x400mm)
® SEALING MATERIAL

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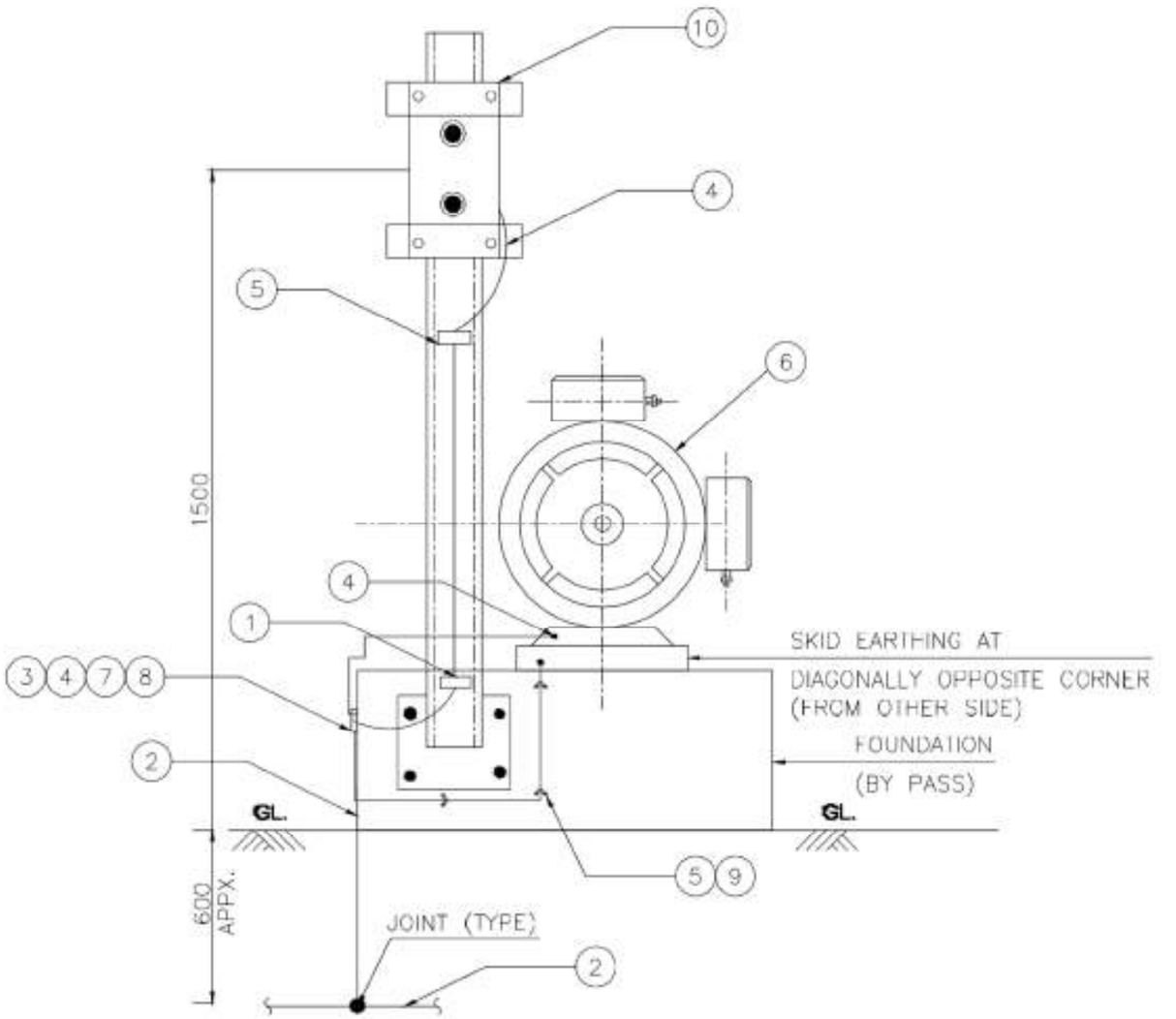
SUBJECT TYPICAL EARTHING INSTALLATION DETAILS
STANDARD EARTHING DETAILS FOR LIGHING POLE

IRACTEBEL

Size	Scale	Sheet
A3	NTS	17 of 23

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EM2

EARTHING OF MOTOR

WITH MOTOR FOUNDATION MOUMTED LCS

NOTES

1. ALL DIMENSION INDICATED ARE IN MM UNLESS OTHERWISE SPECIFIED.

LEGEND

1. EARTHING CONDUCTOR
2. EARTHING STRIP GI
3. EARTH BUS GI
4. TERMINAL LUG WITH NUT , BOLT & SPRING WASHER
5. SADDLE WITH CLAMP
6. MOTOR
7. 12mm DIA. SPACING PIPE (50mm LONG)
8. ANCHOR BOLT DIA 8mm, 100mm LONG WITH NUT,SPRING WASHER & PLAIN WASHER
9. EXPANSION ANCHOR NBOLT WITH FLATWASHER (M6x40mm)
10. LOCAL CONTROL STATION

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SUBJECT TYPICAL EARTHING INSTALLATION DETAILS

EARTHING OF MOTOR WITH MOTOR FOUNDATION MOUNTED LCS

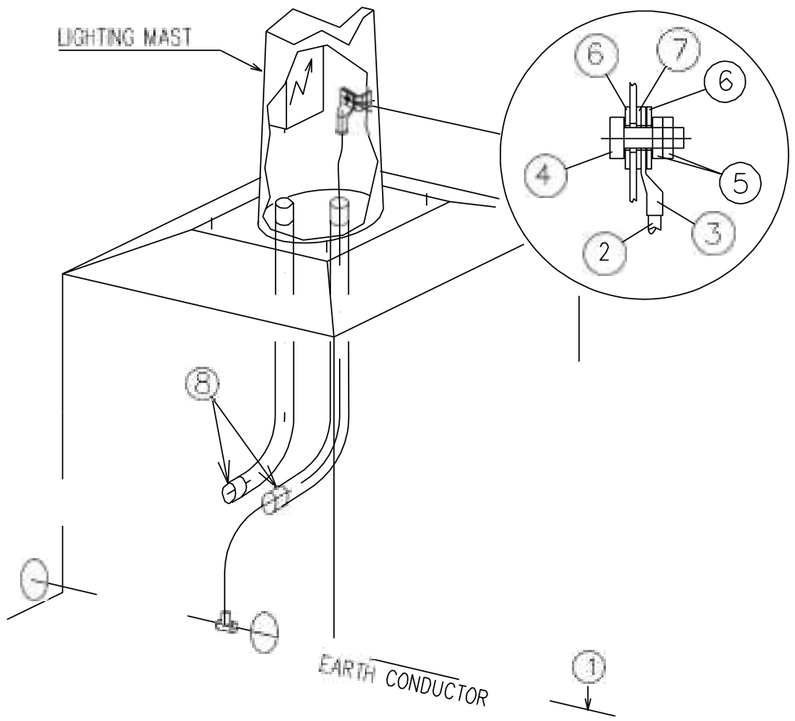
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Size	Scale	Sheet
A3	NTS	18 of 23

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N°	DESIGNATION	MATTER	SURF. TREAT.	OBSERVATION
8	PIPE ø80mm	PVC		SUPPLY BY CIVIL WORK
7	BIMETALLIC WASHER M12	CU/AL		SUPPLY BY LIGHTING SUB-CONTRACTOR
6	CONTACT WASHER	STEEL	Zn8/B/Fe	SUPPLY BY LIGHTING SUB-CONTRACTOR
5	NUT	STEEL	Zn8/B/Fe	SUPPLY BY LIGHTING SUB-CONTRACTOR
4	SCREW	STEEL	Zn8/B/Fe	SUPPLY BY LIGHTING SUB-CONTRACTOR
3	TERMINAL	COPPER	Tinned	SUPPLY BY LIGHTING SUB-CONTRACTOR
2	PROTECTIVE CONDUCTOR	COPPER	Annealed	1x25 Sq.mm
1	EARTHING CONDUCTOR	G.I. FLAT	Annealed	65x8mm

NOTES

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E

TYPICAL DETAIL OF LIGHTING MAST EARTHING

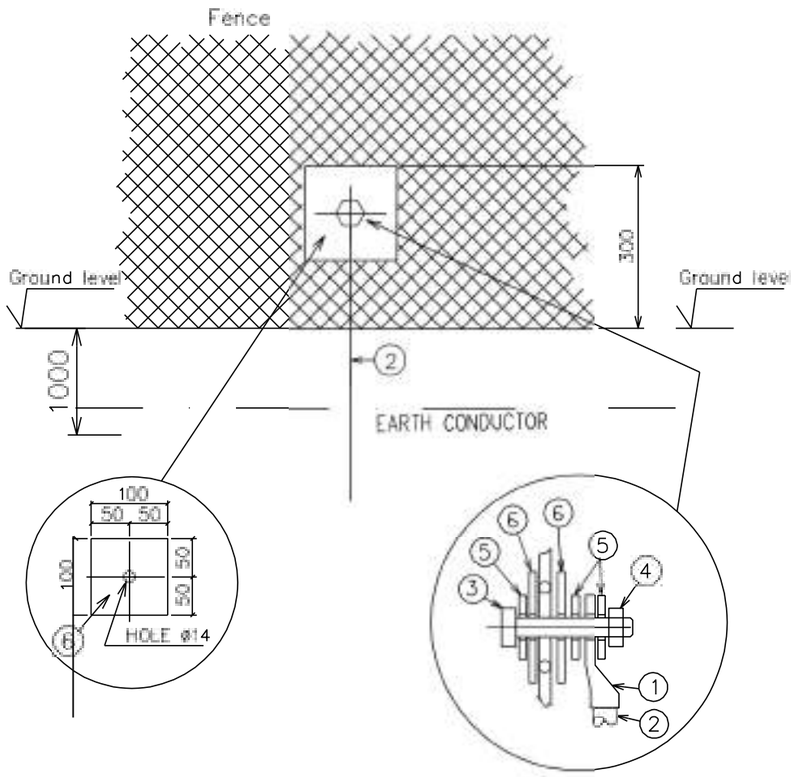
SUBJECT TYPICAL EARTHING INSTALLATION DETAILS
LIGHTING MAST EARTHING

Size	Scale	Sheet
A3	NTS	19 of 23

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For metallic fence for inside facility like transformer yard the earthing conductor wil be bonded to the main buried earthing network.

N°	DESIGNATION	MATTER	SURF. TREAT.	OBSERVATION
6	ALUMINIUM FLAT 100x5	ALUMINIUM		Manufactur. on site
5	BIMETALLIC WASHER M12	CU /AL		
4	NUT H M12	STEEL	Zn8/B/Fe	
3	SCREW H M12 x 40	STEEL	Zn8/B/Fe	
2	PROTECTIVE CONDUCTOR	COPPER	Annealed	S= 50 Sqmm/ L=3m
1	CRIMPING LUG 70-12.5	COPPER	Tinned	

DETAIL OF FENCE EARTHING

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SUBJECT TYPICAL EARTHING INSTALLATION DETAILS OF FENCE EARTHING

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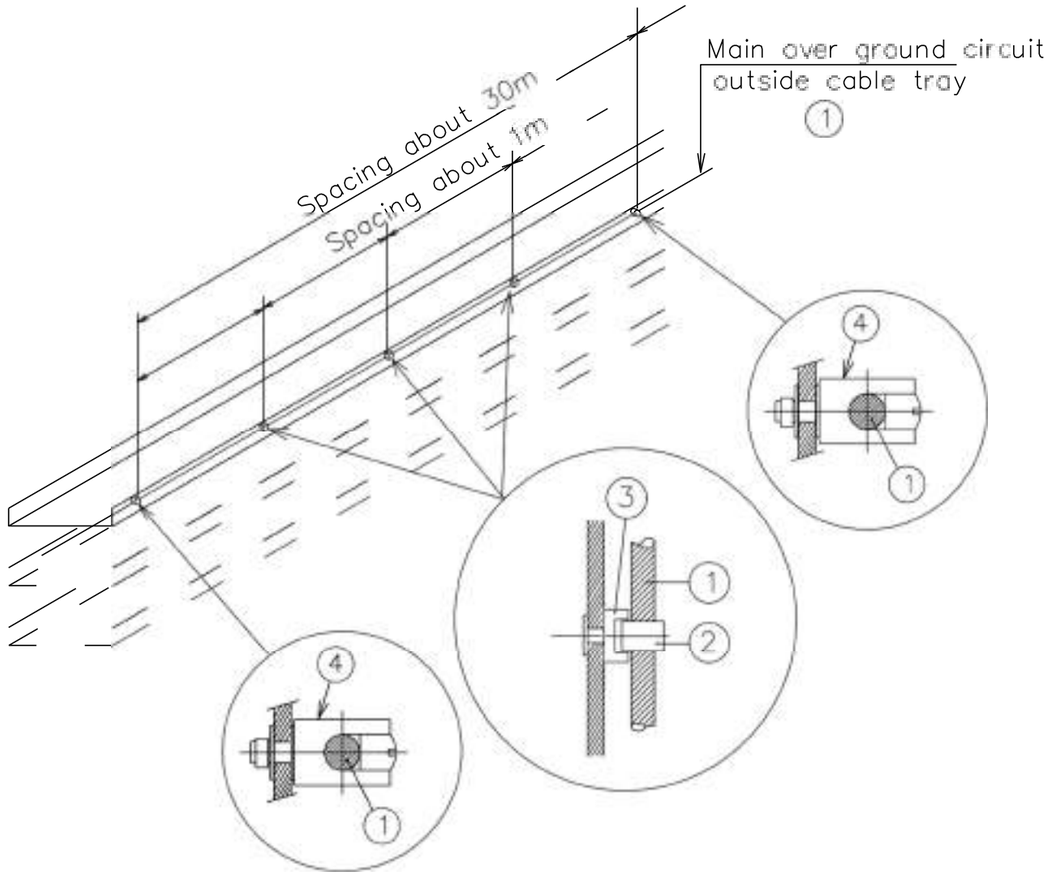
Size	Scale	Sheet
A3	NTS	20 of 23

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NOTES



4	EARTHING CLIP	Brass		
3	BASE FOR CABLE TIE	Polyamide		
2	CABLE TIE	Polyamide		
1	PROTECTIVE CONDUCTOR	GI	Annealed	
N°	DESIGNATION	MATTER	SURF. TREAT.	OBSERVATION

TYPICAL DETAIL OF SINGLE ROW CABLE TRAY EARTHING

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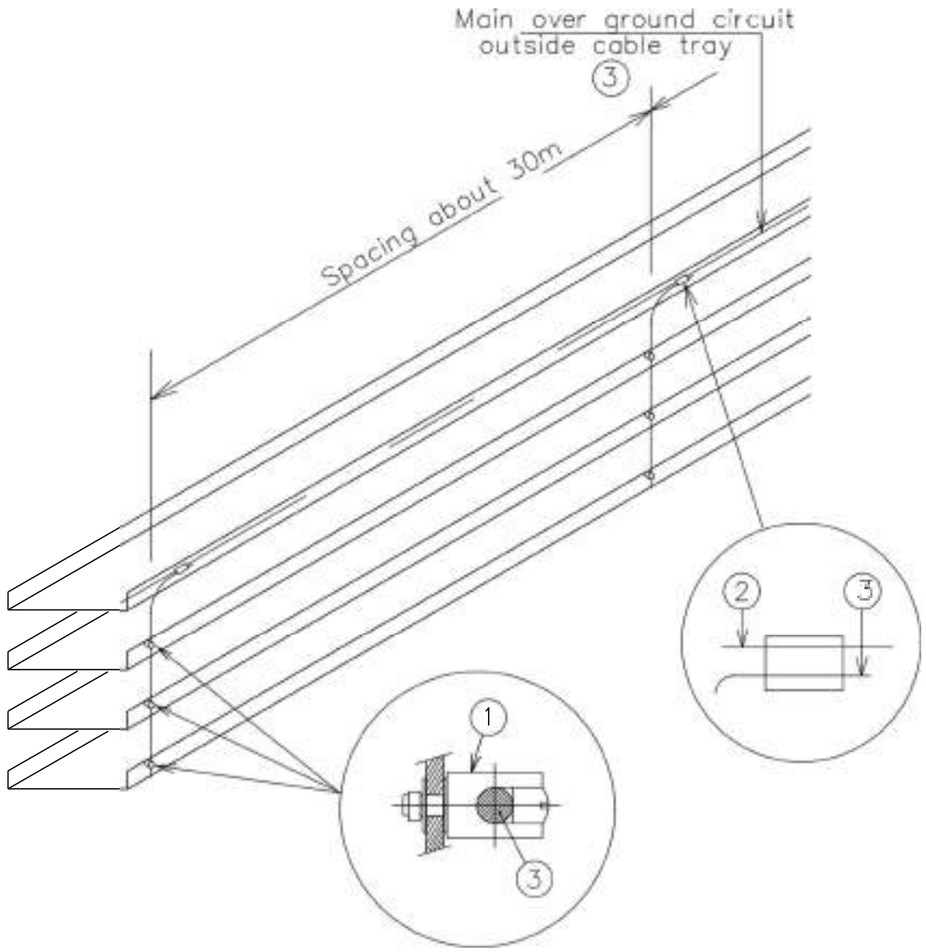
SUBJECT TYPICAL EARTHING INSTALLATION DETAILS OF CABLE TRAY EARTHING

Size	Scale	Sheet
A3	NTS	21 of 23

Drawing No. GGNG-E-20715-0812 | Rev. 0

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3	PROTECTIVE CONDUCTOR	GI	Annealed	65x8
2	PROTECTIVE CONDUCTOR	GI	Annealed	65x8
1	EARTHING CLIP	BRASS		According to number of cable trays
N°	DESIGNATION	MATTER	SURF. TREAT.	OBSERVATION

TYPICAL DETAIL OF MULTIPLE ROW CABLE TRAY EARTHING

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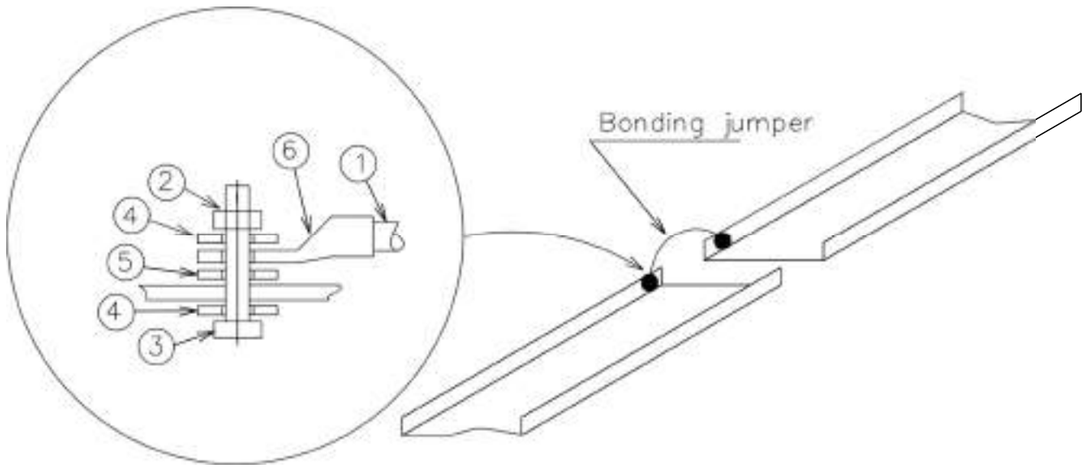
SUBJECT TYPICAL EARTHING INSTALLATION DETAILS OF MULTIPLE ROW CABLE TRAY EARTHING

Size	Scale	Sheet
A3	NTS	22 of 23

Drawing No. GGNG-E-20715-0812 | Rev. 0

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N°	DESIGNATION	MATTER	SURF. TREAT.	OBSERVATION
6	CRIMPING LUG 50-12	COPPER	Tinned	S= 50 Sqmm
5	BIMETALLIC PLATE	CU/AL		
4	BIMETALLIC WASHER M12	CU/AL		
3	SCREW H M12-40	STEEL	Zn8/ B/ Fe	
2	NUT H M12	STEEL	Zn8/ B/ Fe	
1	PROTECTIVE CONDUCTOR	COPPER	Annealed	S=50 Sqmm

TYPICAL DETAIL OF EXPANSION JOINT OF MAIN CABLE TRAY EARTHING

NOTES

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SUBJECT TYPICAL EARTHING INSTALLATION DETAILS OF EXPANSION JOINT OF MAIN CABLE TRAY EARTHING

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Size A3 | Scale NTS | Sheet 23 of 23

Drawing No. | Rev.

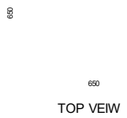
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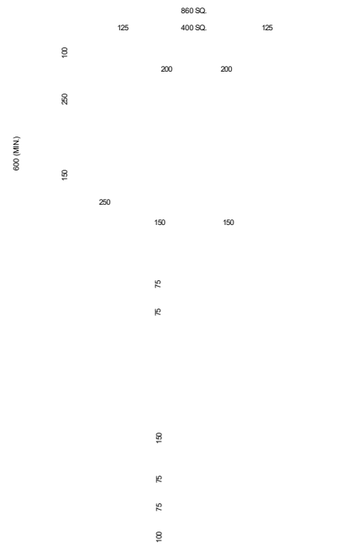
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Date: 2026.09.11 18:16:52 IST

EARTH PIT DETAILS WITH G.I. PIPE ELECTRODE

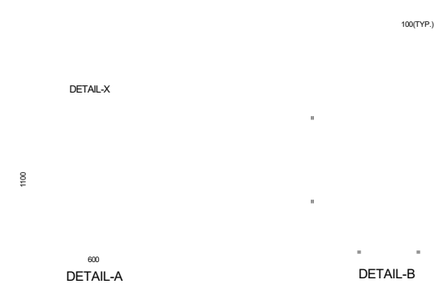


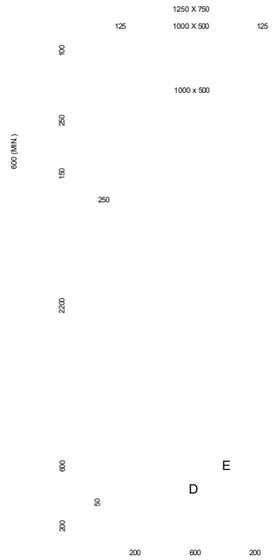




TYPICAL ARRANGEMENT FOR G.I. PIPE ELECTRODE

EARTH PIT DETAILS WITH COPPER PLATE ELECTRODE







TYPICAL ARRANGEMENT FOR COPPER PLATE ELECTRODE

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SUBJECT

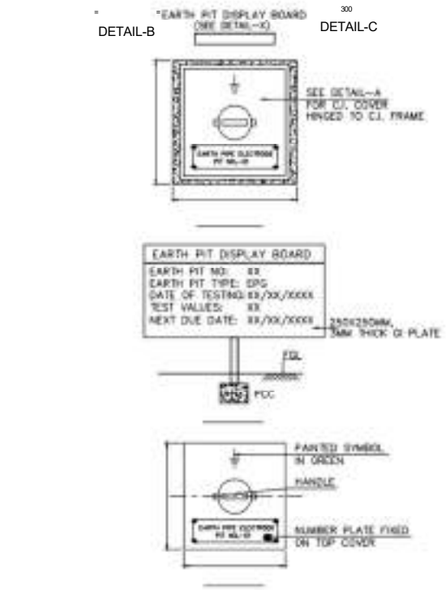
TYPICAL EARTH PIT DETAILS

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Annexure-I

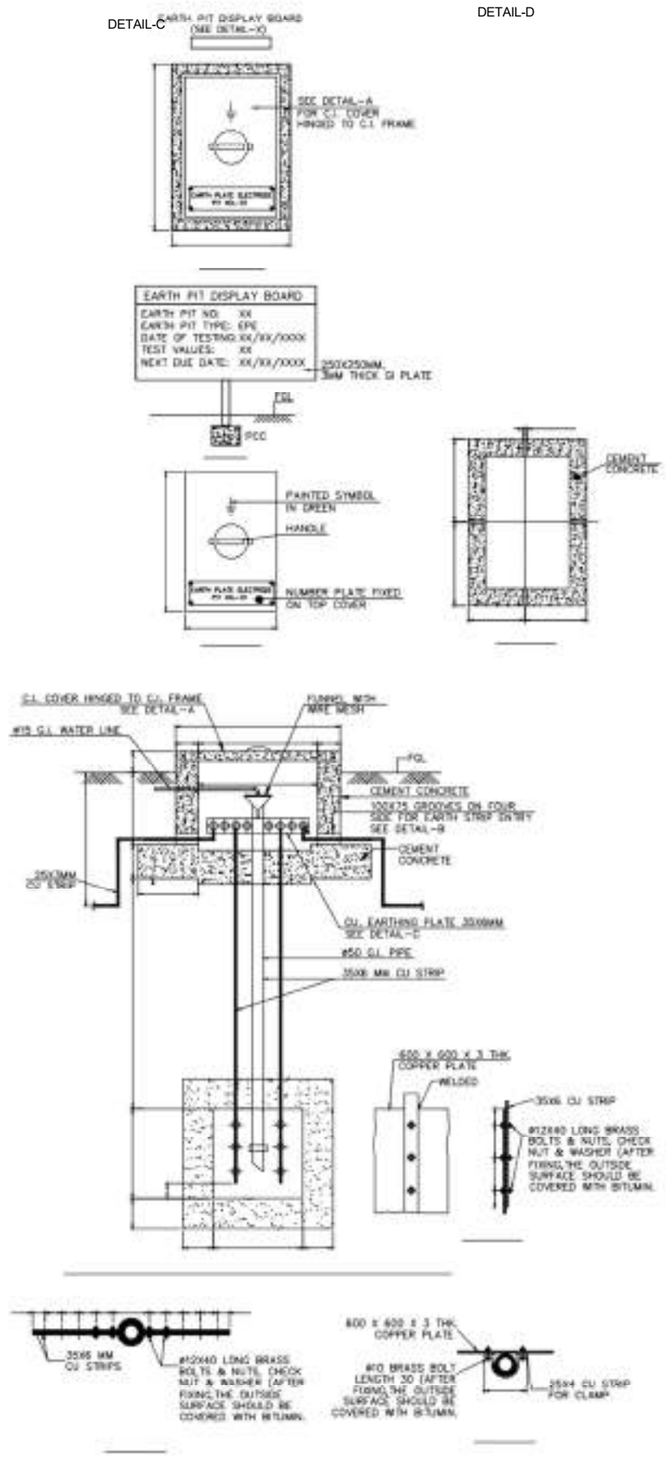
DETAIL-B

DETAIL-C



DETAIL-C

DETAIL-D



NOTES

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. FOLLOW WRITTEN DIMENSIONS ONLY. DO NOT SCALE.
3. THE PIPE ASSEMBLY SHALL BE HOT DIP GALVANISED AFTER FABRICATION.

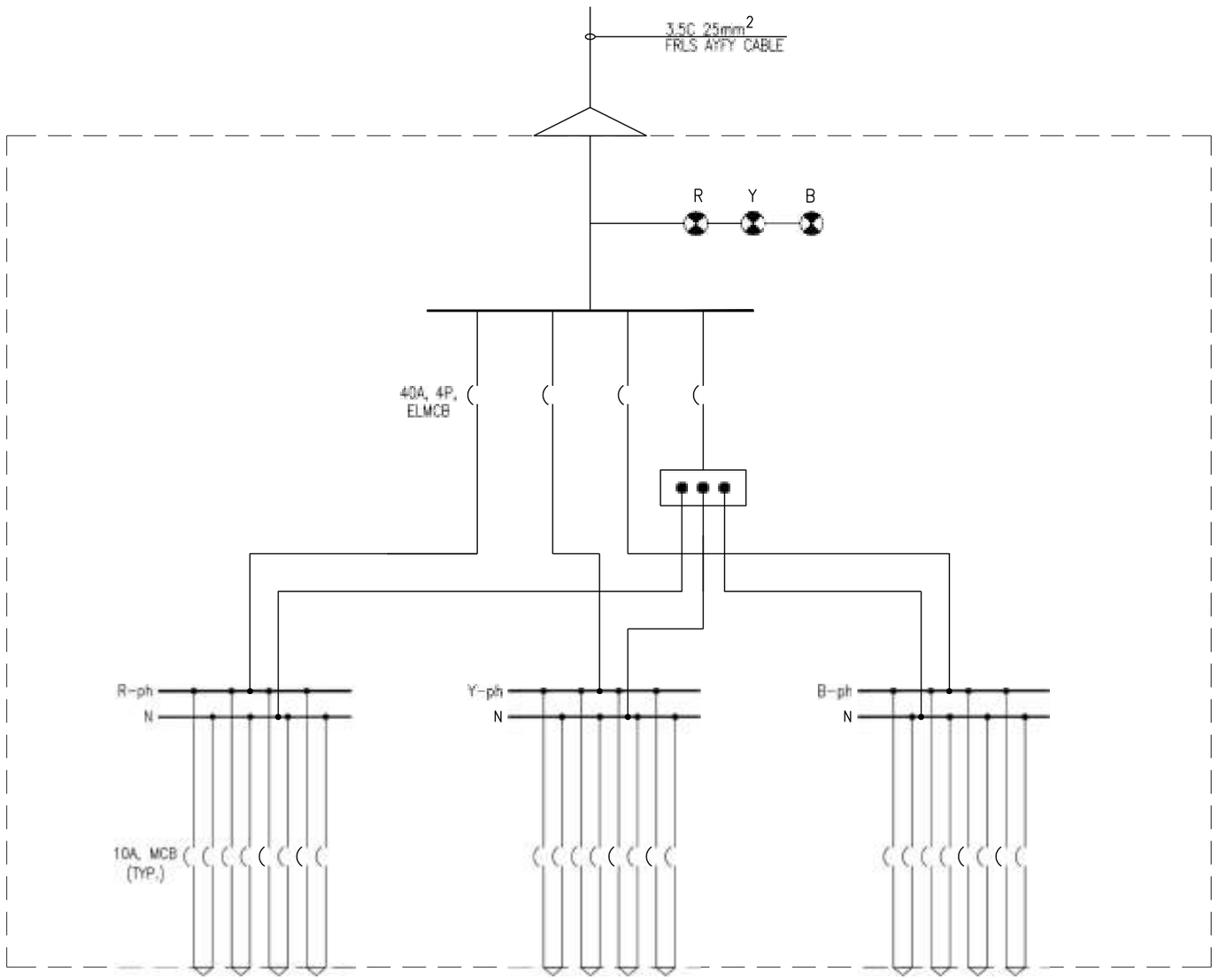
Size	Scale	Sheet
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Drawing No. GGNG-E-20713-3001 Rev. 0

0	22.01.24	APPROVED	RKA	KB	DMY	VG

TRACTEBEL ENGIE

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LEGEND:

	MCB
	INDICATION LAMP

Rev.	D M Y	Modifications	Drawn	Checked	Approved	Validated
0	06.10.16	APPROVED	RKS	PR	KJ	SKH

SUBJECT: WIRING DIAGRAM FOR INDOOR LIGHTING SUB DISTRIBUTION BOARD

TRACTEBEL ENGIE

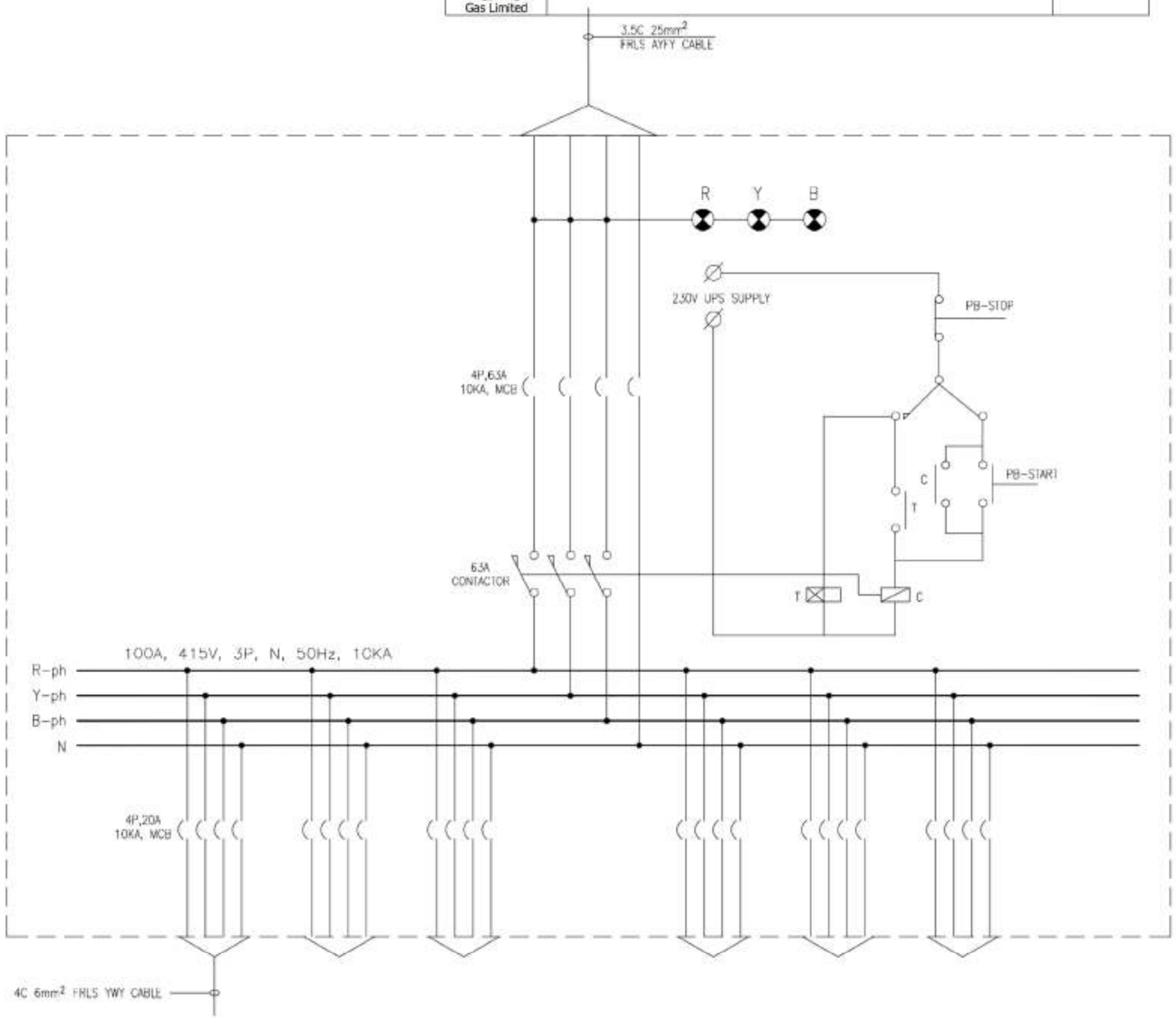
Size A3 | Scale NTS | Sheet 01 of 01

Drawing No. | Rev.

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LEGEND:

	MCB
	INDICATION LAMP
	CONTACTOR
C	CONTACTOR
T	TIMER

Rev.	D M Y	Modifications	Drawn	Checked	Approved	Validated
0	06.10.16	APPROVED	RKS	PR	KJ	SKH

SUBJECT: WIRING DIAGRAM FOR OUTDOOR LIGHTING
SUB DISTRIBUTION BOARD

TRACTEBEL ENGIE

Size	Scale	Sheet
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Drawing No. GGNG-E-20713-3003 Rev. 0

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Rev.	D M Y	Modifications	Drawn	Checked	Approved	Validated

SUBJECT DISPLAY BOARD FOR EARTH PIT

Size A3 Scale NTS Sheet 01 of 01

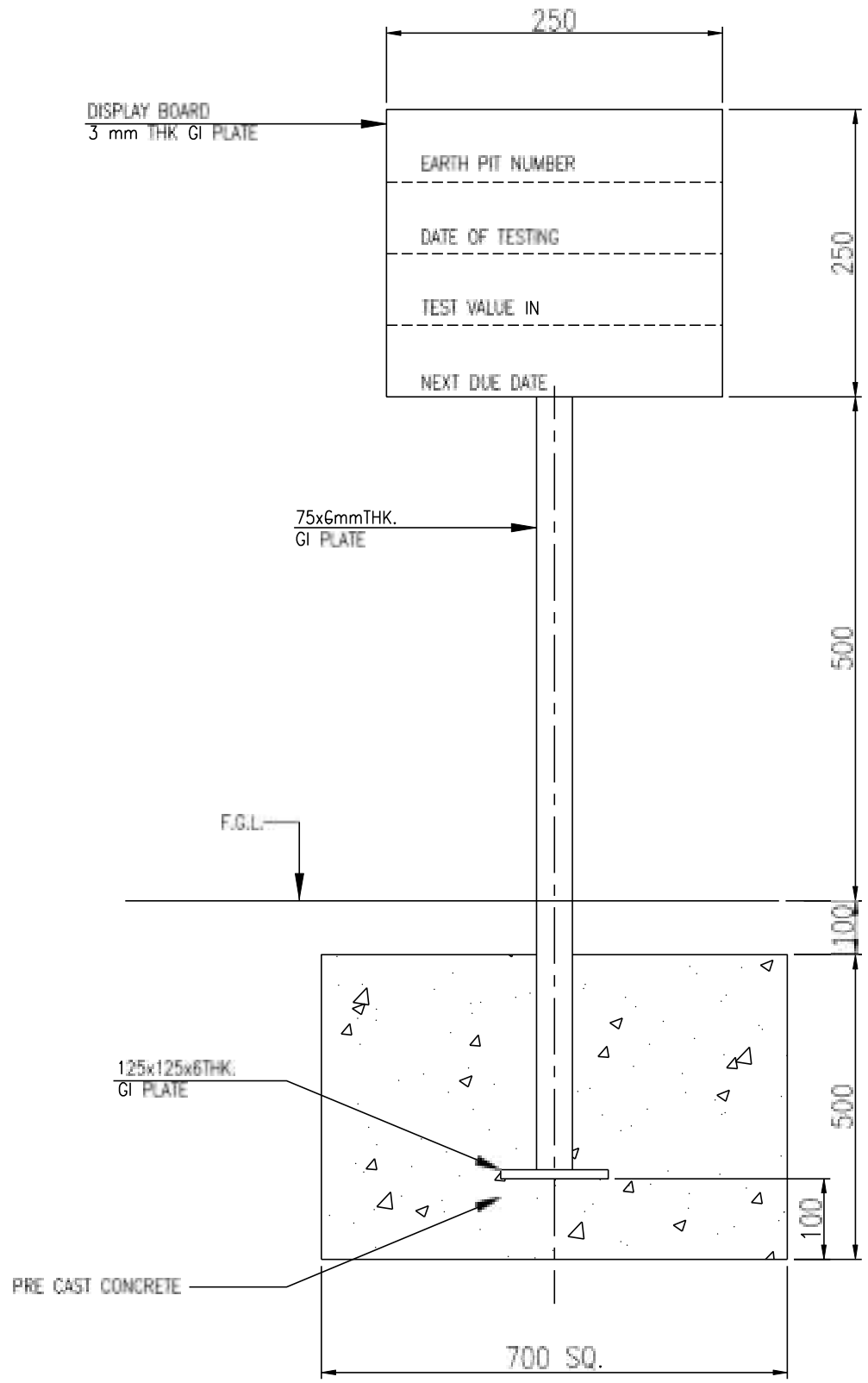
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A

B

D

F



NOTES

1 ALL DIMENSIONS ARE IN MM. UNLESS OTHERWISE SPECIFIED.

2 FOLLOW WRITTEN DIMENSIONS ONLY. DO NOT SCALE.

3 TEXT TO BE WRITTEN ON THE BOARD WITH BLACK ENAMEL PAINT AND FIGURE TO BE WRITTEN WITH RED ENAMEL PAINT.

Drawing No.	Rev.
GGNG-E-20713-3004	0

0	06.10.16	APPROVED	RKS	PR	KJ SKH

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Civil and Architectural Works for development and construction of CNG Mother Stations in Hyderabad GA

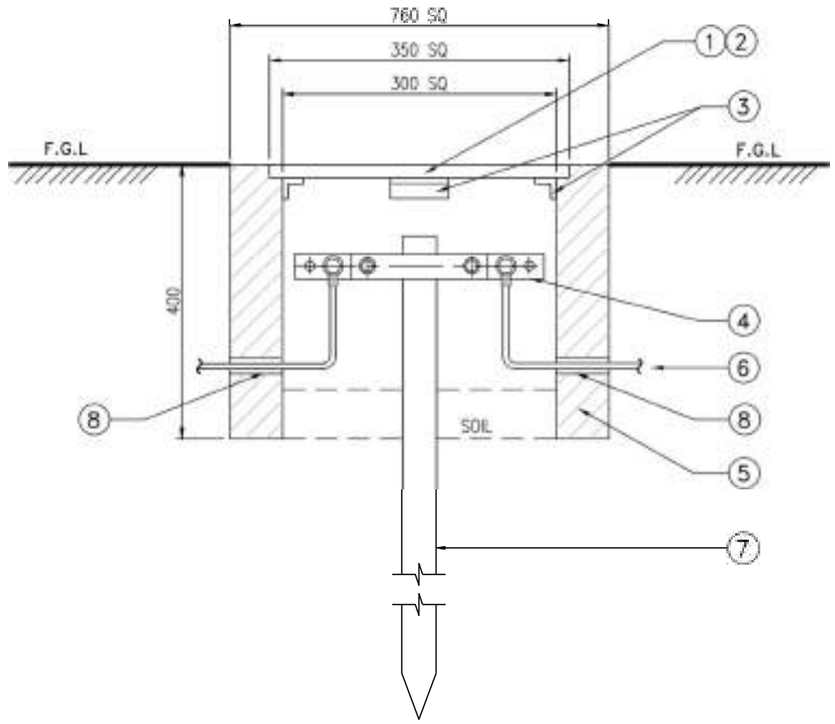
Bid Document No: BGL/780/2026-27

Volume II of II

Bhagyanagar Gas Limited

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(TOP VIEW)

CLAMP TYPE EARTH BAR

NOTES

1 ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2 FOLLOW WRITTEN DIMENSIONS ONLY. DO NOT SCALE.
3 EARTH RODS TO BE PROVIDED WITH A CLAMP TYPE EARTH BAR, WITCH ENSURES CONTINUITY OF MAIN EARTH RING EVEN WHEN REMOVED FROM EARTH ROD.

TAG	MATERIAL DESCRIPTION	CODMAT	QTY.	UNIT
1	STEEL COVER (6 THICK WITH 12 DIA LIFTING HOLE)		1	U
2	MARKED BY WELDING WITH EARTH SYMBOL		–	–
3	SECURING ANGLE IRON WELDED TO COVER		+	M
4	CLAMP TYPE EARTH BAR WITH HARDWARE & ACCESSORIES (NOTE1)		1	U
5	BRICK WORK		+	U
6	PLANT EARTH RING		*	M
7	20mm DIA. EARTH ROD (COPPER CLAD STEEL ROD)		3	M
8	PIPE CONDUIT 1 1/4" PVC HEAVY DUTY		1	M

\+ DECIDED AS PER REQUIREMENT
* QUANTITY AS REQUIRED

Rev.	D M Y	Modifications	Drawn	Checked	Approved	Validated
0	06.10.16	APPROVED	RKS	PR	KJ	SKH

SUBJECT: TYPICAL EARTHING PIT DETAIL

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Size A3 | Scale NTS | Sheet 01 of 0
Drawing No. GGNG-E-20713-3005 | Rev. 0

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Bhagyanagar Gas Limited	**Civil and Architectural Works for development and construction of CNG Mother Stations in Hyderabad GA** **Bid Document No: BGL/780/2026-27**	Volume II of II

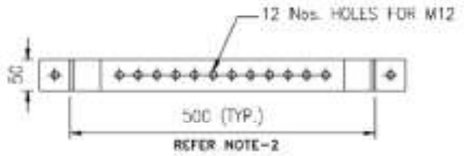
Rev.	D	M	Y	Modifications	Drawn	Checked	Approved	Validated

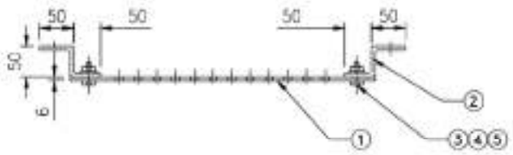
SUBJECT TYPICAL EARTHING BUS DETAILS

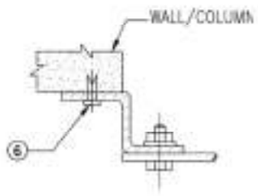
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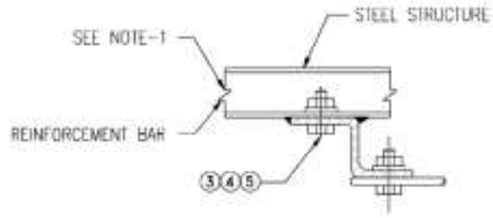
Drawing No. Rev.







MOUNTING TYPE-1



MOUNTING TYPE-2

NOTES

1 ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2 FOLLOW WRITTEN DIMENSIONS ONLY. DO NOT SCALE.
3 EARTH BUS SHALL BE INSTALLED AT CONVENIENT LOCATION NEAR GROUP OF EQUIPMENT PRECISE LOCATION OF GROUND BUS SHALL BE DECIDED BY AS PER SITE CONDITION.
4 LENGHT OF BUS TO SUIT AT SITE CONDITION.

TAG	MATERIAL DESCRIPTION	CODMAT	QTY.	UNIT
1	EARTH BUS 50x6 mm THK. COPPER		*	U
2	MOUNTING BRACKET		1	U
3	BOLT M12 - MS GALVANISED		2	U
4	NUTS (HEXAGONAL HEAD) - GALVANISED		2	U
5	PLAIN WASHER - GALVANISED		1	U
6	ANCHOR BOLT		4	U

* QUANTITY AS REQUIRED

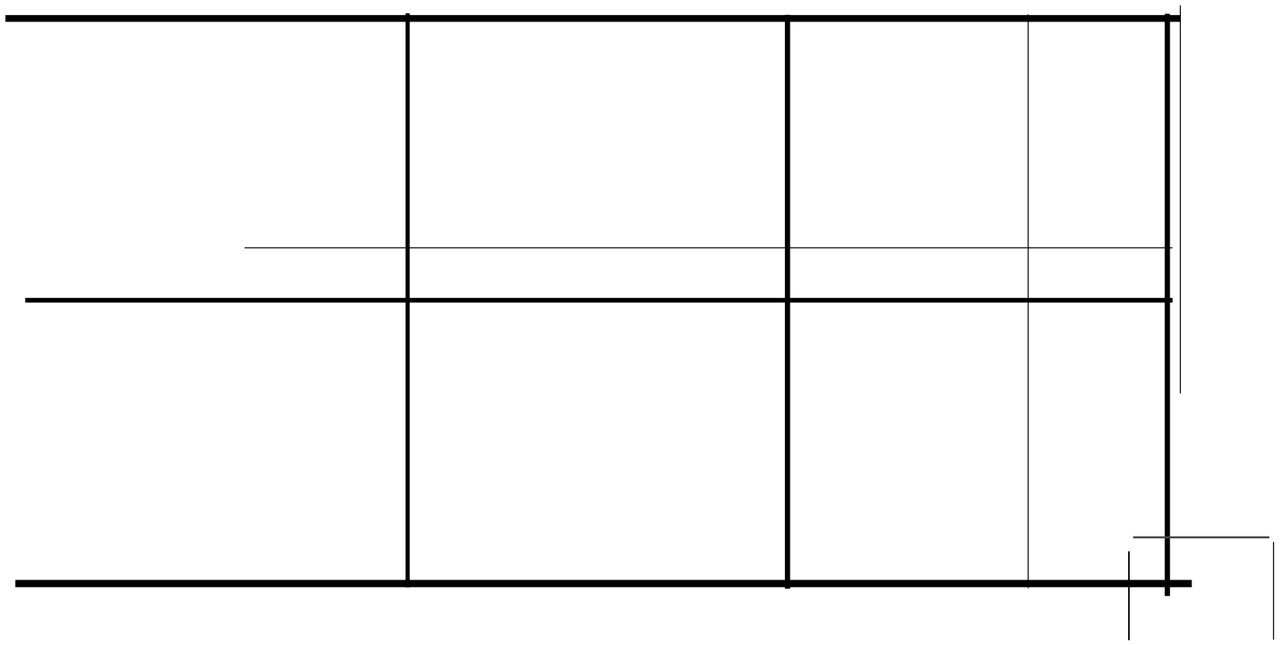
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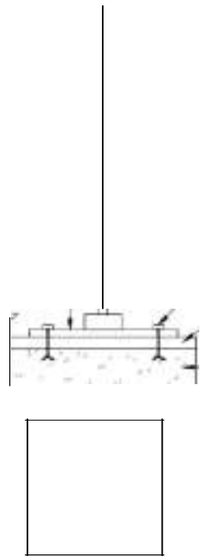
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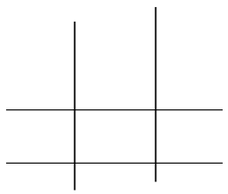
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EP D

20 M :W M 2C M

DETAIL 'B"

/f1 DETAIL 'A"
EP

TERRACE PLAN

75r/J COPPER
HOLLOW SPHERE

20r/J COPPER TUBE
AIR TERMINAL

200x200x6 MM
M.S. PLATE -

12 MM r/J X 1OOMtv LONG,
70 GROUTED IN SLAB

WATER PROOFING

ROOr SLAI:3

25x3 mm
GJ lad Stcip

SADDLI:

25x3 mm
G.I. Earth Strip

25x3 mm G.I. Earth Strip

BRICK WALL

25x3 mm
G.I. Earth Strip

Nl:.ITLI:. 80LII WOOC SCRI:.W 10 No.
!)0 LONG rIXID WIIH FILL 1-'LUG

25x3 mm G,I. arth Strip
FROM ROOr CONDUCTOR

CONNECTOR CLAMP (TYP.)

10 MM¢ x 25 mm LONG
HEXAGONAL HEAD BRASS
BOLT WITH WASHER

TEST LINK (4 Nos.)

GROUND LVL

"'-- TO EARTH ELECTRODE

FIXING ARRANGEMENT FOR HORIZONTAL DOWN CONDUCTORS
DETAIL 'A"

TEST LINK FOR LIGHTINING PROTECTION
DETAIL 'B"

NOTES

1 ALL DIMr.NSIONS ARE IN MM UNLt.SS OIHt.RWISE SPECIrlt.D
2 FOLLOW WRITTEN DIM NSIONS ONLY. DO NOT SCALE.
3 G.I. SADDLE TO BE FIXEDFOR HORIZONTAL DOW11 CONDUCTOR A THE INH:RVAL Or 150mm.

LEGEND GGNG-E-20713-3007 0

S.No.	SYMBOL DESCRIPTION	SYMBOL
1	25x3 mm G.I. EARTH TRI	
2	2'.Jxj mm DOWN CONDUCIOR	@
3	LIGHTNING ARRESTOR (VERTICAL AIR TERMINAL)	
4	EARTH PIT	EP[!:

Rev.	D M Y	Modifications	Drawn	Checked	Approved	Validated
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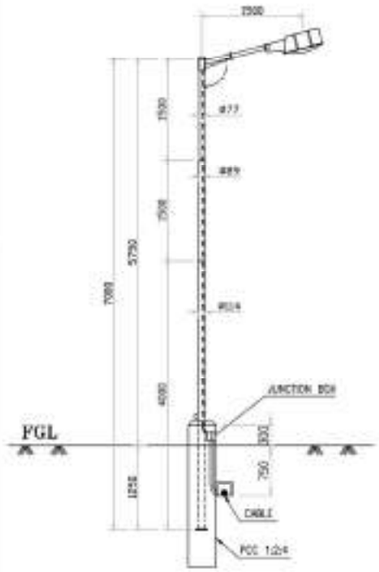
SUBJECT: TYP. LIGHTNING PROTECTION DETAIL FOR CONTROL ROOM BUILDING

IRACTEBEL CINGIe

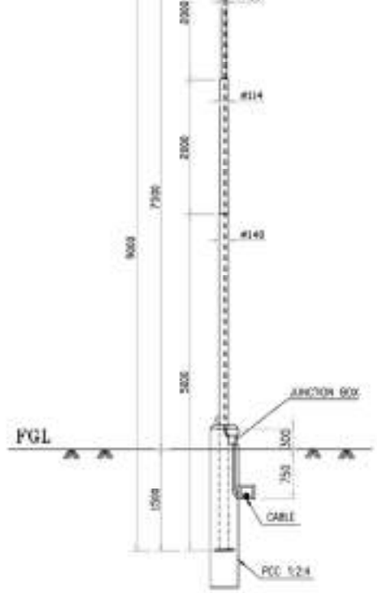
Size A3 | Scale NTS | Sheet 01 of 01 | Rev.
Drawing No.

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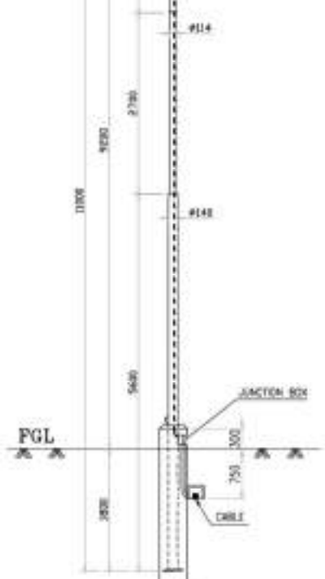
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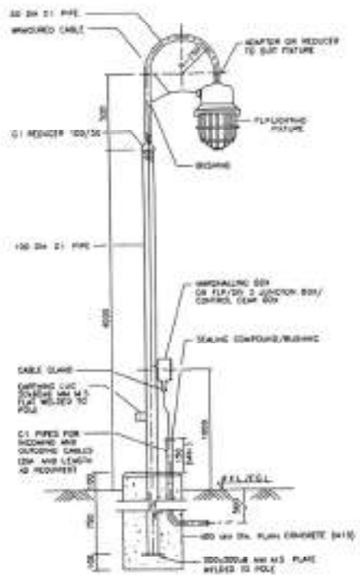
7M HEIGH POLE TYPE-(410 SP-3)



9M HEIGH POLE TYPE-(410 SP-30)



11M HEIGH POLE TYPE-(410 SP-50)



4.5M HEIGH FLP WELL GLASS LIGHTING FIXTURE SUITABLE FOR HAZARDOUS AREA (ZONE 1/ZONE 2)

NOTES

1 ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2 FOLLOW WRITTEN DIMENSIONS ONLY. DO NOT SCALE.
3 THE LIGHTING POLE SHALL BE ACCORDING TO IS:2713.

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SUBJECT: LIGHTING POLES DETAILS

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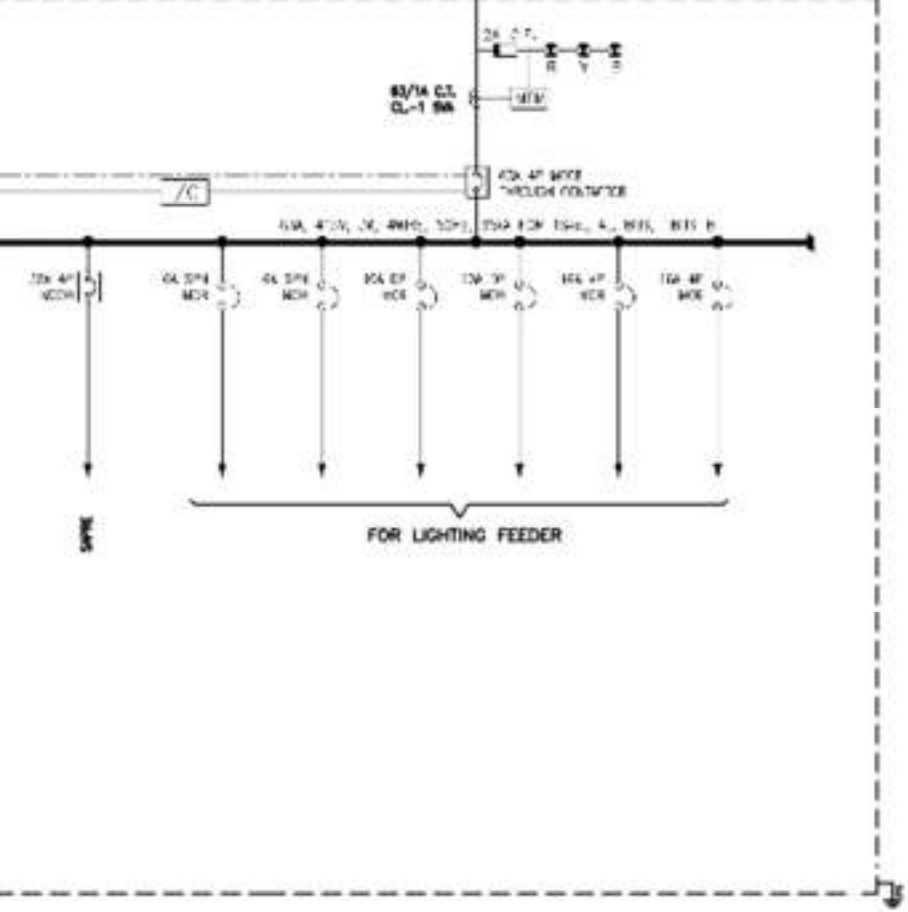
Drawing No. GGNG-E-20713-3009 | Rev. 0

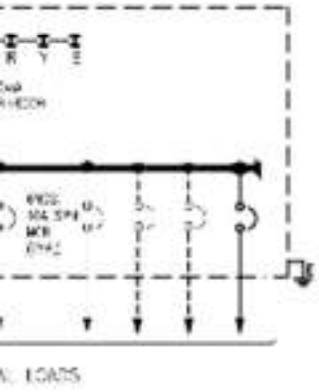
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LEGEND

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	MINIATURE CIRCUIT BREAKER (MCB)
	MOULDED CASE CIRCUIT BREAKER (MCCB)
	INDICATION LAMP
	EARTH.
A	AMMETER
V	VOLTMETER
	CURRENT TRANSFORMER
MFM	MULTIFUNCTION METER
	FUSE
	BYPASS TRANSFORMER WITH SOLID STATE VOLTAGE STABILIZER
	VOLTAGE SELECTOR SWITCH
	INVERTER
	RECTIFIER
	BATTERY
	TRAFO.
	STATIC SWITCH
	INTERLOCK
	CHANGE OVER SWITCH
	EXPLOSION PROOF FUSE BOX
	SERVO CONTROLLED VOLTAGE STABILIZER

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3	DATA SHEET	PRESSURE GAUGE	P.019141 G11049 I001	0	1	
4	DATA SHEET	JUNCTION BOX	P.019141 G11049 I002	0	1	
5	DATA SHEET	INDOOR DOME FIXED CCTV CAMERA SPECIFICATION	P.019141 G11049 I003	0	1	
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8	DATA SHEET	NVR, CCTV WORKSTATION SPECIFICATION	P.019141 G11049 I006	0	1	
9	DATA SHEET	NETWORK VIDEO RECORDER	P.019141 G11049 I007	0	1	
10	DATA SHEET	FIRE DETECTION CONTROLLER	P.019141 G11049 I008	0	1	
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14	DATA SHEET	EX PROOF BEACON WITH HOOTER	P.019141 G11049 I012	0	1	
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	SCOPE OF WORK- INSTRUMENTATION	P.019141 G11039 I001

BHAGYANAGAR GAS LIMITED (BGL)

MOTHER STATION COMPOSITE WORKS (CIVIL, MECHANICAL, INSTRUMENTATION AND ELECTRICAL WORKS) IN HYDERABAD GA.

SCOPE OF WORK

INSTRUMENTATION

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	SCOPE OF WORK- INSTRUMENTATION	P.019141 G11039 I001

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2.0 POWER SUPPLY 1

3.0 APPLICABLE CODES & STANDARDS 1

4.0 STATUTORY APPROVALS / CERTIFICATES (AFTER GETTING ORDER) 4

5.0 ENGINEERING UNITS 4

6.0 CONTRACTOR SCOPE OF WORK 4

7.0 QUALITY ASSURANCE AND QUALITY CONTROL 9

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Date: 2026.09.11 18:16:52 IST

1.0 INTRODUCTION

1.1 BHAGYANAGAR GAS LIMITED (BGL), (hereinafter referred as Owner), has been authorized by PNGRB for setting up infrastructure and operation of City Gas Distribution Network. Natural gas will be transported to residential, commercial, industrial (PNG) and automobile consumers (CNG) in the city.

1.2 BGL is now inviting tenders on Competitive Bidding basis for Supply, laying, erection, testing and commissioning of Mechanical piping & fittings, Civil works, Electrical works and Instrumentation works.

1.3 Brief scope

- Scope of work shall comprise of system Design, Detail Engineering, Procurement of Materials, manufacturing or fabrication, Supply, Installation, Inspection & Factory Acceptance Testing & Testing of system, Packaging, forwarding, Insurance, Shipping related all formalities, Inland Transportation to site, and Supply of all type of Erection Items, site engineering, Pre-Commissioning activity, Testing, Interconnection, Trial Run, Commissioning, Training, support and Warranty Including any civil works etc., & documentation of total system, Testing certificates, calibration certificates of equipment required to complete in all respect.(for details refer Scope Matrix).
- Scope includes Loading from site store, unloading at project site, erection, installation, testing and assistance during commissioning of third-party equipment as per site requirement including required cable and cabling from JB to control system if any.

2.0 POWER SUPPLY

In general, the following power supply shall be used:

- 230 VAC +/- 10%, 50 Hz +/- 3%, Single Phase UPS power supply for all control systems such as Fire detection panel, Gas Detection panel, CCTV panel, Odoriser unit, RTU, telecom and all the associated facility available at station.
- Contractor shall do necessary required voltage conversion from AC to DC (24 V or 48 or 12) as per the system & instrument requirement inside cabinet/panel or else.
- 230 VAC +/- 10%, 50Hz +/- 3%, Single Phase Non-UPS Utility Power for maintenance activities, miscellaneous requirements, utility sockets, Odoriser control unit etc.

3.0 APPLICABLE CODES & STANDARDS

The following Indian/ international or relevant codes and standards shall be used for designing the system. In all cases, latest revisions with amendments, if any, to be followed Apart from the specific codes mentioned herein, all other relevant and related codes concerning the specific job under consideration and/or referred to in these codes and technical specifications shall be followed wherever applicable. All codes shall be of the latest revision as on the date of issuing the tender/ bid document.

In the event of any conflict between this specification, related standards and codes, any other attachment to this tender, the Contractor shall refer the matter to OWNER'S/OWNER' REPRESENTATIVE for clarification and only after obtaining the confirmation on the same, should proceed with the manufacture/ supply / engineering of the item in question. The decision of the OWNER'S/OWNER' REPRESENTATIVE shall be binding on the Contractor.

CONTRACTOR shall seek COMPANY's final interpretation of any conflicts prior to the execution of

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work. Rework of engineering and relevant scope arising out of underestimation shall be done at no additional cost to the COMPANY.

Sr. No	Codes	Description
1	ANSI/ISA S 51.1	Process Instrumentation Terminology.
2	ISA 5.4	Instruments Loop diagrams.
3	IEC 60529 / IS 2147 / NEMA	Specification for Weatherproof Enclosure.
4	IEC 60079	Specification for Flame Proof Enclosure
5	IEC 61000	Electromagnetic Compatibility for Industrial Process Measurement and Control equipment.
6	IEC 60801	EMI and RF interference
7	IS-1554 Part 1	PVC insulated (heavy duty) electric cables- working voltage up to and including 1100V.
8	BS-5308 Part 1, Type 2	Specification for PVC insulated cables.
9	IS 8130	Conductors of insulated cables
10	IS 5831	Specification for PVC insulation and sheath of insulated cables.
11	IS-3975	Mild steel wires, formed wires and tapes for armouring of cables.
12	ASTM D 2843	Test method for Max smoke density for cable
13	ASTM D 2863	Test method for measuring of Temp and O2 Index.
14	IEC 60754	Acid generation test
15	IEC-332-3 Part 3	Tests on bunched wires and cables.
16	BS 6121, EN 50262	Cable gland – flame proof Ex”d” or Exe increase safety.
17	DIN- 50049	Document on Material Testing.
18	ASME PTC 19.3	Temperature Measurement- calculation of natural frequency.
19	IEC 751 / DIN 43760	RTD

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Sr. No	Codes	Description
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21	ISO 5167	Measurement of fluid flow by means of orifice plates, Nozzles and Venturi tube inserted in filled piping circular profile.
22	IS 3624 / BS EN 837	Pressure gauge
23	OISD	Oil Industry Safety Directorate Government of India
23.1	OISD 118	Layouts for Oil & Gas installations
23.2	OISD 152	Safety Instrumentation for Process System in Hydrocarbon Industry
23.3	OISD 153	Maintenance and Inspection of Safety Instrumentation in Hydrocarbon Industry
23.4	OISD 163	Process Control Room Safety
23.5	OISD 195	Safety in Design, Operation, Inspection and Maintenance of Hydrocarbon Gas Compressor stations and Terminals
23.6	OISD-STD-226	Natural Gas Transmission Pipelines and City Gas Distribution Networks.
24	NFPA	National Fire Protection Association
24.1	NFPA-70	National Electrical Code
24.2	NFPA-497	Electrical installation, classification of Class1 & Class 2 hazardous locations
24.3	NFPA-101	Life Safety Code
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25	PNGRB/T4S	Technical & safety standards statutory requirements for natural gas pipelines.

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4.0 STATUTORY APPROVALS / CERTIFICATES (AFTER GETTING ORDER)

4.1 The bidder shall be responsible for obtaining all statutory approvals, as applicable for all instruments and instrumentation systems.

4.2 Equipment / instrument / systems located in electrically hazardous areas shall be certified for use by statutory authorities for their use in the area of their installation. In general, following certification shall be provided by the bidder.

a. For all flameproof equipment / instrument / systems, which are manufactured abroad (outside India) certification by any approving authority like BASEFA, FM, UL, PTB, LCIE, CENELEC etc. shall be required.

b. For all flameproof equipment / instrument / systems manufactured locally (within India), certification shall be carried out by any of the approved testing houses – Central Mining Research Institute (CMRI) etc. The manufacturer shall hold a valid Bureau of Indian Standards (BIS) license.

c. Approval certificate from Chief Controller of Explosives (CCE) or Petroleum and Explosive Safety organisation (PESO) is mandatory for all electronic / electrical instruments / equipment to be installed in India, irrespective of country of origin.

5.0 ENGINEERING UNITS

a	Flow	
	Gas	Sm^3/hr / MMSCMD
	Mass flow	kg/hr.
	Volumetric flow	m^3 / hr.
b	Pressure	Barg
c	Temperature	°C.
d	Level	%.

6.0 CONTRACTOR SCOPE OF WORK

6.1.1 Contractor shall procure and supply all materials other than Company supplied materials, required for permanent installation of I&C items in sequence and at appropriate time. All equipment, materials, components etc. shall be for the intended service, with high reliability and a proven track record.

6.1.2 Recommended vendor list has been enclosed with the bid package for various items. For items which are not covered in the Vendor list, Contractor shall obtain approval from OWNER'S/OWNER' REPRESENTATIVE prior to supply. Necessary details like PTR, data sheets & specifications for the items shall be enclosed.

6.1.3 Stores management includes receipt, warehousing, preserving the material in good condition, issue of material to construction site, reconciling / handing over surplus material to OWNER.

6.1.4 Carryout proper documentation of inspection and quality assurance program for bulk materials duly approved by OWNER'S/OWNER' REPRESENTATIVE. Contractor shall maintain an accurate and traceable listing of procurement records for the location, quality and character of all permanent materials in the Project.

6.1.5 Contractor shall immediately report to the OWNER'S/OWNER' REPRESENTATIVE any defect or change in material which will affect material quality, and necessary corrective actions to be taken as directed by OWNER'S/OWNER' REPRESENTATIVE.

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6.1.6 All construction works shall be carried out as per "Approved for Construction" drawings, procedures, specifications and applicable codes and standards. Any changes at site shall need prior approval from the Company followed by subsequent revision of relevant drawings upon approval.

6.1.7 Contractor shall also inform all local authorities in advance and obtain all necessary approvals for works wherever encountered along the system. Contractor shall be required to carry out all the works as mentioned in the work permit.

6.1.8 In some areas where machine excavation is not possible, Contractor shall have to do manual excavation also. Contractor shall consider all these eventualities while bidding.

6.1.9 Providing schedules, progress reporting, organization chart at construction site, quality assurance plan and developing quality control procedures, as per requirements of the bid package.

6.1.10 Providing all equipment, manpower, machinery, consumables, apparatus, tools and tackles for fabrication, installation, inspection, testing, pre-commissioning and commissioning complete as required.

6.1.11 Coordination and supervising the work of Sub-Contractors.

6.1.12 Transportation of appropriate materials to worksite, intermediate storage points, maintaining and operating an adequate material control procedure at worksite.

6.1.13 Fabrication of all small piping, stand, tubing, structural components as per approved drawings or site conditions.

6.1.14 All associated civil, structural, electrical, instrumentation; and telecom works shall be performed in accordance with relevant specifications, drawings and requirements.

6.1.15 Provide, maintain and operate all temporary facilities required for the construction related works and remove after completion of work.

6.1.16 Mobilizing and providing all equipment's, manpower (skilled and unskilled), consumables and other resources etc. as required for the execution of complete work.

6.1.17 Preparation of as built drawings, documents, photographs, project records as per specification and instructions of the Company including furnishing of all Test Certificates/Inspection Reports for all materials used for permanent installation.

6.1.18 All incidental and associated works and any other works not specifically listed herein but are required to be carried out to complete entire work and the associated facilities and making the entire system ready for operation.

6.1.19 The scope of work under this contract shall be inclusive of breaking of walls and floors, and chipping of concrete foundations necessary for the installation of equipment, materials, and making restoration of the same.

6.1.20 Minor modifications wherever required to be done in the OWNER'S/OWNER' REPRESENTATIVE free supplied equipment's or devices to enable cable entry, termination, etc.

6.1.21 Sealing of openings made in the walls / floors for cable trays, cables, bus ducts, etc. suitably using acceptable practice and standards.

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6.1.22 As-built drawing & document shall be provided for all work done including old systems where any integration has been done. All documentation to be provided as printed documents and computer files compatible with MS Office and Autocad.

6.1.23 Contractor shall be responsible for installation, field testing, calibration and providing assistance for pre-commissioning and commissioning of all instrumentation items.

6.1.24 During trial run/startup/commissioning, Contractor shall provide skilled personnel and supervision round the clock at Contractor's cost. Any defect or changes of setting, recalibration, etc., if any during the above activity shall be rectified / done immediately to the satisfaction of OWNER'S/OWNER' REPRESENTATIVE. The number and category of the personnel shall be as decided by OWNER'S/OWNER' REPRESENTATIVE. The cost of the above is deemed to be included by the Contractor in the rate quoted.

6.2 All system grounds of various cards and equipment, shields of signals (instrument) cables shall connect to system ground bus, which is electrically isolated from the AC mains earthing bus. The equipment shall provide separate earthing strip for the same. The system ground bus shall have independent ground buses through insulated wires.

a) System grounding/Instrument earth (earth resistance less than 1 ohm)

b) Power earth (earth resistance less than 5 ohms)

6.3 Lightning protection

Where connections between control systems and/or distant equipment may be affected by lightning surges or by other inducted high voltages, the connection cables shall be equipped with over-voltage arresters.

6.4 Contractor shall also carry all the calibration equipment/ testing equipment like multi-meter, handheld calibrator, 4-20mA simulator, modbus simulators, diagnostic tools etc.

6.5 Supply and laying of power, signals, control and communication cables, earthing cables. Including supply, laying of cable tray including terminations, ferruling, cable numbering, marking, testing including hot & cold loop testing. Branch cable shall be laid in cable tray and cable from Junction box or field local panel shall be buried. Tentative distance are given below as applicable

- Tentative distance between field instruments to junction box is contractor discretion.
- Tentative average aerial distance between Field JB to control room is 80 mtrs.
- Tentative average aerial distance from ACDB/DCDB to equipment cabinet is 50 mtrs

Note –Contractor shall choose the cable size and type according to need bases to reduce the number of runs but cable size and type shall be according tender only.

6.6 **SCOPE MATRIX**

Part A

Sr. No	Equipment/Packages	Works Packages (Contractor) Scope of work	Free issue material

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1	Pressure gauges, Temperature Gauge with thermowell (as per P&ID)	Design, Detail Engineering, Procurement of Materials, manufacturing or fabrication, Supply, installation of field instruments (including supply, fabrication of canopies, mounting stands, supports etc as per situ conditions), testing, integration with System, configuration/programming, commissioning as per user requirement, test run, and handover as per "PTS-Instrumentation with Appendices" and other tender documents. Scope also includes supply and installation all the erection hardware such as impulse tubing, fittings, protection shed/canopy, SS tag plates with SS Chain, mounting bracket as applicable, mounting stands including associated civil works	None
2	Fire Detection system	Supply, inspection, Testing, factory calibration, installation, erection, site calibration, commissioning and site acceptance, documentation & drawing and handover to Owner etc. "PTS-Instrumentation with Appendices". Scope also includes supply and installation all the erection hardware such as detectors, controller panel, MCP, Exit Sign, Hooter & beacon, Control panel etc. cabling, mounting stands (if any) including all associated works	none
3	CCTV Package	Supply, inspection, Testing, factory testing, installation, erection, site testing, commissioning and site acceptance, documentation & drawing and handover to Owner etc. PTS-Instrumentation with Appendices " Scope also includes supply and installation all the erection hardware , mounting poles, along with the cable accessories, including all associated works, Cable, JB etc. Size and height of mounting pole given in SOR is tentative. Same shall be supply and installed as per site conditions.	None
4	Cables (Signal cable, control cable, communication cable, LAN cable, RS-232/485 cables etc. Optical fiber cable) Fire detection system and CCTV	Cable supply, laying, glanding, termination (field instrument, JB end, panel end), ferruling, lugging, tagging, clamping, marking etc. Scope includes supply of cable tag plates, Cable ferrule, clamps and all the required items to complete the laying works. Cable laying from as below as per cable schedule. Preparation of earthing pit, Laying of earthing cables/ strips for instrument enclosures, junction boxes, cabinet to earth grid. Installation of GI / copper strips for grounding of racks / cabinets / panels in the terminal building with earth pit; Preparation of buried cable trenches (if applicable) including excavation, back filling, compacting, providing of brick protection by second-class bricks, spreading of fine river sand, including all supplies. The job includes repairing of all civil works damaged during installation of electrical facilities.	None

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		Complete loop checking and megger testing of cables.	
5	Cable Tray with cover-branch tray	Supply and laying of perforated branch cable tray (50mm /100m/300m) as per site requirement Scope also includes supply and installation of all the erection hardware such as angle/channels supports, CS/MS plates, including associated civil works.	None
6	Field test	Hydraulic testing of instrument impulse lines (piping/tubing). Field instrument, detectors site calibration,	

Part B

		Scope		
Sr. No.	**Item Description**	**Contractor**	**Client**	**Remarks**
1	Unloading the material/equipment received from vendors to site, shifting of equipment/material from store to installation location etc.	YES		
3	Staff and labor transportation	YES		
4	Labor accommodation.	YES		
5	Labor license.	YES		
6	Wooden sleeper as required.	YES		
7	Required material for preparation of platform	YES		
8	Obtaining statutory approval (if any) for instrumentation system of project.	YES		
9	Preparation of Job Planning and schedule and DPR	YES		
10	All statutory compliance for Hazardous area instruments.	YES		
11	All civil work for earthing pits, repairing of plaster (If required during conceal wiring work).	YES		
12	Scaffolding material and installation	YES		As per requirement.

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13	Welding machines	YES		As per requirement.
14	Documentation like procedure preparation, work schedule, calibration reports, inspection report, progress report, termination details etc. test certificates compliance reports	YES		
15	Temporary Illumination at work site	YES		

7.0 QUALITY ASSURANCE AND QUALITY CONTROL

Contractor shall be fully responsible for their Quality Assurance and associated Quality Control process.

Unless otherwise agreed by the PURCHASER, the Contractor's quality system shall meet the requirements of ISO 9001:2015 Quality System and shall be accredited by a recognized authority.

Contractor is required to establish an acceptable Quality Plan, inclusive of quality manual and procedures that cover all activities of the order, in order to comply with the Quality System requirements.

Contractor shall be responsible for arranging/liaising with the Third-Party Inspection Agency and other agencies for design appraisal, inspection, survey and certification requirements as required by the specification/requisition.

When required, waiver and acceptance of non-conformances shall be subjected to Third Party Inspection Agency approval before COMPANY endorsement. These concession records shall be included in the Manufacturer's Final Documentation.

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	PTS – INSTRUMENTATION WITH APPENDICES	**P.019141 G11077 I001**

BHAGYANAGAR GAS LIMITED

(BGL)

MOTHER STATION COMPOSITE WORKS (CIVIL, MECHANICAL, INSTRUMENTATION AND ELECTRICAL WORKS) HYDERABAD GA

INSTRUMENTATION WITH APPENDICES

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	PTS – INSTRUMENTATION WITH APPENDICES	P.019141 G11077 I001

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1.0 SCOPE

1.1 This document covers design, engineering, testing at works, supply, installation, calibration, erection, testing at site and commissioning, guarantee run, handing over of control and instrumentation system package which includes all field instruments, fire detection system, instrument cables and armoured OFC cables and CCTV system for this PROJECT.

1.2 Scope also includes the supply, erection and installation of material, fabrication, cable laying, fittings, flanges, connectors, impulse tubing and all the associated accessories as required. Refer Scope of work for details.

2.0 DEFINITIONS

Subject to the requirements of the context, the terms (hereafter listed in alphabetical order) used in this specification are given the following meaning:

AGREEMENT	Designates the agreement concluded between the CLIENT and the CONTRACTOR, under which the latter undertakes to the former the GOODS and/or SERVICES according to the stipulations which are agreed and specified in the form of an order.
CLIENT	Designates the purchaser of the GOODS and/or SERVICES which are the subject of the AGREEMENT.
CONTRACTOR	Designates the individual or legal entity with whom the order has been concluded by the CLIENT. The term "CONTRACTOR" may be used indifferently for a supplier, a manufacturer, an erection contractor, etc.
DAYS - WEEKS – MONTHS	Specify the number of calendar days, weeks or months and not of working days, weeks or months.
ENGINEER	Designates the individual or legal entity to which the CLIENT has entrusted various tasks in relation with the carrying out of his PROJECT
GOODS and/or SERVICES	Designate, depending on the case, all or part of the drawings or documents, substances, materials, materiel, equipment, structures, plant, tools, machinery to be studied, designed, manufactured, supplied, erected, built, assembled, adapted, arranged or put into service by the CONTRACTOR under the AGREEMENT, including all the studies, tasks, works and services specified by the order. The Terms GOODS or SERVICES may by indifferently used one for the other as required by the context.
PROJECT	Designates the aggregate of GOODS and/or SERVICES to be provided by one or more CONTRACTORS.

3.0 REVIEW AND/OR APPROVAL

Whenever CLIENT and/or ENGINEER review and/or approval is requested on a document to be submitted

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by the CONTRACTOR, or before an action is implemented by the CONTRACTOR, such review and/or approval shall always be requested in writing by the CONTRACTOR to the CLIENT and/or the ENGINEER, before any action subject of this review and/or approval is taken.

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CLIENT and/or ENGINEER approval shall always be given in writing.

4.0 APPLICABLE CODES & STANDARDS

The following Indian/ international or relevant codes and standards shall be used for designing the system. In all cases, latest revisions with amendments, if any, to be followed Apart from the specific codes mentioned herein, all other relevant and related codes concerning the specific job under consideration and/or referred to in these codes and technical specifications will be followed wherever applicable. All codes will be of the latest revision as on the date of issuing the tender/ bid document.

In the event of any conflict between this specification, related standards and codes, any other attachment to this tender, the Contractor shall refer the matter to OWNER'S/OWNER' REPRESENTATIVE for clarification and only after obtaining the confirmation on the same, should proceed with the manufacture/ supply / engineering of the item in question. The decision of the OWNER'S/OWNER' REPRESENTATIVE shall be binding on the Contractor.

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c. Approval certificate from Chief Controller of Explosives (CCE) or Petroleum and Explosive Safety organisation (PESO) is mandatory for all electronic / electrical instruments / equipment to be installed in India, irrespective of country of origin.

6.0 ABBREVATIONS

- ISO (International Standards Organisation)
- IS (Indian Standards).
- IEC (International Electro technical Commission).
- ASTM (American Society for Testing Materials).
- EIA (Electronics Industry Association).
- BIS (Bureau of Indian Standards).
- IEEE (International Electrical and Electronics Engineers).
- CCE (Chief Controller of Explosives, Nagpur).
- PT – Pressure transmitter

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- TE – Temperature element

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- TT – Temperature Transmitter
- RTU – Remote terminal unit
- SCADA – Supervisory control and data acquisition system
- GOOAV – Gas over oil actuated valve
- HOV – Hydraulic operated valve

7.0 ENGINEERING UNITS

a	Flow	
	Gas	Sm^3/hr / MMSCMD
	Mass flow	kg/hr.
	Volumetric flow	m^3 / hr.
b	Pressure	Barg
c	Temperature	°C.
d	Level	%.

8.0 DESIGN PRINCIPLES

8.1 GENERAL

Instrumentation and control and monitoring systems shall be in accordance with this specification and as defined in the P & I Diagrams.

8.2 INSTRUMENT SELECTION

Instruments and instrumentation systems of proven reliability and latest technology shall be used.

Selection of instrumentation shall be made from the RECOMMENDED Instrument Supplier Lists.

Any exception has to be justified and is subject to approval by the CLIENT.

8.3 TAGGING

All instruments and instrumentation equipment shall be permanently identified by tags, labels and/or nameplates. Use of adhesive tapes shall not be allowed.

8.4 PAINTING

Manufacturer's standard colours shall be used for all instrumentation equipment in control and instrument rooms, unless otherwise specified.

Field instruments shall generally be epoxy painted, unless otherwise specified.

8.5 TRANSMISSION SYSTEMS

Transmission of the process variables shall generally be by means of electronic or low level signals. The output signal for electronic instruments shall be 4 to 20 mA DC or digital.

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No process fluid shall be piped into the control rooms or the instrument rooms.

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8.6 ENCLOSURES AND MATERIALS

All instruments shall be suitable to withstand the environmental conditions specified for the plant location.

All parts subject to moisture, fungus growth or insect attack shall be suitably treated (Tropicalisation).

Local instrument housings shall be weather-proof (IP 65 minimum) and meet the electrical area classification requirements.

All parts of instruments exposed to process fluids shall be resistant to corrosion by the corresponding fluid.

8.7 ELECTRONIC INSTRUMENTATION IN HAZARDOUS AREAS

In hazardous areas, intrinsically safe instrumentation shall be provided in general.

If not possible or not practical, flameproof protection concepts may also be used wherever applicable.

All electrical instruments to be installed in hazardous locations shall be ATEX certified. Contacts shall be encapsulated, hermetically sealed and, if used in intrinsically safe circuits, contacts shall be gold plated.

8.8 R.F. IMMUNITY

All instruments and control systems shall be immune from the effects of any R.F. interference that may occur at the plant location in accordance with IEC 801 "Electromagnetic compatibility for industrial-process measurement and control equipment".

Equipment to be installed inside the control room shall be in compliance with the European Community directive requirements, denoted by the "CE mark". This compliance shall extend to each relevant item.

8.9 ELECTROMAGNETIC INTERFERENCE

The equipment offered shall incorporate the most effective techniques available to minimize the electromagnetic interference effects to ensure that other electronic systems neither adversely affect nor get adversely affected by the system supplied by the contractor. The contractor shall ensure that the electromagnetic interference generated by the system is well below the permissible levels as per applicable standards.

The equipment shall be required to meet one or more of the following standards:

a) IEC 801 – 3 –Latest edition

b) BS 6667- PART 3 - Latest edition

c) ANSI/ IEEE C 37.1- Latest edition

d) MIL – STD - 461

e) VDE 0871

The equipment to be supplied shall be type tested for Electromagnetic Compatibility if certificate of compliance from an independent test authority or test laboratory cannot be furnished.

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8.10 ENGINEERING AND DESIGN DOCUMENTS & DRAWINGS

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The documents and drawings to be prepared by the CONTRACTOR are listed hereunder.

8.10.1 DOCUMENTS

As a minimum requirement, the following documents shall be provided, whenever applicable.

- Instrument data sheets

The data sheets shall comprise all necessary technical data associated with the Instruments as per the enclosed format.

- Certification files

They shall contain copies of all electrical safety certificates and all documents applicable to the safety of electrical equipment installed in hazardous areas (e.g. intrinsically safe loop specifications, " Explosion proof certificate, CCOE certificate etc").

8.10.2 DRAWINGS

As a minimum requirement, the following drawings shall be prepared, when applicable.

- Logic drawing

Plant logic drawings with all the interlocks details for GOOAV, fire detection system, gas detection system and wherever applicable.

- Cable schedule

The cable schedule shall indicate details of the required cables (e.g. cable number, type, length, termination points, pair no, colour code etc.).

- Cable layout drawings

The cable layout drawings shall show the main routing of instrument cables and the location of all instrument junction boxes and local panels.

- Wiring diagrams

The wiring drawings shall show all cable termination details for junction boxes, cross boards, control cabinets, power supply cabinets, auxiliary cabinets, control panels, desks, etc.

- Earthing drawings

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

- Loop diagrams

The loop diagrams shall show the connections between components of each loop with identification of terminals and cables.

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- Control room layout drawings

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Those layout drawings shall show the location of panels inside control room, front and rear arrangements and all the main sizes of panels, cabinets and desks.

- Process hook-up drawings

The process hook-up drawings shall show installation details for the various instruments, complete with a schedule of required material. Contractor to refer attached standard drawings.

9.0 INSTRUMENTATION EARTHING SYSTEM

9.1 General

The earthing for electrical earth and electronic earth shall be arranged to provide safe installations, and to prevent electrical interference with their operation.

All earthing and shielding shall comply with the requirements of all standards applicable to the area classification in which the equipment is installed.

9.2 Instrument cases, panels. etc.

a) All parts of field installations, e.g. Cable trays, junction boxes, local panels, instrument housings, conduits, cable armour, etc.., shall be effectively grounded via the general plant earthing system.

b) Earthing of cable trays shall be in accordance with the IEC requirements as a minimum.

9.3 Each supplied instruments, local control panel, fire detection panel, gas detection panel system shall have earthing lugs with their frames. All these lugs/ strips shall properly secured to the electrical earthing bus.

9.4 All system grounds of various cards and equipment, shields of signals (instrument) cables shall connect to system ground bus, which is electrically isolated from the AC mains earthing bus. The equipment shall provide separate earthing strip for the same. The system ground bus will have independent ground buses through insulated wires.

a) System grounding (earth resistance less than 1 ohm)

b) Frame and AC mains grounding (earth resistance less than 5 ohms)

9.5 Lightning protection

Where connections between control systems and/or distant equipment may be affected by lightning surges or by other inducted high voltages, the connection cables shall be equipped with over-voltage arresters.

10.0 ENVIRONMENTAL SPECIFICATIONS

All equipment shall be designed for operation, storage and transportation under the following environmental condition:

Max. / Min. Temperature	:	0 °C / 55 °C
Design temperature	:	(-) 20 °C to 60 °C

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Relative Humidity	:	95%

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Hazardous Area Classification	:	Zone 2, Gas Group II A or B, Temp. Class T 3
Control Room & Electrical Room	:	Safe Area

11.0 POWER SUPPLY

Electrical power supply shall be provided at one point inside the battery limit as per the details provided below. Further distribution shall be in the scope of the CONTRACTOR. If any other voltage levels are required, then all necessary conversions shall be in the scope of CONTRACTOR.

Normal supply : 230 V AC UPS power supply shall be provided at all the stations for F&G panel. Necessary power conversion 24 VDC or 48 V DC as required shall be done by contractor.

12.0 INSTRUMENTS SPECIFICATION

Follow these specifications as applicable as per P&ID

12.1 PRESSURE GAUGES (PG)

PG shall be Direct-mounting type having element of bourdon tube and dial size of 150 mm. It shall have shatterproof glass. Connection shall be ½" NPT (M) from bottom. Enclosure shall be weatherproof to IP65. Protection shall be 130% over range. Accuracy shall be ±1% of FSD. PG shall have blown out disc facility. For higher pressure applications (above 60 Barg), it shall be solid front type.

Pressure gauge dial shall be white, non-rusting plastic with black figures. The dial face shall be marked with pressure element material. Pointers shall have micrometer adjustment.

Pressure gauge sensing element shall be of SS 316 and moving elements of SS 304, as a minimum.

12.2 THERMOWELL

All temperature measuring instruments shall be provided with thermowell. The process connection shall be flange type. Minimum line size for thermowell connection shall be 4". For lower line size, same shall be expanded to 4".

The thermowell shall be constructed from drilled bar stock of SS316 material. Thermowell shall have a sufficient internal bore to properly accommodate the devices, which are to be placed in the bore.

All thermowells shall be stress analysed for velocity conditions. Calculation shall be done as per ASME PTC 19.3 code. 100% radiography shall be conducted for all fabricated thermowells. Thermowells of long length shall be provided with alternate arrangements as per standards.

Immersion length of thermowell shall be a follows

Line size	Immersion length
From 4" to 6"	280mm
From 8" onward	320mm
Vessel/ Column	400mm

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13.0 INSTRUMENT CABLES

13.1 DESIGN & CONSTRUCTION

13.1.1 All cables shall be Flame retardant low smoke (FRLS) type.

13.1.2 Voltage Grade of cables shall be 650/1100 V.

13.1.3 1Px1.5 mm², 1Qx1.5mm², 2Px1.5 mm², 12Tx1.5mm², 6Px 0.5 mm², 12Px0.5 mm², 1Tx1.5mm² cables shall be used for instrumentation purposes. No other combination shall be acceptable.

13.1.4 Cable shall be supplied in drum and negative tolerance in cable length for each drum shall not be acceptable.

13.1.5 1T x 1.5mm² shall be used for gas detection system. Quad cable shall be used for RTD. Single pair or two pair cable shall be used from field instruments to junction box.

13.1.6 Multi pair cable individual and over all shielded shall be used for all the along signals from junction box to control room and panel to panel inside the control room as applicable

13.1.7 Multi pair over all shielded cable shall be used for all the digital input /output signals from junction box to control room and panel to panel inside the control room as applicable.

13.2 SINGLE PAIR AND QUAD SHIELDED CABLE

13.2.1 Each core shall be 1.5 mm2 made of 7 stranded annealed electrolytic copper conductor. Each strand shall be 0.53 mm dia.

13.2.2 For Intrinsically safe application, primary insulation shall be low density poly ethylene (LDPE). For non-intrinsically safe application, primary insulation shall be 85°C polyvinyl chloride (PVC) as per IS5831 Type C. Thickness shall be 0.5 mm minimum.

13.2.3 A pair shall have twisted cores and number of twists shall be not less than 10 per metre. Colour of core insulation shall be black blue in pair and black, blue and brown in triad.

13.2.4 Individual pair shall be shielded. Shield shall be Aluminium backed by Mylar/polyester tape with the metallic side down helically applied with either side 25% overlap and 100% coverage. Minimum shield thickness shall be 0.05 mm. Drain wire shall be 0.5 mm2 multi-strand bare tinned annealed copper conductor. The drain wire shall be in continuous contact with Aluminium side of the shield.

13.2.5 Inner and outer jacket shall be made of extruded flame retardant 90oC PVC to IS 5831-Type ST2. Oxygen index of PVC shall be over 30%. Temperature Index shall be over 250°C. The thickness of the jacket shall be as per IS-1554 Part 1.

13.2.6 Inner jacket colour shall be black. Outer jacket colour shall be black except, for cables to be used in intrinsically safe systems it shall be light blue. A rip cord shall be provided for inner jacket.

13.2.7 Armour over inner jacket shall be galvanized steel wire as per IS-1554 Part 1.

13.3 MULTIPAIR CABLE WITH INDIVIDUAL PAIR SHIELD AND OVERALL SHIELD:

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13.3.1 Generally the cable shall be same as single pair shielded cable except conductor sizes shall be 0.5 mm2 made of 7 strands of annealed electrolytic copper conductor. Each strand shall be of 0.3 mm dia.

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13.3.2 Overall shield shall be of Aluminium backed up by Mylar/polyester tape helically applied with the metallic side down with either side 25% overlap and 100% coverage. Minimum shield thickness shall be 0.05 mm. Drain wire shall be similar to individual pair drain wire and shall be of the overall shield.

13.3.3 A pair of communication wire shall be provided for multipair cables. Each wire shall be 0.5 mm2 of plain annealed single or multi-strand copper conductor with 0.4 mm thick 85°C PVC insulation. Insulation shall be green and red colour coded.

13.3.4 Pair identification shall be with numbers at interval of not more than 250 mm as per vendor's standard.

13.4 MULTIPAIR CABLE WITH ONLY OVERALL SHIELD

13.4.1 These cables shall be same as above except that the individual pair shall not have shielding.

13.5 ELECTRICAL CHARACTERISTICS

13.6 RESISTANCE:

Maximum DC resistance of the conductor of the completed cable shall not exceed 12.3 Ω / km at 20°C for cables with 1.5 mm^2 conductors and 39.7 Ω / km at 20°C for cables with 0.5 mm^2 conductors.

13.6.1 Capacitance:

Mutual Capacitance:

The mutual capacitance of the pairs or adjacent cores shall not exceed a maximum of 250 pF / m at a frequency of 1 kHz.

Capacitance between any core or screen:

The capacitance between any core or screen shall not exceed a maximum of 400 pF / m at a frequency of 1kHz.

13.6.2 L/R ratio of adjacent core shall not exceed 40 µH / Ω for cables with 1.5 mm2 conductors and 25 µH / Ω for cables with 0.5 mm2 conductors.

13.6.3 The drain wire resistance including shield shall not exceed 30 Ω / km.

13.6.4 Electrostatic noise rejection ratio shall be over 76 dB.

13.7 INSPECTION AND TESTING

CLIENT reserves the right to test and inspect all the items at the manufacture's works.

Manufacturer shall furnish documents such as test certificates to prove the quality and composition of the materials used for manufacturing the cable to the satisfaction of CLIENT/CLIENT's Representative during expediting and inspection.

13.7.1 Type Test:

a) Type Certificates shall be furnished.

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b) Cable shall be flame retardant to IEC 332-3 Part 3 Cat A.

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13.7.2 Routine Tests:

a) These tests shall be carried out by manufacturer during various stages of manufacturing. CLIENT shall review the related documents.

b) Insulation and Sheaths: All tests as per IS-5831 except insulation resistance, voltage and spark test shall be as per BS-5308 Part 2.

c) Armour test as per IS-3975.

d) Conductor resistance.

e) Cable capacitance, L/R ratio.

13.7.3 Acceptance Test:

These tests shall be carried out in the presence of CLIENT / CLIENT's Representative.

13.7.4 Continuity test:

a) Voltage test as per BS-5308 Part 2.

b) Conductor resistance and drain wire resistance.

c) Cable capacitance and L/R ratio test.

d) Electrostatic noise rejection test, type wise for each lot.

e) Tests for uniformity of galvanization of armour as per IS-2633.

f) Oxygen index test as per ASTM D 2863, temp. index test, smoke density rating test, acid gas generation test and flammability test.

g) Dimensional check for overall diameter and under armour/over armour diameter.

h) Overall finish check. In case of any lump purchaser shall have the right to cut outer sheath for lump portion and reject the cable.

i) Check of Drum length and overall length tolerances.

Immediately after completion of electrical tests, the ends of the cable shall be sealed to prevent ingress of moisture with suitable PVC/Rubber caps.

13.8 CABLE GLANDS

13.8.1 Cable gland shall be provided for all the above mentioned cables both at field instrument, junction boxes and local control panel.

13.8.2 Instrument cable gland shall be ½" NPTM insulating glands double compression type, weather proof (WP) IP 65 in field instrument side only for underground instruments tapping to protect the CP current drainage.

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13.8.3 Except that, all other shall be standard metallic gland. All cables glands shall be of nickel-plated brass WP IP65 and they shall be double compression type suitable for armoured cables.

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13.8.4 Flame proof Ex (d) glands in hazardous area shall be supplied and along with Ex (d) certification.

13.8.5 Cable gland shall have PVC shroud.

13.8.6 Reducer/adapter & plug shall be supplied as per requirement. These shall be Nickel plated brass, Weather proof and Flame proof as require.

13.9 CABLE TRAYS AND CABLE DUCTS

13.9.1 All branch cables/trench cable shall run on cable trays.

13.9.2 These cable trays shall be made out of galvanized iron-perforated type of 2.5 mm thickness. These trays are supported with suitable clamps shall be supplied for binding the cables/tubes at every 500 mm interval. All the cable/tubes will be laid in trench, false flooring/ ceiling trays, instrument support structures and supported with 50 mm x 50 mm angles as a minimum.

13.9.3 Maximum width of the cable tray shall be 600mm and height 50mm, 75mm or 100mm as applicable. 25% spare capacity shall be provided in cable trays.

13.9.4 The above ground outdoor field cables shall be laid in durable, non-corrosive hot dipped galvanized perforated cable trays of suitable sizes shall be provided for cable routing between junction boxes/ instruments and buried trench in the station/unit facilities. The cable trays shall be supported at regular intervals.

13.9.5 Contractor shall submit details of cable trays including size, layout drawings etc. during detailed engineering stage. Supply, installation and fixing of Prefabricated hot dipped galvanized perforated cable trays of width 50 mm / 100 mm / 150 / 300 mm as per site requirement for laying of cables. The work includes cutting to size, fixing with all accessories on concrete / wall / structures etc.

13.9.6 The proper NEMA strength classification trays shall be used in accordance with loading requirements. The tray shall be installed with standard vendor/contractor components and shall be covered with perforated covers (of same material) after laying cables.

13.9.7 Cable tray shall be rigidly supported to carry the weight of the cables laid within, as well as any vibrations which may be experienced in normal operation of work. At no time shall the cable tray be used to sit or stand on, nor shall tools or pipe be placed on the tray.

13.9.8 Cable trays and supporting steel structure etc. to be painted as per standard procedures of painting to meet the corrosive area requirement. Proper color shall be provided in the cable trays. Epoxy based paint is to be applied on the all MS structures including support structures. Cable trays shall be installed with cabling etc as per site requirements. Cable laid in horizontal trays shall be fixed to the trays by means of suitable detachable type, non-corrosive straps at intervals not exceeding 500 mm.

13.9.9 Cable trays shall be supported at each 2500 mm or less of horizontal run and shall be so routed that there is no danger of mechanical damage. Routing shall follow major structure axis.

13.9.10 Cable trays for Hydrocarbon detectors cabling etc as per site requirement.

13.10 JUNCTION BOXES

13.10.1 Junction boxes shall be provided for intrinsically safe and non-intrinsically safe instruments also as required for packages such as gas detection system, fire detection system etc.

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13.10.2 For non-intrinsic safe signals, junction box shall be explosion proof to Exd. IIA/IIB, T3 and weatherproof to IP 65 and made up of dia cast aluminium.

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13.10.3 For intrinsic safe signals, junction box shall be weatherproof to IP 65 made up of di-cast aluminium.

13.10.4 Enclosure: Cast in corrosion resistant light aluminium alloy (LM-6) suitable for Group C & D gases. The construction shall comply to IS: 2148 - 1981 and relevant international standard (IEC - 79.1), BS: 229 - 1957). The enclosure shall have ample space for proper termination of cables as per summary of requirement attached and as mentioned in these specifications.

13.10.5 In addition, the enclosure shall be totally dust, vermin and weatherproof suitable for outdoor installation without any canopy. Degree of protection should be minimum IP-65 as per IS/IEC: 60529 – 2001.

13.10.6 Terminals: Junction boxes shall be provided with vibration proof terminals (as per vendor list) clip on type 2.5 sq.mm suitable for 500 VAC working voltage. Arrangement of fixing terminals strip shall be made such that cable connections can be made easily.

13.10.7 Earthing: External and internal earthing terminals complete with set of washers shall be provided.

13.10.8 Mounting: The junction boxes shall be suitable for field mounting on M.S supporting structures.

13.10.9 Painting: Junction boxes shall be pre-treated by first coat of epoxy zinc chromate primer followed by anti-corrosive industrial epoxy grey paint shade IS 631.

13.10.10 Cable entries: The junction boxes shall have bottom entry and should be of NPT threads only.

14.0 FIRE DETECTION SYSTEM

14.1 Fire detection system shall be Conventional/Addressable Type Microprocessor based system. Fire detection system shall be comprised of multisensory detectors, includes optical photo electric type smoke detectors and heat detectors based on rate of raised. Multi sensor detectors shall be installed in the miscellaneous rooms like electrical room, control room/equipment room battery room, false ceiling, and false flooring as applicable of the different stations along the pipeline network. Two detectors shall be connected in loop to avoid false notification.

14.2 Multi sensor shall have combined feature of smoke detectors and thermal sensor (heat detectors). Smoke activity shall be monitored by optical sensing technology in a single detectors/base assembly. Heat detectors shall be fixed with selectable rate of rise setting.

14.3 Optical/photo electric type smoke detectors for timely detection of smoke/fire. Smoke detectors installed above the false ceiling and below false flooring wherever applicable in order to sense the fire occurred in the electrical wiring & fittings etc. The smoke detectors above the false ceiling and below false flooring are not be visible, these detectors shall be fitted with remote Response Indicators located below the false ceiling, and above false flooring (on adjacent wall) which shall glow in the event of actuation of these detectors.

14.4 The Fire Detection and Alarm System shall be of high quality fast-acting conventional system. The system shall consist of compatible microprocessor-based fire alarm control panel, junction boxes, detectors, hooters, beacons, exit signs, response indicators, with starter, Break glass unit (Manual call points) etc. with associated wiring.

14.5 The detecting units shall be installed, tested and commissioned in accordance with NFPA-72, IS & other international standards on Automatic fire detectors.

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14.6 All system components and devices shall be connected to two wire loop circuits in such a way that removal or disconnection of any device from the loop shall not affect the functioning and performance of the system.

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14.7 The system should also have provision to give fault signal which shall be a distinct signal audible and/or visual indicating a failure of electric supply, presence of a break, an earth or other electrical fault on a circuit or system of circuits.

14.8 Devices like hooters, horns, or like which give the sound signals shall be installed to give sounds with the electrical alarm signals from the detectors or when there is fault in the system.

14.9 Electrical wiring must conform to IS: 732-1963 or equivalent International Standards.

14.10 All electrical cables shall conform to IS: 1554 / BS: 5308 Part 2 or equivalent international Standards with latest amendments. All cables to be laid underground in the field shall be armoured type. Cables laid inside conduits in buildings may be unarmoured type

14.11 On the alarming, Hooter outside building area will be actuated.

14.12 A break glass unit (BGU) shall be installed at the outer side of each room and in field wherever feasible (decided during engineering stage) for manual actuation of the fire alarm.

14.13 When a detector is in alarm condition, the information shall be sent to the central unit and the central unit shall send to RTU. The alarm situation of the detector shall remain "ON" until a manual reset device is activated on the central unit. An indicating LED shall permit the direct identification of the detector that is the cause of alarm.

14.14 The fire control panel will derive its power from a 24V DC main, which will be converted to require voltage (DC) level by the contractor inside the panel if require. The fire control panel shall provide the required power to the sensors and accessories and will monitor the zonal circuits for open and short circuit faults. The fire control panel shall also be provided with a secondary power source comprising Maintenance free batteries, for 30 min alarm condition with 24 Hrs back up which automatically takes over the system in the event of failure of main power supply.

14.15 Contacts used in intrinsically safe circuit shall be gold plated. All electronic circuits used in the system shall be free from the effects of any RF interference.

14.16 Fire detection system shall be suitably hooked up with CO2/Clean agent fire suppression system for auto/manual flooding in control room/equipment room and electrical.

14.17 Fire detection system shall have provision of hardwire signals common potential free contact fire detected & sensor fault for interface with RTU/SCADA system.

14.18 HEAT DETECTORS

Heat detectors shall be used negative temperature coefficient thermistor for sensing and for reference. The detectors shall be designed to give a response that depend on both absolute temperature and rate of raise.

The rate of raise element shall be carefully calibrated to ignore any normal fluctuation in temperature, but to respond quickly when the temperature rise is 9 °C or more per minute (also decided during detailed engineering stage).

The fixed temperature feature should be entirely independent of the rate of raise element. The operating temperature of fixed temperature element should be factory set at 57 °C ±5 °C.

The detectors shall be self-restoring type ensuring repeated use and easy maintenance.

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14.19 OPTICAL/PHOTO ELECTRIC SMOKE DETECTORS

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Optical smoke detectors shall work on the principle of light scattering utilizing a light emitting diode.

14.20 Input/output signals

The input signals of the central unit of the fire detection system shall be from:

a) Multisensor detectors etc.

b) Break glass units for a manual actuation of the fire alarm,

c) Break glass units connected in series, located in the plant and actuated manually when fire is detected.

d) LED type Exit sign board

e) Ex proof beacon with hooter field mounted

14.21 SYSTEM COMPONENTS

The system shall for each site comprise:

a) Smoke detectors and Heat detectors (Multisensor)

b) Safe & hazardous area hooter & beacon.

c) Break glass units, (Exit gate of each room)

d) A central unit equipped with “silence alarms” and “reset” key push-button.

14.22 THE FOLLOWING TECHNICAL DATA SHALL BE SUPPLIED BY THE CONTRACTOR:

a. Power supply:

- Operating
- minimum
- maximum

b. Consumption during normal condition.

c. Consumption during alarm condition.

d. Operating temperature range.

e. Operating humidity range.

f. Sensibility,

14.23 DETECTOR

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The detector shall consist of:

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a) an I.R. source LED,

b) a SI-diode receiver,

c) electronic connections and electric contacts with high impedance,

d) heat sensor

e) a metallic protection,

f) sensitive elements impregnated with silicone rubber,

g) an anti-condensation system,

h) an indicating LED,

i) A mounting base.

14.24 CENTRAL UNIT

The central unit shall consist mainly of:

a) A power supply module comprising power supply and charger for one 24 V safeguard battery.

b) A monitor module for earth leak faults, short-circuits, lamp or LED test and general reset push button,

c) A monitor module for power supply and battery failures associated with a general alarm switch and an indicating lamp or LED,

d) A general alarm module associated with a reset push button of the audio signal,

e) A module able to monitor the state of the input signals and to generate the right action with regard to the output signals,

f) A front panel with lamps or LEDS to indicate the state of the input and output signals.

g) Sensor fault shall be provided from Fire Alarm Control Panel (FACP) to RTU.

h) All devices connected at the inputs of the central unit shall be supplied with electronic connections and electric contacts with high impedance to facilitate the immediate detection of short-circuit or line cuts.

i) Fire detection panel shall be wall mounted.

14.25 Input supply and battery backup

- Input Supply 24 V DC
- 24 hrs backup (normal state) & 30 min in alarm state
- Batteries VRLA

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14.26 Battery charger provided in the FACP shall be modular mounted on a draw out chassis. Charger module shall be located on the front allowing withdrawal with the help of handlebars for maintenance.

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14.27 Logic of operation shall be preferably built on "Fail safe" feature i.e. NC contact of field devices shall be considered as healthy condition and NO as fire condition. 1 NO+ 1 NC contact of output relays shall be wired to terminal block for interface with Owner's other equipment.

14.28 It shall be possible to test lamps, hooters, flasher circuit, and carry out functional tests etc. through common "Test" push button.

14.29 The circuit shall be so designed that silencing of the current alarm by ACCEPT push button shall not prevent annunciation of subsequent fire alarm received from any other location.

14.30 Signal-to noise ratio shall be high to avoid spurious actuation due to noise induced in the field wiring because of proximity with power cables. Cables for field devices shall be multicore copper conductor, unscreened, armoured, copper conductor cable.

14.31 Detectors and BGUs shall be wired through 1.5 mm2 multi-core, copper conductors, PVC insulated, armoured FRLS cable.

14.32 LEDs shall be provided for fire/ fault visual annunciation on the panel front. LED shall also be provided for Power supply healthy, Battery backup ON, Battery/ Charger status.

14.33 If zone is protected with clean agent/CO2 system, the detectors and BGUs of the zone shall be wired in cross-zones by providing minimum two signaling circuits in a zone. The last device in each circuit shall be provided with end of line resistor of suitable value as per circuit design to facilitate cable open circuit and short circuit detection.

14.34 Vendor shall decide the zones according to area/rooms. These zones shall be created in coordination with CO2/Clean agent supplier. Zone wise alarm output signals shall go to the Beacon, Hooter, Siren actuation, CO2/Clean agent flooding system and RTU.

14.35 SCHEME FOR FIRE/ FAULT ANNUNCIATION:

System condition	AUDIO	VISUAL
NORMAL	OFF	OFF
FIRE	ON	Flasher ON, Fire LED Steady ON
Accept	OFF	Flasher steady, Fire LED steady ON
Reset	OFF	Flasher OFF, Fire LED OFF

15.0 CCTV System

15.1 POE CCTV system will be provided at all stations in each GA in order to provide enhanced security and movement control at each station.

15.2 All the Cameras and NVR shall be ONVIF compliant.

15.3 CCTV system is required to selectively display real time video signals of the field area in the control building. This system shall monitor video signal from various cameras installed at different locations within GA. It shall be able to select individual camera without interfering with the off-line functioning of the CCTV system

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since recording of all cameras shall be simultaneous and in real time environment.

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15.4 CCTV system shall have provision for superimposing text in order to identify camera positions with a time and date stamp facility and shall have facility of both i.e. viewing and for recording as well. This system shall have an extensive self-diagnostic program to detect and report any system fault.

15.5 Network Video Recorder (NVR) will be provided to record CCTV camera video feed. Recording shall be on a continuous basis for 30 days and suitable storage shall be provided in order to store the recorded video. It shall have programmable facility to restrict access through password. It shall have real time clock.

15.6 CCTV camera shall be color camera (day / night) with high resolution. Camera shall be able to generate alarm on detecting loss of video. All outdoor cameras shall be ingress protected to a minimum of IP 65. Camera installed in hazardous area shall be explosion proof Ex'd' as a minimum.

15.7 The CCTV system shall include, but not limited to, the following equipment:

- Network Video Recorder (NVR) with storage
- Workstation with monitor
- Big screen
- Fixed Camera – Outdoor.
- Camera Poles.

16.0 INSTALLTION MATERIAL SPECIFICATION

16.1 All instruments impulse line (1/2" tubes) shall be consist of tubing and piping. The impulse tube shall be SS316. Compressed type ferrule fitting such as ½" NPT (M) to NPT (F) fittings (male/female connectors), ½" tee, ½" union including ½" isolation needle/ball valves & other accessories shall be according piping material specifications.

16.2 Instrument Impulse tubing

1/2" OD x 0.065" and 1/4" OD x 0.065" (if applicable) wall thickness, seamless, fully annealed 316 stainless steel tubing shall be used.

Tubes shall be cold drawn as per ASTM A 269.

Hardness of the tubes shall be Rockwell RB 70 – 79.

16.3 Compression fittings

- Compression fittings shall be of the two-ferrule type in 316 stainless steel.
- Fittings shall be of flareless compression type and four-piece (for double compression type) construction consisting of two ferrules, nut and body suitable for use on SS tubes conforming to ASTM A 269 TP 316 with hardness in the range of RB 70 to 79.
- Hardness of the ferrules shall be in the range of RB 85-90 so as to ensure a hardness difference of the order of 5 to 10 between tubes and fittings for better sealing.
- Nuts and ferrules of a particular size shall be interchangeable for each type.

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- Spanner hold shall be metric.
- Threaded ends of fittings shall be NPT as per ANSI B 1.20.1

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- Specific techniques like silver plating shall be used over threading in order to avoid jamming and galling.
- It shall be ensured by the contractor that all fittings shall match the seamless ½" OD SS 316 instrument tube with wall thickness of 0.065" conforming to ASTM A 269

16.4 Instrument valves and manifolds

- Vendor shall supply instrument valves (miniature type) and valve manifolds wherever required.
- Body rating shall be as per piping class or higher.
- Valve body and trim material shall be 316 SS unless otherwise specified. Superior trim material shall be selected as required by process conditions. Packing material in general shall be of PTF
- The isolation valves for instrument service shall be 316 stainless steel, unless process conditions require another material.

16.5 Instrument Sunshades

Instrument sunshades shall be made from Fiber glass reinforced, polyester/Metallic, supplied with mounting clamp (epoxy coated) suitable for a 2" instrument stand.

For instruments located in hazardous area, sunshades shall be as described here above but anti-static type.

16.6 Instruments supports/structural steel

The supports for instruments and junction boxes shall be in accordance with the "Instrumentation Standard hook up drawing "as attached. Vendor shall supply instrument stands, stanchions and other structural steel material required for supporting the cable trays, impulse line and instruments.

16.7 Cable Ties

All cable ties shall be constructed from black PVC and have a breaking load greater than 20 kg. They shall be of a self-locking style and non-slip but shall be releasable for the addition of extra cables. Cable ties for use on trays shall fix into the tray slots (two-piece ties).

16.8 Nameplates Tags labels

The nameplates, tags and labels for identifying junction boxes, instruments, panels, cabinets, etc shall be made from engraved trifoliate.

17.0 INSPECTION AND TESTING

17.1 The manufacturer shall carry out inspection and testing as per relevant codes and service requirements of this specification, for all items of work prior to shipment. Manufacturer's test certificates in proper format must be sent with the despatch paper of all supply items.

17.2 All instruments and system-oriented items shall undergo factory testing and inspection by Contractor's authorized representatives, Owner/Consultant unless specified otherwise.

17.3 Wherever inspection at manufacturer's shop is waived because of any reason, the sub vendor's own testing

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reports shall be verified before dispatch. In no case, items shall be released without proper inspection/ verification.

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17.4 The instrumentation inspection and testing shall be carried out as per inspection and test plan attached with bid document, other specifications and documents. Where, the inspection and test plan is not available, Contractor shall develop the inspection and test plan and submit for review/approval by the Owner/Consultant.

17.5 Testing and inspection of all instrumentation items shall be carried out as per approved factory testing procedures. For instrumentation items where no testing is witnessed by the Owner/Consultant, following test certificates shall be forwarded for review before dispatch of such instrument:

- Verification of certificates as applicable for the material certificates, NDT reports like radiography/ X-ray/ die-penetration/ MP etc., statutory certificates for Intrinsic safety and explosion proof, certificates of conformity etc.
- Visual verification for quantity, quality and workmanship.
- Hydro testing and pneumatic testing as applicable.
- Functional and performance test certificates including calibration, accuracy, and repeatability testing of instruments.
- Test certificates for pressure relief valves, set pressure & seat leakage test
- Radiographic test for pressure relief valves and thermowells.

17.6 Contractor shall submit all instrumentation test records / test results for records to Owner/Consultant as bound volume along with the test procedure for each test carried out.

17.7 Acceptance test

After completion of the CONTRACTOR tests, the CONTRACTOR shall perform, at the CONTRACTOR's facility, a functional test on 100 % of inputs and outputs with simulation panel provided and wired up by the CONTRACTOR.

All deficiencies shall be recorded, and corrections made.

Appropriate tests shall be run to demonstrate that the deficiencies have been corrected and that there has been no degradation to the system.

17.8 On-site acceptance test

These tests shall be basically a repeat of the system factory acceptance test. To the extent possible, the simulation of I/O signals shall be replaced by the actual signals.

18.0 PAINTING, MARKING AND SHIPMENT

All items shall be painted and marked as per manufacturer's standard before shipment. All items shall be properly packed and protected to avoid damage during shipment. Insurance during shipment shall be ensured by the manufacturer.

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PRESSURE GAUGE

UNITS: Flow<-> Liquid- m*3/hr Gas- Sm*3/hr Steam- kg/hr Pressure-> Barg Temperature<-> oC Level/Length<-> mm

1	Type:-	Direct	
2	Mounting:-	Local	
3	Dial Size:-	150 mm	
	Colour:-	White with black inscriptions	
4	Case Material:-	SS316	
5	Bezel Ring:-	Beyonet type SS316	
6	Window Material:-	Shatterproof glass	
7	Enclosure:-	WP to IP 65 as per IEC 60529 / IS 2147	
8	Pressure Element:-	Bourdon	
9	Element Material:-	SS316	
10	Socket Material	SS316	
11	Accuracy:-	+/-1% of FSD	
12	Zero adjustment:-	Micropointer	
13	Connection:-	1/2" NPT(M)	
	Connection Location:-	Bottom	
14	Movement:-	SS316	
15	Diaphargm Seal:-	--	
	Type:-	--	
	Wetted Parts Material:-	--	
	Others Material:-	--	
	Process Connection: Size & Rating	--	
	Facing & Finish:-	--	
	Capillary Material:-	--	
	Armour - Flexible Material:-	--	
	Capillary Length:-	--	
	Flushing/Filling connection with:-	--	
16	Over Range Protection:-	130% of FSD	
17	Blow Out Protection:-	Yes	
18	Options :-	a) Snubber	
	b) Syphon	c) Gauge Saver	
	d) Liquid Filled casing	e) Vaccum Protection	
	f) Solid front	g) Two valve manifold	
19	Quantity :-	*	

SL. NO.	TAG NO.	RANGE Kg/Cm²	PRESSURE			TEMPERATURE			SERVICE	OPTIONS
			OP.	MAX.	DES.	OP.	MAX.	DES.		
	As per P&ID	0 to 60							Natural gas	g required

* Venodr to furnish

1 Contractor shall develop details data sheet with all the required information like make/model etc, during detail engineering

☐ DEVIATION ☐ NO DEVIATION VENDOR'S SIGNATURES WITH SEAL

		P.019141 G11049 I001						
Sheet No. 01 of 14	CLIENT:	BGL						
	PROJECT:	HYDERABAD GA						
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JUNCTION BOXES

General	1	Tag No.	Quantity	*	*
	2	Application		For Instrumentation Non-IS cables	
	3	Area Classification		Zone 2, Gr. IIA / IIB, T3	
	4	Enclosure		**WP to IP 65 as per IEC60529 & Exd IIB T6 as per IEC 60079 / IS 2148**	
	5	Material of Construction		Die cast aluminium (LM6 alloy)	
	6	Overall Dimension		*	
	7	Cover		Screwed	
	8	Painting		Surface : grey & Inside : White	
	9				
Single Cable	10	No. of Entry	Left Side	6 nos. - 1/2" NPT(F)	
	11		Right Side	6 nos. - 1/2" NPT(F)	
	12		Top Side	-	
	13		Bottom Side	-	
	14		Other	-	
	15	Cable Gland	Type	Double compression, Nickel plated brass & WP to IP 65 & EExd IIB T6 as per IEC 60079 / IS 2148	
	16		Size	1/2" NPT(M)	
	17				
	18				
	19				
Multi Cable	20	Entry		2 Nos, 1 1/2" NPT, Bottom	
	21	Cable Gland	Type	Double compression, Nickel plated brass & WP to IP 65 & EExd IIB T6 as per IEC 60079 / IS 2148	
	22		Size	11/2" NPT(M)	
	23				
	24				
Terminals	25	Type		Spring loaded, antiloosening & vibration-proof, screwless clamp type	
	26	Quantity		48 Nos.	
	27	No. of Rows		2 Nos.	
	28	Numbering System		Terminal strips & terminals shall be suitably numbered	
	29	Size		2.5 mm2	
	30	Make		*	
	31				
Options	32	Telephone Socket & Plugs		Required	
	33	Plug		1/2" NPT(M) & 11/2" NPT(M)	
	34	Ground Busbar		Required	
	35	Rail(s) for terminals		Required	
	36	PVC hood alongwith Cable gland		Required	
	37	Hinges		Required	
	38	Nameplate Fixture		Required	
	39	Gasket		Neoprene Rubber	
	40	Hardware		MS Zinc passivated	
	41	Mounting		Suitable for mounting wall, column, steel structure	
Others	42	Manufacturer		As per Approved /Recommended vender list	
	43	Model		*	
	44				
	45				
	46				
	47				

NOTES:

* : Vendor to furnish

1 Junction boxes shall have detachable cover which is fixed to the box by means of cadmium plated triangular head / hexagonal head screws.
2 Junction boxes shall have a warning engraved / integrally cast on the cover as "ISOLATE POWER SUPPLY ELSEWHERE BEFORE OPENING".
3 Quantity of Cable glands & plugs shall be as per requirement.
4 Junction box numbers based on cable schedule along with data sheet shall be submitted by contractor for approval

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INDOOR DOME FIXED CCTV CAMERA SPECIFICATION			
SYSTEM	1	**Type**	Fixed POE based Note-1
	2	**Video Standard**	PAL/NTSC
	3	**Scaning System**	Progressive
	4	**Image Sensor**	1 / 3" 4 Megapixel progressive CMOS or Better
	5	**Resolution**	4MP
	6	**Number Of Pixels**	2688(H) x 1520(V)
	7	**Minimum illumination**	0.005 Lux/F1.5 (Color,30IRE), 0 Lux/F1.5 (IR ON) or Better
	8	**Compression**	H.265/H.264 sub-stream: H.265/H.264//MJPEG
	9	**Frame Rate for Main & Sub Stream**	Main Stream: *4MP - 25/30 fps Sub Stream: * 2MP - 25/30 fps
	10	**Video Output**	4M (2688 x 1520); 3M (2304 x 1296); 1080p (1920 x 1080); 1.3M (1280 x 960); 720p (1280 x 720); D1 (704 x 576/704 x 480); VGA (640 x 480); CIF (352 x 288/352 x 240)
	11	**Video Frame Rate**	25fps or better
	12	**Sync System**	Internal
	13	**Automatic Electronic Shutter**	1/20 to 1/15000 sec or better
LENS	14	**Lens**	2.7 mm~13.5 mm, Motorized
	15	**Angle of View**	H:26°-90° , V:20°-60°
	16	**IR LED'S**	Yes

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CAMERA FEATURES	17	**IR Illumination Distance**	Up to 40m or Better
	18	**SNR**	More than 30db
	19	**Day / Night**	Auto
	20	**Automatic Gain Control**	Auto
	21	**White Balance**	Auto
	22	**Digital Noise Reduction**	3DNR
	23	**Wide Dynamic Range**	120 Db
	24	**Backlight Compensation**	BLC / HLC / WDR
	25	**OSD**	YES
	26	**On Board Storage**	Built-in microSD/SDHC/SDXC slot, up to 256 GB (min.) or Better
ANALYTICS	27	**Analytics**	Motion Detection, Video Tamper,Smart Tripwire, Intrusion
NETWORK	28	**Ethernet**	RJ-45 (10 / 100 Base-T) or Better
	29	**Connector**	RJ-45
	30	**Security**	Password Protected access, IP address filtering & user access log facility
	31	**Compatibilty**	ONVIF Profile S / G / M / T
BITRATE	32	**Bit Rate Control**	*
	33	**Bit Rate**	*
ELECTRICAL	34	**Input Voltage**	*
	35	**Power Consumption**	*
AL C	36	**Dimensions**	*

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MECHANI	37	**Weight**	*
	38	**Construction**	*
ENVIROMENTAL	39	**Operating Temperature**	-10°C to + 50˚C
	40	**Relative humidity**	Less than 95%, non-condensing IP
	41	**IP Rating**	IP 65 or better
	42	**Vandal Resistance**	IK10 or better
REGULATORY	43	**Certifications/Approvals**	UL,BIS,FCC,CE
	44	**Emissions**	*
	45	**Immunity**	*
	46	**Safety**	*
GENERAL	47	**Make**	*
	48	**Model**	*

Notes:

a)	Vendor to specify.*
b)	Vendor to confirm the below points :
1	If the distance is not within range, then the vendor shall supply & lay power cable and optical cable along with a media converter.
2	Vendor shall supply & install the CCTV's with microSD/SDHC/SDXC card of suitable Capacity (min- 256 GB).
3	For installation of Dome CCTV's JB's along with SPD shall be provided as per the site conditions with each camera .

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	PROJECT:	HYDERABAD GA	0	25.09.2024	KR	SD	MS
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OUTDOOR WP FIXED BULLET CCTV CAMERA SPECIFICATION			
SYSTEM	1	**Type**	Fixed POE based Note-1
	2	**Video Standard**	PAL/NTSC
	3	**Scaning System**	Progressive
	4	**Image Sensor**	1 / 3" 4 Megapixel progressive CMOS or Better
	5	**Resolution**	4MP
	6	**Number Of Pixels**	2688(H) x 1520(V)
	7	**Minimum illumination**	0.005 Lux/F1.5 (Color,30IRE), 0 Lux/F1.5 (IR ON) or Better
	8	**Compression**	H.265/H.264 sub-stream: H.265/H.264//MJPEG
	9	**Frame Rate for Main & Sub Stream**	Main Stream: *4MP - 25/30 fps Sub Stream: * 2MP - 25/30 fps
	10	**Video Output**	4M (2688 x 1520); 3M (2304 x 1296); 1080p (1920 x 1080); 1.3M (1280 x 960); 720p (1280 x 720); D1 (704 x 576/704 x 480); VGA (640 x 480); CIF (352 x 288/352 x 240)
	11	**Video Frame Rate**	25fps or better
	12	**Sync System**	Internal
	13	**Automatic Electronic Shutter**	1/20 to 1/15000 sec or better
LENS	14	**Lens**	2.7 mm~13.5 mm, Motorized
	15	**Angle of View**	H:26°-88° , V:20°-60°
	16	**IR LED'S**	Yes

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CAMERA FEATURES	17	**IR Illumination Distance**	Up to 50m or Better
	18	**SNR**	50db or Better
	19	**Day / Night**	Auto
	20	**Automatic Gain Control**	Auto
	21	**White Balance**	Auto
	22	**Digital Noise Reduction**	3DNR
	23	**Wide Dynamic Range**	120 Db
	24	**Backlight Compensation**	BLC / HLC / WDR
	25	**OSD**	YES
	26	**On Board Storage**	Built-in microSD/SDHC/SDXC slot, up to 256 GB (min.) or Better
ANALYTICS	27	**Analytics**	Motion Detection, Video Tamper,Smart Tripwire, Intrusion
NETWORK	28	**Ethernet**	RJ-45 (10 / 100 Base-T) or Better
	29	**Connector**	RJ-45
	30	**Security**	Password Protected access, IP address filtering & user access log facility
	31	**Compatibilty**	ONVIF Profile S / G / M / T
BITRATE	32	**Bit Rate Control**	*
	33	**Bit Rate**	*
ELECTRICAL	34	**Input Voltage**	*
	35	**Power Consumption**	*
CAL	36	**Dimensions**	*

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MECHAN	37	**Weight**	*
	38	**Construction**	*
ENVIROMENTAL	39	**Operating Temperature**	-10°C to + 50˚C
	40	**Relative humidity**	Less than 95%, non-condensing IP
	41	**IP Rating**	IP 66 or better
	42	**Vandal Resistance**	IK10 or better
REGULATORY	43	**Certifications/Approvals**	UL,BIS,FCC,CE
	44	Emissions	*
	45	Immunity	*
	46	Safety	*
GENERAL	47	Make	*
	48	Model	*

Notes:

a)	Vendor to specify.*
b)	Vendor to confirm the below points :
1	If the distance is not within range, then the vendor shall supply & lay power cable and optical cable along with a media converter.
2	Vendor shall supply & install the CCTV's with microSD/SDHC/SDXC card of suitable Capacity (min- 256 GB).
3	For installation of Bullet CCTV's JB's (IP-65) along with SPD shall be provided as per the site conditions with each camera .

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	PROJECT:	HYDERABAD GA	0	25.09.2024	KR	SD	MS
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OUTDOOR EXPROOF FIXED BULLET CCTV CAMERA SPECIFICATION			
SYSTEM	1	**Type**	POE/AC/DC Power based Note-1
	2	**Video Standard**	PAL/NTSC
	3	**Scaning System**	Progressive
	4	**Image Sensor**	1 / 2.8" 2 Megapixel progressive CMOS or Better
	5	**Resolution**	2MP
	6	**Number Of Pixels**	1920(H) x 1080(V)
	7	**Minimum illumination**	0.005 Lux/F1.8 (Color), 0 Lux/F1.8 (IR ON) or Better
	8	**Compression**	H.265/H.264; sub-stream: H.265/H.264//MJPEG
	9	**Frame Rate for Main & Sub Stream**	Main Stream: *2MP - 50/60 fps Sub Stream: * 2MP - 25/30 fps
	10	**Video Output**	1080p (1920 x 1080); 1.3M (1280 x 960); 720p (1280 x 720); D1 (704 x 576/704 x 480); VGA (640 x 480); CIF (352 x 288/352 x 240)
	11	**Video Frame Rate**	25fps or better
	12	**Sync System**	Internal
	13	**Automatic Electronic Shutter**	1/20 to 1/8000 sec or better
LENS	14	**Lens**	4.3 mm~129 mm
	15	**Optical Zoom**	30X
	16	**Angle of View**	H:2.3°-60° , V:1.7°-37°
CAMERA FEATURES	17	**SNR**	50 db or Better
	18	**Day / Night**	Auto
	19	**Automatic Gain Control**	Auto
	20	**White Balance**	Auto
	21	**Digital Noise Reduction**	3DNR
	22	**Wide Dynamic Range**	120 Db or Better
	23	**Backlight Compensation**	BLC / HLC / WDR
	24	**OSD**	YES

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	25	**On Board Storage**	Built-in microSD/SDHC/SDXC slot, up to 256 GB (min.) or Better
ANALYTICS	26	**Analytics**	Motion Detection, Video Tamper,Smart Tripwire, Intrusion
NETWORK	27	**Ethernet**	RJ-45 (10 / 100 Base-T) or Better
	28	**Connector**	RJ-45
	29	**Security**	Password Protected access, IP address filtering & user access log facility
	30	**Compatibilty**	ONVIF Profile S / G / T
BITRATE	31	**Bit Rate Control**	*
	32	**Bit Rate**	*
ELECTRICAL	33	**Input Voltage**	*
	34	**Power Consumption**	*
MECHANICAL	35	**Dimensions**	*
	36	**Weight**	*
	37	**Construction**	*
ENVIROMENTAL	38	**Operating Temperature**	-40°C to + 60˚C
	39	**Relative humidity**	Less than 95%, non-condensing IP
	40	**IP Rating**	IP 68 or better
	41	**Housing**	*
REGULATORY	42	**Certifications/Approvals**	ATEX/IECEx , BIS , PESO
	43	**Emissions**	*
	44	**Immunity**	*
	45	**Safety**	*
	46	**Hazardous Certifications**	*

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GENERAL	47	**Make**	*
	48	**Model**	*

Notes:

a)	Vendor to specify.*
b)	Vendor to confirm the below points :
1	If the distance is not within range, then the vendor shall supply & lay power cable and optical cable along with a media converter. The convertor etc . will be placed in an Ex-Proof Junction Box. For installation of Ex-Proof CCTV's JB's (IP-65 IIC Exd , T3) along with SPD shall be provided as per the site conditions with each camera .
2	Vendor shall supply & install the CCTV's with microSD/SDHC/SDXC card of suitable Capacity (min- 256 GB).

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NVR, CCTV WORKSTATION SPECIFICATION			
GENERAL	1	**Make**	*
	2	**Model No.**	*
	3	**Type**	NVR , ONVIF compliant
	4	**Qty**	As per SOR
INPUT	5	**Type**	*
	6	**IP Video Input**	16 - channel
	7	**Two - way audio Input**	1 - channel, RCA (2.0 vp-p, 1 KΩ) or Equivalent
	8	**Incoming Bandwidth**	80 mbps or better
OUTPUT	9	**Decoding Resolution**	5 MP/ 4 MP/ 3 MP/ 1080P or better
	10	**HDMI/VGA Output**	1 - Channel resolution: 1920x1080P/60Hz, 1600x1200/60Hz, 1280x1024/60Hz, 1280x720/60hz,
	11	**Audio Output**	1 - Channel RCA (Linear, 1kΩ) or Equivalent
	12	**Playback Resolution**	5 MP/ 4 MP/ 3 MP/ 1080P or better
	13	**Synchronous Playback**	16 Channel 4CIF / 8-CH 720P / 4-CH 1080P /2-Ch 5MP
HARD DISK	14	**SATA**	2 SATA HDD interfaces per port support upto 10TB
	15	**Capacity**	2TB or better
DISPLAY	16	**Work Station**	32" Client Workstation along with licensed Operating System Software, Keyboard along with required cables, connectors, interfaces complete as per specifications.
EXTERNAL INTERFACE	17	**Network Interface**	Ethernet Interface
	18	**USB Interface**	2 x USB 2.0 or better

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PROCESS	19	**Power Supply**	240 VAC UPS supply
	20	**Consumption**	*
	21	**Operating Temperature**	-10 to 55 Deg c
	22	**Operating Humidity**	10% to 90%
	23	**Chassis**	19-inch rack-mounted 1U chassis
	24	**Dimension(WxDxH)**	*
	25	**Weight**	*

Notes:

a)	Vendor to specify.*

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CCTV MONITOR SPECIFICATION		
1	Make	*
2	Model	*
3	LED Screen Size	32" or Better
4	Resolution (per LED Cabinet)	Min 1920 x 1080 (Full HD)
5	Contrast Ratio	3,000:1 or Better
6	Bezel Width	Slim
7	LED Type	3-in-1 Black SMD
8	Environment/Application	Indoor; Fixed,
9	Standard Mounting Configurations	Fixed, Self-Standing
10	Installation, Service	Rear
11	Pixel Configuration	SMD 3-in-1 (1R1G1B)
12	LED Configuration	1 Red, 1 Green, 1 Blue
13	LED Surround	Black
14	Brightness	600 nits
15	Brightness, Uniformity	0.97
16	Viewing Angle	160° (horizontal), 140° (vertical) or Better
17	Color Space	92% NTSC
18	Color Uniformity	0.97
19	Colors	200 trillion
20	Frame Rate	50, 60 Hz
21	LED Refresh Rate	3,000 Hz
22	Runtime Duty Cycle	24x7
23	Acoustic noise	Fan less Operation
24	Operating Temperature/Humidity (degrees F/C, relative humidity)	+14° to +104°F (-10° to +40°C) at 10-80% RH
25	Storage Temperature/Humidity (degrees F/C, relative humidity)	-4° to 140°F (-20° to +60°C) at 10-85% RH
26	Redundancy	Optional dual power supply, optional redundant video cabling
27	Line Voltage	100-240 Volts AC, 50 & 60Hz
28	Input Analogue	RGB
29	Input external control	RS 232C
30	Input USB	2 nos USB 2.0
31	Input wired LAN	RJ 45

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32	Input Wi-Fi	Yes
33	Audio output	Yes
34	Video Input Type	HDMI
35	Accessories	Remote controller including 2 nos spare batteries, mounting brackets etc.

Notes:

a) Vendor to specify.*

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Datasheet-Conventional /Addressable type Fire Detector Controller

1	Fire Detection Panel	**Make**	*
2		**Model**	*
3		**Panel Type**	Wall Mounting
4		**Panel Size (W X D X H)**	as per OEM standard
5		**MOC**	as per vendor
6		**Cable Entry**	Bottom
7		**Colour**	RAL 7035
8		**Internal Wiring**	0.5, 1.5 & 2.5 Sq MM Flexible Wires
9		**Protection Class**	IP 42 minimum
10		**Indication on Panel**	UPS/battery charger supply ON-OFF, 24VDC ON-Off , Lamp Test , Battery On-Off
11		**System capacity**	Expandable to 1.5 times
12		**Rest / Acknowledge**	Push Button/soft buttonss for Reset and Acknowledge
13		**SIL 2 certification**	-
14	CONTROLLER	**Type**	*
15		**Power Supply**	24 VDC
16		**Power Conversion**	Vendor to decide if any
17		**Current in Noraml condition**	*
18		**Current in Alarm condition**	*
19		**Sensor Input**	*
20		**Alarm output**	Following ouput shall be provided
21		**Zoneswise**	Zonewise potential free contact for Flooding system to initiate flooding after getting alarm
22		**Hooter**	Potential free contact to Field mouned dual tone hooter (Note 2) and wall mounted hooter with flasher
23		**Repeater**	All zone wise alarm shall be repeated to repeater panle in Guard room (Note 4)
24		**Hooter**	Common alarm signal from all the zones (Potential free contact)
25			
26		**Front Panel Indication**	Zones wie alrm indication, Power indication, fault & Alarm. Reset / Accept Button, Battery healthiness indication
27		**Operating Temp**	0 deg C to + 50 Deg C
28	RTU Interface (Note 6)	**RS 485**	-
29		**Common Alarm**	24 V DC Potentail free contract (Separate terminal block is required)
30		**Common Alarm (MCP)**	24 V DC Potentail free contract (Separate terminal block is required)
31		**Sensor fault**	24 V DC Potentail free contract (Separate terminal block is required)
32		**Battery**	24 hrs backup (normal state) & 30 min in alarm state

NOTE :

1	All Alarm signals from all the sensor shall be connected in series and provided common alarm for RTU
2	Fire detection system shall be in compliace with NFPA 72. All required certificate shall be submitted
3	-
4	Supply of all the fire detectors signals, power and communication cables shall be in contractor scope incluidng laying and termination

	P.019141 G11049 I008						
Sheet 08 of 14	CLIENT:	BGL					
	PROJECT:	HYDERABAD GA					
	VENDOR:		0	25.09.24	PP	SD	MS
			REV.	DATE	PREP	CHKD	APPD

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DATA SHEET-
MULTI SENSOR OPTICAL-PHOTO ELECTRIC SMOKE / THERMAL DETECTOR

Genral	1	**Equipment Name**	Multi Sensor Photo Electric Smoke/Thermal Detector
	2	**Type**	Conventional/Addressable
	3	**Make**	As per approved/Recommended vendor list
	4	**Model**	*
	5	**Mfg.Std.**	EN 54 Part 5(2000)
Function	6	**Principle of Detection**	Light Scattering & Thermistor
	7	**Maximum current stand by - mA**	*
	8	**Operating Voltage**	24 VDC
	9	**Max Permissible Alarm Current - mA**	*
MOC	10	**Body**	*
	11	**Mounting**	Surface
	12	**Dimension**	*
	13	**Colors**	*
	14	**Weight**	*
Service Condition	15	**Application**	Indoor
	16	**Indication**	Alarm condition : RED LED Healthy condition : GREEN LED
	17	**Humidity Range**	5% to 95% Rh(Non condensing)
	18	**Temp. Range**	0 to +50 ° C
	19	**Detector wire size**	*
Approval	20	**Product Certification**	LPCB/Vds/CE

NOTE :

1	* - Vendor to Furnish
2	Bidder shall provide necessary Test / Calibration certificate
3	Bidder shall give more details as on above for better clarity of detector.
4	Bidder shall submit product catlogue with technical datasheet for reference , review and approval.
5	Refer the applicable PTS
6	Remote response indicator for detectors installed above flase ceiling and in the cable trenches shall be considered along with detectors
7	Mounting accessories and tag plate shall be provided for detectors.

	P.019141 G11049 I009						
Sheet 09 of 14							
	CLIENT:	BGL					
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MANUAL CALL POINT			
Genral	1	**Equipment Name**	Manual Call Point with LED indication
	2	**Type**	Addressable/ Conventional (Break glass type)
	3	**Make**	As per approved/Recommended vendor list
	4	**Model**	*
	5	**Mfg.Std.**	EN 54 Part 11
Function	6	**Principle of MCP**	PRESS - Type Re-Settable
	7	**Operating Voltage**	24 VDC
	8	**Current Consumption - A**	*
MOC	9	**Body Material**	Manifacturing std/PC/ABS
	10	**Mounting**	Surface
	11	**Dimension**	*
	12	**Colors**	*
	13	**Weight**	*
Service Condition	14	**Application**	Indoor/safe area
	15	**Indication**	Required, Alarm LED
	16	**Humidity Range**	0-to 95% Rh(Non condensing)
	17	**Temp. Range**	0 to +50 ° C
	18	**MCP wire size**	*
Approval	19	**Product Certification**	LPCB/Vds/CE
	20	WP Protection	IP 42

Note	
1	* - Vendor to Furnish
2	Bidder shall provide necessary Test / Calibration certificate
3	Bidder shall give more details as on above for better clarity of Manual call point during detail engineering.
4	Bidder shall submit product catalogue with technical datasheet for reference , review and approval.
5	Refer the applicable PTS

	P.019141 G11049 I010						
Sheet 10 of 14							
	CLIENT:	BGL					
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EXIT SIGN			
Genral	1	**Equipment Name**	Exit Sign
	2	**Type**	Conventional/Addressable
	3	**Make**	Std
	4	**Model**	*
	5	**Mfg.Std.**	*
	6	**Mounting**	Wall mounted
	7	**Operating Voltage**	24 VDC/battery operated
	8	**Current Consumption - A**	*
Technical	10	**Housing**	Aluminium
	11	**Weight**	*
	14	**Diamension**	*
	15	**colour**	Green background white text
	16	**Back light**	Required
	17	**Battery backup**	3-4 Hrs
	18	**Rechargeble Battery**	Required Ni-CD
Approval	19	**Recharge time**	*
	20	**Protection**	IP 42

Note	
1	* - Vendor to Furnish
2	Bidder shall provide necessary Test / Calibration certificate
3	Bidder shall give more details as on above for better clarity during detail engineering.
4	Bidder shall submit product catalogue with technical datasheet for reference , review and approval.
5	Refer the applicable PTS

	P.019141 G11049 I011						
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	CLIENT:	BGL					
	PROJECT:	HYDERABAD GA					
	VENDOR:		0	25.09.24	PP	SD	MS
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DATA SHEET - EX PROOF HOOTER WITH FLASHING BEACON

1	General	**Model**	*
2		**Make**	*
3		**Type**	Dual tone sound with Flashing Light
4		**Ingress Protection**	IP 65
5		**Material of Construction**	CAST Aluminium Alloy LM6
6		**Finish**	Inside & Outside light grey Epoxy Powder coating
7		**Field Mounted Reset Push Button**	Required
8		**Humidity**	0 - 95 % R.H.
9		**Temperature**	0 - 65 degc
10		**Certification**	PESO/CCOE
11		**Mounting accessories**	Mounting Bracket/Plate lncluding all accessories,
12		**Power consumption**	*
13		**Supply Voltage**	24 V DC
14	BEACON	**Type**	Xenon Lamp , red colour
15		**Flashing Frequency**	Beacon flashing frequency shall be 1 flash/sec
16		**Flashing colour**	Red
17		**Glass**	Shatter-Proof Heat Resistant Clear Glass
18	HOOTER	**Type**	Dual tone with Adjustable sound level
19		**Sound Level**	90 to 110 db @ 1 Mtr.
20		**Cable Entry**	Power entry and Two seperate entey for fire and Gas detetion system alarm cable
21		**Field Mounted Reset Push Button**	Required

NOTE :

1	" * " Indicate Vendor to fill data
2	
3	
4	

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WP HOOTER WITH FLASHER			
Genral	1	**Equipment Name**	Hooter with flasher
	2	**Type**	Conventional
	3	**Make**	As per approved/Recommended vendor list
	4	**Model**	*
	5	**Mfg.Std.**	*
	6	**Mounting**	Wall mounted
	7	**Operating Voltage**	24 VDC
	8	**Current Consumption - A**	*
Hooter with flasher	10	**Flashing Frequency**	1 flash/sec
	11	**Flashing colour**	Red
	14	**Sound Level**	80 @ 1 Mtr.
	15	**Cable Entry**	*
	16	**Loation**	Safe Area
	17	**Temp. Range**	0 to +50 ° C
	18	**wire size**	*
Approval	19	**Product Certification**	
	20	**Protection**	IP 42

Note	
1	* - Vendor to Furnish
2	Bidder shall provide necessary Test / Calibration certificate
3	Bidder shall give more details as on above for better clarity during detail engineering.
4	Bidder shall submit product catalogue with technical datasheet for reference , review and approval.
5	Refer the applicable PTS

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TEMPERATURE GAUGE								
1	GENERAL	Tag Numbers			As per P&ID			
2		Quantity			As per P&ID			
3		Line Number			As per P&ID			
4		Service			Natural Gas			
5		Line Size & Line Schedule			As per P&ID			
6		Make / Model No			*			
7	DIRECT TG	Type			Bimetallic			
8		Mounting			Local			
9		Dial Size			150 mm			
10		Colour			White with black inscriptions			
11		Case Material			SS316			
12		Bezel Ring			Bayonet - SS316			
13		Window Material			Shatter proof glass			
14		Enclosure			WP to IP65 or better as per IEC 60529 / IS 2147			
15		Accuracy			± 1% of FSD			
16		Zero Adjustment			Micropointer (External)			
17		Connection			1/2" NPT(M)			
18		Connection Location			Bottom			
19		**Stem**						
20		Type			Adjustable Union			
21		Material			SS316			
22		Size			1/2" NPT(M)			
23		SAMA Class			As per Specification			
24		Stem Dia			To Suit Well			
25	FILLED TG	**Filled System**			-			
26		SAMA Class			-			
27		Compensation			-			
28		Bulb Type			-			
29		Bulb Material			-			
30		Bulb Uniion Threaded to			-			
31		Extension Type			-			
32		Bulb Dia			-			
33		**Capillary Material**						
34		Armour Flexible			-			
35		Armour Material			-			
36		Capillary Length			-			
37		Overange Protection			-			
38								
39	THERMOWELL	**THERMOWELL**						
40		Material			SS316/SS316L			
41		Construction			Drilled Bar Stock			
42		Process Connection			Welded			
43		Gauge Connection			1/2" NPT (F)			
44		Thermowell Drawing			*			
45		U - Immersion Length			*			
46		T - Lagging Length			*			
47		**Optional**						
48		Liquid Filled			*			
Notes:								
	*	Vendor to Provide						
	1	Element length shall,be suitable for thermowell.						
	2	U-length shall be selected in such a way that the thermowell tip shall be preferably at the centre of pipe to sense the temperature accurately.						
		P.019141 G11049 I014						
Sheet 14 of 14								
		CLIENT:	BGL					
		PROJECT:	HYDERABAD GA					
		VENDOR:		0	25.09.24	PP	SD	MS
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		QUALITY ASSURANCE PLAN FOR INSTRUMENT CABLES				**P.019141 Q 11013 I001**			
						Consultant	**TE-IN**		
SL. No.	**Component/Operation**	**Charachteristics**	**Type of Check**	**Quantum of Check**	**Reference Doc**	**Acceptance Norms**	**Inspection Agency**		
							Manifacturer /Vendor	**Contractor's TPIA**	**Remark**
1	**Raw Material Inspection**								
1.1	Copper / Aluminium wire (As Applicable)	1. Surface Finish	Visual	100% Sample	IS 8130/ BS 5308(P-2) & Relevant Standard as per Specification	IS 8130/ BS 5308(P-2) Relevant Standard as per Specification	P	R	
		2. Diameter/Dimension	Physical						
		3. Resistance	Electrical						
		4. Chemical property (Persulphate test for tinned copper)	Chemical						
		5. Annealing Test	Physical						
1.2	Insulation & Sheathing compound	1. Tensile & Elongation before & after ageing	Visual	One sample per batch	IS 5831/ BS 5308(P-2)Relevant Standard as per Specification	IS 5831/ BS 5308(P-2)Relevant Standard as per Specification	P	R	
		2. Type of compound	Visual						
		3. Thermal Stability	Physical						
	FR Test for FR PVC only	1. Oxygen Index	Enviro		ASTM-D2863	Min. 30%			
		2. Temperature Index	Enviro			Min 250deg C			
1.3	Armour-Galvanised steel round wire/strip	1. Surface Condition	Visual	One sample per batch	IS 3975/ BS 5308(P-2) Relevant Standard as per Specification	IS 3975/ BS 5308(P-2) Relevant Standard as per Specification	P	R	
		2. Uniformity of Zinc Coating	Chemical						
		3. Tensile strength & elongation	Physical						
		4. Torsion/ Winding	Physical						
2	**Process Inspection**								
2.1	Insulated core	1. Type of Material	Visual	Each setting & during run of M/c	BS 5308(P-2) & Relevant Standard as per Specification	BS 5308(P-2) & Relevant Standard as per Specification	P	R	
		2. Thickness of Insulation (Avg. Min.)	Physical						
		3. Core Identification	Visual						
		4. Surface Finish	Visual						
		5. Spark test	Electrical						
		6. Volume Resistivity	Electrical						
2.2	Pair/Triad- laying	1. Sequence of laying	Visual	Setting & During Process			P	R	
		2. Continuity of conductor	Electrical						
		3. Continuity of common pair	Electrical						
		4. Dimension	Physical						
		5. Lay Length	Physical						
2.3	Pair/Triad screeing & Overall screeing	1. Tape thickness	Physical				P	R	
		2. Tape overlap	Visual						
		3. Drain wire size	Physical						

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		QUALITY ASSURANCE PLAN FOR INSTRUMENT CABLES				**P.019141 Q 11013 I001**			
						Consultant	**TE-IN**		
SL. No.	**Component/Operation**	**Charachteristics**	**Type of Check**	**Quantum of Check**	**Reference Doc**	**Acceptance Norms**	**Inspection Agency**		
2.6	Inner sheath and outer sheath	1. Type of PVC	Visual	Each setting & at the running of M/c			P	R	
		2. Dimension	Physical						
		3. Thickness of Inner Sheath	Physical						
		4. Surface finish & Colour	Visual						
		5. Embossing/ Printing/Sequential Markingon outer sheath	Visual						
2.7	Armouring	1. No. of strips/wires	Visual	Starting of M/c & during process			P	R	
		2. Dimension of strips/wires	Physical						
		3. Direction of lay	Visual						
2.8	Conductor	1. Make up	Visual	100% spools at start & end	IS 8130/ BS 5308(P-2) & Relevant Standard as per Specification	IS 8130/ BS 5308(P-2) Relevant Standard as per Specification	P	R	
		No. of strands	counting						
		2. Size/Dimensions	Physical						
		3. DC Resistance at 20deg C	Electrical						
		Annealing (Before stranding) for copper	Physical						
3	Routine Test	1. Conductor Resistance	Electrical	100% Drums	IS 8130/ BS 5308(P-2) & Relevant Standard as per Specification	IS 8130/ BS 5308(P-2) & Relevant Standard as per Specification	P	W	
		2. Mutual Capacitance	Electrical	10% Drums	BS 5308(P-2) & Relevant Standard as per Specification	BS 5308(P-2) & Relevant Standard as per Specification	P	W	
		3. Capacitance between core & screen	Electrical	10% Drums					
		4. L/R Ratio	Electrical	10% Drums					
		5. HV Test a) Core to core b) Core to shield/Armour	Electrical	100% Drums					
		6. Spark Test a. Core b. Sheath			BS 5308(P-2) / BS 5099 & Relevant Standard as per Specification	Relevant Standard as per Specification	P	W	
		7. Test for rodent & termite repulsion					P	W	
		1. HV Test a) Core to core b) Core to shield/Armour	Electrical	10% Sample	BS 5308(P-2) & Relevant Standard as per Specification	BS 5308(P-2) & Relevant Standard as per Specification			
		2. Conductor Resistance	Electrical	10% Sample	IS 8130/ BS 5308(P-2) & Relevant Standard as per Specification	IS 8130/ BS 5308(P-2) & Relevant Standard as per Specification			

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		QUALITY ASSURANCE PLAN FOR INSTRUMENT CABLES				**P.019141 Q 11013 I001**			
						Consultant	**TE-IN**		
SL. No.	**Component/Operation**	**Charachteristics**	**Type of Check**	**Quantum of Check**	**Reference Doc**	**Acceptance Norms**	**Inspection Agency**		
4	Acceptance Test	3. Continuity test	Electrical	10% Sample	BS 5308(P-2) & Relevant Standard as per Specification	BS 5308(P-2) & Relevant Standard as per Specification	P	W	
		4. Insulation Resistance (Before & After HV) a. Individual Conductor b. Individual Screens	Electrical	One sample per lot					
		5. Tensile Strength & Elongation for Insulation & sheath before ageing	Physical	10% Sample					
		6. Dimension	Visual	10% Sample					
		7. Cable Capacitance between core & screen & L/R ratio test	Electrical	10% Sample					
		8. Spark Test a. Core b. Sheath			BS 5308(P-2) / BS 5099 & Relevant Standard as per Specification	Relevant Standard as per Specification			
		9. Test for rodent & termide repulsion.	Chemical	One sample per lot	"	"			
		10. Uniformity of zinc coating on armour	Chemical	"	"	"			
		11. Oxygen Index test as per ASTMD:2863	Chemical	"	"	"			
		12. Temperature Index test as per ASTMD:2864	Chemical	"	"	"			
		13. FR test as per IS:10810	Thermal	"	"	"			
		14. Overall finish & drum length	Visual	"	"	"			
5	**Flammability Test for FRLS PVC only**	1. Oxygen Index	Enviro	One sample per lot	ASTM-D2863	Min. 30%	P	W	
		2. Temperature Index	Enviro			Min 250deg C			
		3. Flammability test	Fire		IEC 332-1	Shall Pass			
		4. Smoke Density	As Applicable		ASTM 2843				
		5. Acid Gas Generation	As Applicable		IEC-754-1				
		6. Swedish Chimmney Test	As Applicable		As per Relevant Staandard				
6	**Type Test**								
		1. Conductor Resistance	Electrical	One sample per	IS 8130/ BS 5308(P-2) & Relevant Standard as per Specification	IS 8130/ BS 5308(P-2) & Relevant Standard as per Specification	P	R	

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6.1	Tests For Conductor	2. Annealing Test on Cu	Physical	lot	BS 6360 & Relevant Standard as per Specification	BS 6360 & Relevant Standard as per Specification	P	R	

		QUALITY ASSURANCE PLAN FOR INSTRUMENT CABLES				**P.019141 Q 11013 I001**			
						Consultant	**TE-IN**		
SL. No.	**Component/Operation**	**Charachteristics**	**Type of Check**	**Quantum of Check**	**Reference Doc**	**Acceptance Norms**	**Inspection Agency**		
6.2	Test on Armour wire/strip	1. Tensile strength	Physical	One sample per lot	BS 5308(P-2) & Relevant Standard as per Specification	BS 5308(P-2) & Relevant Standard as per Specification	P	R	
		2. % Elongation	Physical						
		3. Torsion/Winding	Physical						
		4. Wt. of zinc coating	Chemical						
		5. Dimensions	Physical						
		6. Uniformity of coating	Chemical						
6.3	Thickness of Insulation & Sheath	Thickness of Insulation & Sheath	Physical	One sample per lot	BS 5308(P-2) & Relevant Standard as per Specification	BS 5308(P-2) & Relevant Standard as per Specification	P	R	
6.4	Physical tests on Insulation & Outer Sheath	1. Elongation & T. S. Before & After Ageing	Physical	One sample per lot	BS 5308(P-2) & Relevant Standard as per Specification	BS 5308(P-2) & Relevant Standard as per Specification	P	R	
		2. Ageing in Air oven	Physical						
		3. Shrinkage test	Physical						
		4. Hot Deformation	Physical						
		5. Heat Shock	Physical						
		6. Thermal stability	Physical						
		7. Flammability Test	Physical						
		8. Loss of Mass	Physical						
6.5	Insulation Resistance test at room & rated temperature	Volume resistivity	Electrical	One sample per lot	BS 5308(P-2) & Relevant Standard as per Specification	BS 5308(P-2) & Relevant Standard as per Specification	P	R	
6.6	H.V. test at room temperature	H.V. test at room temperature	Electrical	One sample per lot	BS 5308(P-2) & Relevant Standard as per Specification	BS 5308(P-2) & Relevant Standard as per Specification	P	R	
6.7	Noise Test	Electrostatic noise rejection ratio test	Electrical	One sample per lot	BS 5308(P-2) & Relevant Standard as per Specification	BS 5308(P-2) & Relevant Standard as per Specification	P	R	
7	packing in drum	Finish	Visual	100%	As per Relevant Standard	As per Relevant Standard	P	R	
		Marking on drum							
LEGEND:	**R: Review of Docs**		**C: Critical**	**B: Major**		**RW-Random witness**		**M-Manufacturer,**	
	A: Minor		**W: Witness**	**TPIA-Third Party Inspection Agency**		**H-HOLD**		**P-Perfomer,**	

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	QUALITY ASSURANCE PLAN FOR JUNCTION BOX	**P.019141 Q 11013 I002**

Sl.No	Description	Characterisitc	Quantum of Check	Record	Inspection Agency			Remark
					Manifacturer /Vendor	TPIA	Client	
1	**Material Inspection**							
1.1	Incoming materials like Castings, Terminals etc.	Material Identification, Visual, Pressure test on castings for hazardous area Junction boxes.	100%	Material Test Certificates / Lab test certificates /Relevant Standard as per Specification	P	R	R	
2	**In process Inspection**							
2.1	Machining of components	Visual, Dimensions	100%	Test Records / Relevant Standard as per Specification	P	R	-	
3	**Final Inspection**							
3.1	Final Inspection	· Visual, dimensional, clearance & Paint shade check for all items. JB TAG no. Plate · Verification of Terminal Nos., sizes and no. of entries · Bill of material verification. · Warning plate for junction boxes and marking on cable glands, Adapters, Plugs etc. · Pressure test on casting for flameproof junction boxes. · High Voltage and insulation resistance test. · Air leak test report on pneumatic JBs.	100% by Supplier	Supplier's Test Records / Relevant Standard as per Specification	P	W	W/R	

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	QUALITY ASSURANCE PLAN FOR JUNCTION BOX	P.019141 Q 11013 I002

Sl.No	Description	Characterisitc	Quantum of Check	Record	Inspection Agency			Remark
					Manifacturer /Vendor	TPIA	Client	
4	**Painting**							
4.1	(Painting of JBs prior to assembly)	Pre treatment, primer, final paint shade, thickness	100%	Suppliers Internal Test Reports	P	R	R	
5	**Documentation and IC**							
5.1	Documentation and IC	· Certificate from authority like BASEEFA, FM, PTB, ATEX, UL, CIMFR etc. for use in specified hazardous area. · Statutory approval certificates for instruments from CCOE/PESO for use in specified hazardous area. · Degree of protection certificate for instrument housing. · Traceability of record. · Suppliers Internal Test Records	Prototype for type tests / 100% for others	Statutory Approval Certificates / Type Test Certificates / Suppliers Internal test records	P	R	R	
LEGEND :	**R: Review of Docs**	**C: Critical**	**B: Major**	**RW-Random witness**		**M-Manufacturer,**		
	A: Minor	**W: Witness**	**TPIA-Third Party Inspection Agency**	**H-HOLD**		**P-Perfomer,**		

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QUALITY ASSURANCE PLAN
FOR PRESSURE GAUGE

P.019141
Q 11013
I003

Sr. No.	Component Operation	Charactristics Checked	Category	Type/Method of Check	Extent of Check		Referrence Document	Acceptance Norm	Format of Plan	Agency			Remarks
					P	W				M	TPIA	C	
1	Raw Material	a) Dimensions	MA	Mechanical	100%	100%	PO approved	PO approved	TC	P	R	W/R	
		b) Chemical Analysis	MA	Chemical	Sample	_	Spec/Drg.	Spec/Drg.	TC	P	R	W/R	
		c) Marking, Tagging	MA	Visual	100%	100%	Approved Spec/PO	Approved Spec/PO	TC	P	W	W/R	
2	Routine test	Accuracy Hystresis Repeatability	CR	Measurement 5 Points	100%	100%	EN 837-1	EN 837-1	Calibration Report	P	W	W/R	
		Over range protection	CR	Visual	100%	100%	EN 837-1	EN 837-1	Test Report	P	W	W/R	
	Accessories (If applicable) Guage Saver in SS 316	1) Chemical Analysis 2) Dimensions 3) Leak Tightness	MA MA CR	Chemical Measurement Hydrotest	Sample 100% 100%	 100% 100%	Approved/PO specs/Datasheet/Drawing	Approved/PO specs/Datasheet/Drawing	TC Work Certificate Test Certificate	P	W	W/R	
3	IRN										P	R	

Note: 1) Material and Type shall be as per tender specification / datasheet.

Category: CR - Characteristics affecting safety of equipment and personnel
MA - Characteristics affecting safety of Performance
MT - Charactristics affecting safety of Appearance

M-Manufacturer
TPIA-Third Party Inspection Agency
C-Client/ Counsaltanr

P-Perform

W-Witness

R-Review

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		QUALITY ASSURANCE PLAN FOR PRESSURE GAUGE						**P.019141 Q 11013 I004**			
SL. No.	**Component Operation**	**Characteristics Checked**	**Type/ Method of check**	**Extent of check**	**Reference document**	**Acceptance norm**	**Format of plan**	**Inspection**			**Remarks**
TG Assemblies								**VENDOR**	**TPIA**	**Client**	
1	Bimetal Temp.Gauge assemblies	a) Chemical composition of Raw material (case , tube , etc.)	Testing	100%	As per Relevant STD / PTC 19.3	As per Approved Datasheet and Drawing	Test certificate	P	R	W/R	
			*	100%	As per Relevant STD / PTC 19.3	As per Approved Datasheet and Drawing		P	R	W/R	
			*	100%	As per Relevant STD / PTC 19.3	As per Relevant STD / PTC 19.3		P	W	W/R	
			Testing	Sample of design	As approved data sheet	As approved data sheet		P	R	W/R	
			analysis	_	As per Approved Datasheet and Drawing	As per Approved Datasheet and Drawing		P	R	W/R	
2	Routine test	Accuracy Hysteresis Repeatability Response Time	Measurement	100%	EN 13190	Calibration Report		P	W	W / R	
		Over range protection	Visual	100%	EN 13190	Test Report		P	W	W / R	
3	Thermowell	a) dimension	measuring	100%	Approved Drawing	Approved Drawing	Log book test report	P	W	W/R	The results logged in the log book would be issued in the form of test certificates as per DIN
		b) hydro test	testing	100%	As per Approved Datasheet and Drawing	No leakage	Log book test report	P	W	W/R	
		c) bore concentricity test	go- no gauge	100%	As per Relevant STD / PTC 19.3	As per Relevant STD / PTC 19.3	Log book	P	W	W/R	
		d) visual	observation	100%	As per Relevant STD / PTC 19.3	As per Relevant STD / PTC 19.3	Log Book	P	W	W/R	
		e)workmanship/finish	observation	100%	As per Relevant STD / PTC 19.3	As per Relevant STD / PTC 19.3	Log Book	P	W	W/R	
		f) Spec/ tagging	visual	100%	As per Approved Datasheet and Drawing	As per Approved Datasheet and Drawing	Log book	P	W	W/R	
		g) threading	thread gauge	100%	As per Relevant STD / PTC 19.3	As per Relevant STD / PTC 19.3	Log book	P	W	W/R	

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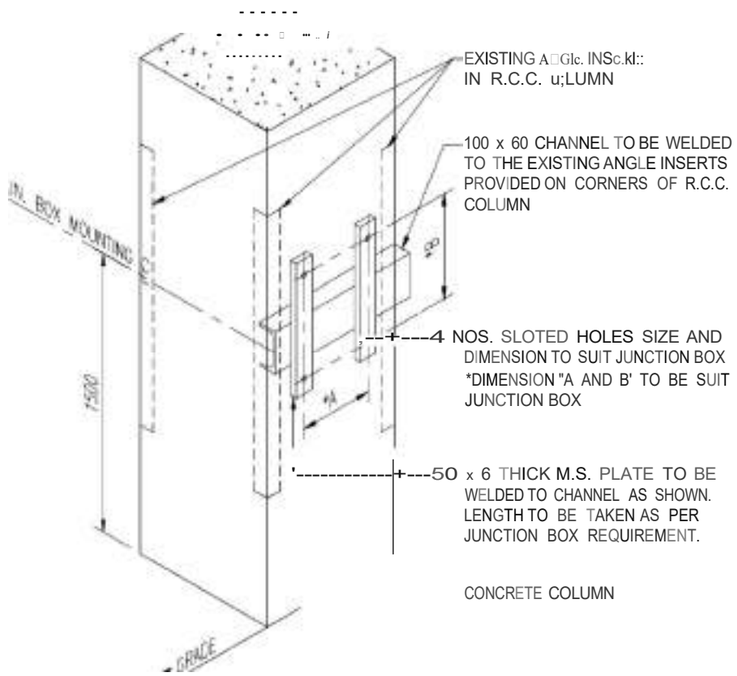
		h) surface finish	visual	100%	As per Relevant STD / PTC 19.3	As per Relevant STD / PTC 19.3	Log book	P	W	W/R	Page 1
4	IRN				Page 1 of 1				R	R	

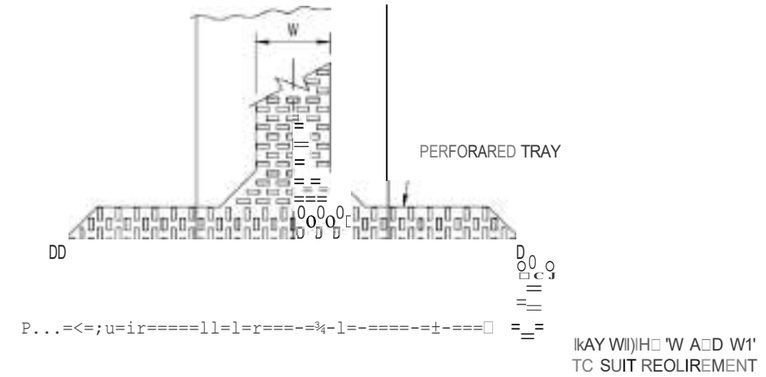
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2 3 4

A

B

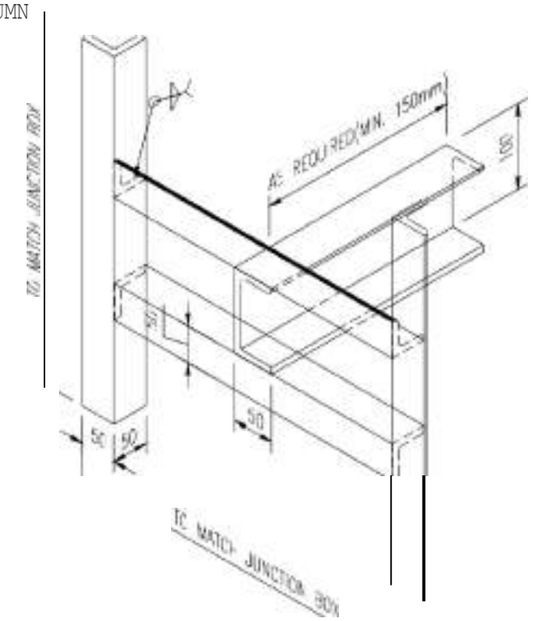


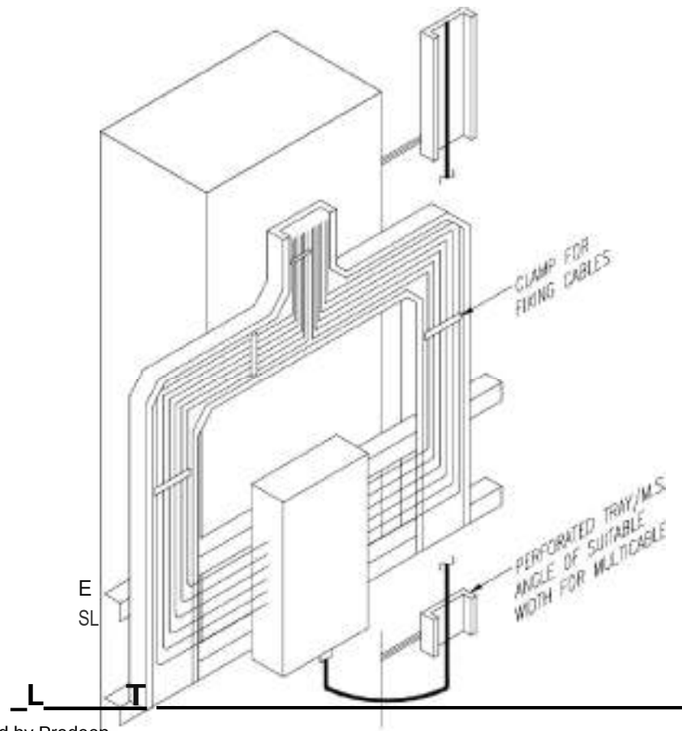


C

0□ A CONCRETE CCLUMN

D





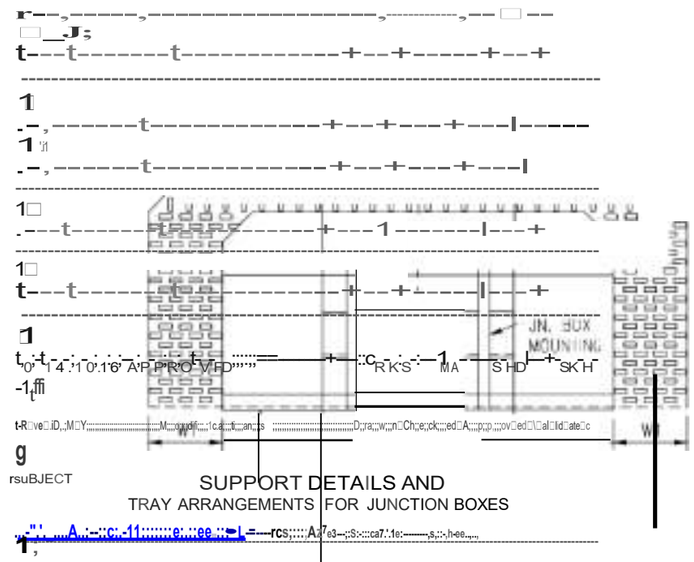
E

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TRAY AFRANGEIVENT FCR JUNCTICN BOXES



NTS

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1 2 3 4

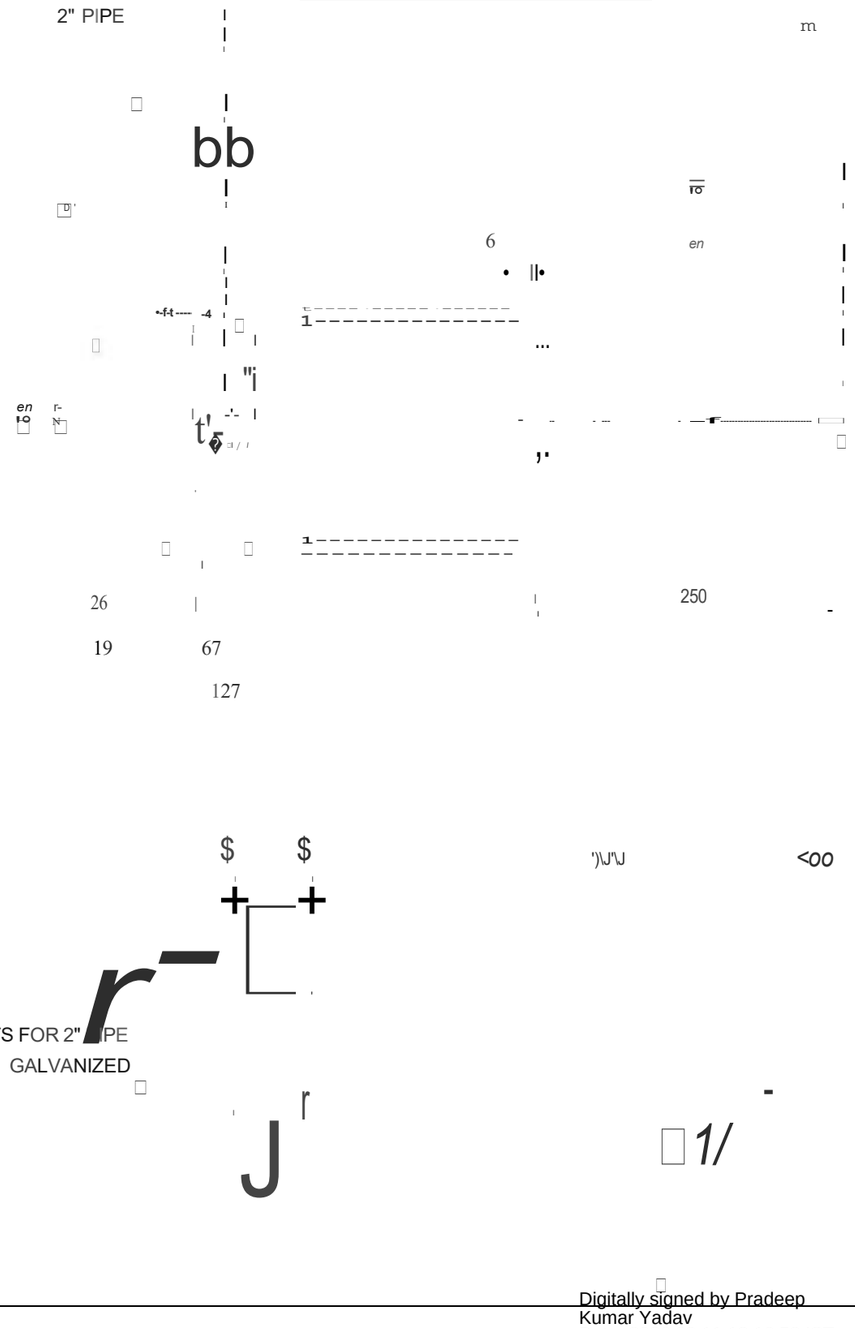
A

B

C

D

MOUNTING FOR VERTICAL PIPE

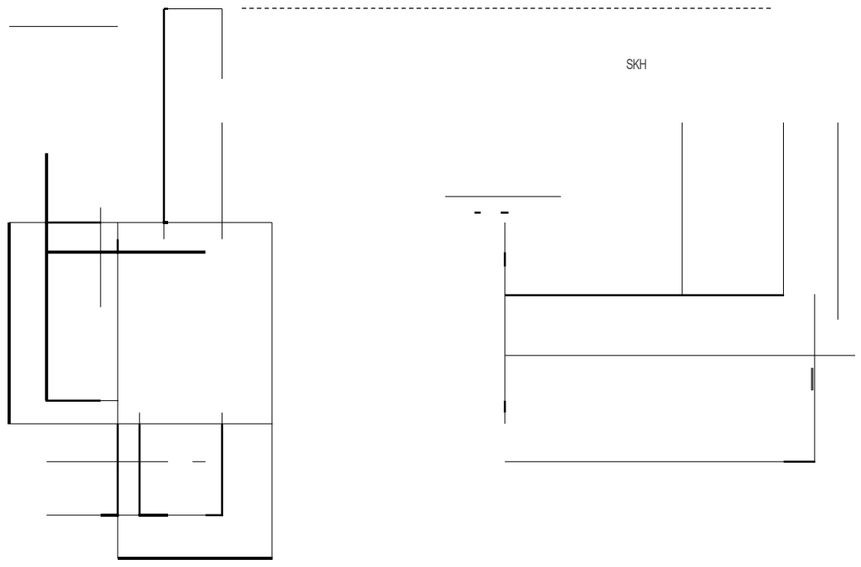


NOTES

1. ENTIRE ASSEMBLY TO BE WELDED CONSTRUCTION
2. THICKNESS OF ALUMINIUM SHEET 2MM.
3. ALL DIMENSION ARE IN MM.

APPROVFD

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Rev. D MY Modifications Drawn Checked Approved Validated

SUBJECT

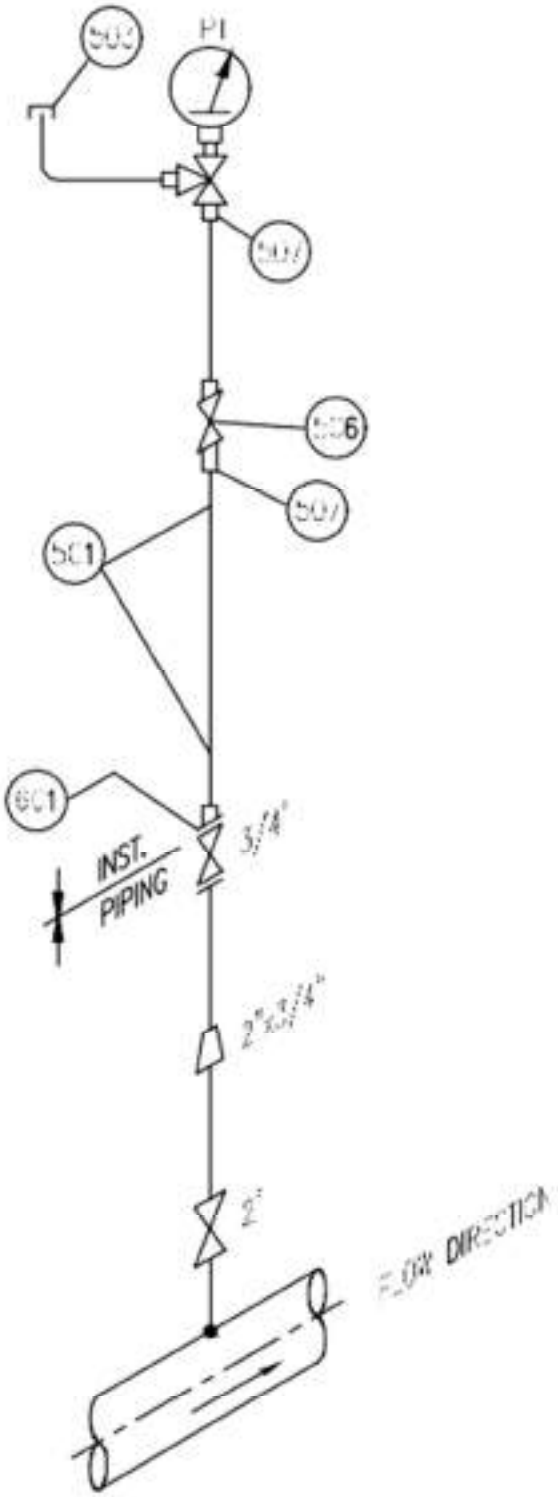
TYPICAL DRAWING FOR CANOPY

TRAC.TEBEL Engineering pvt ltd

Size A3 | Scale NTS | Sheet 01 of 01

Drawing No GGNG-I-20725-305 | Rev 0

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BILL OF MATERIAL

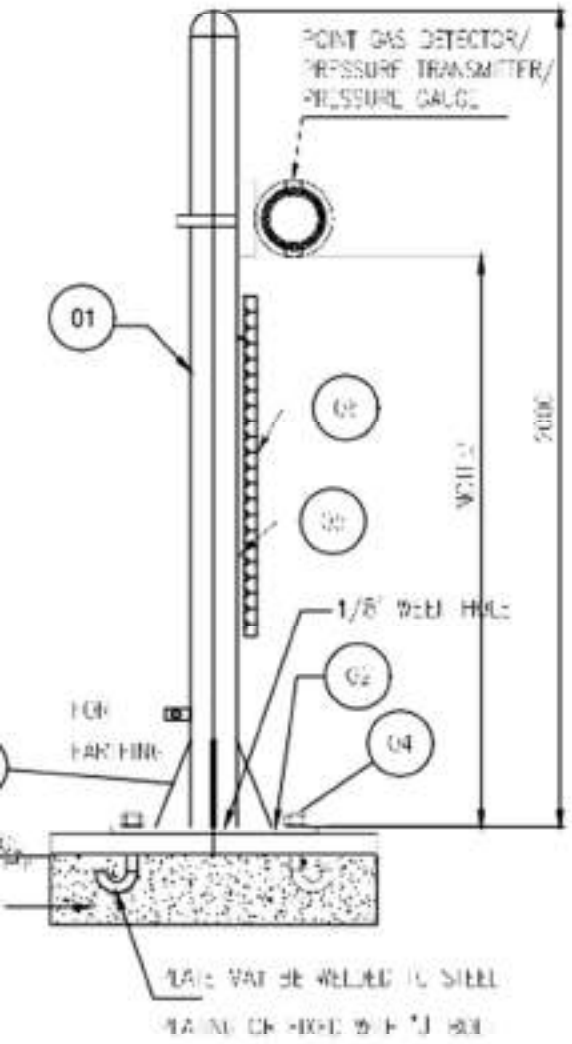
ITEM NO.	MATERIAL	DESCRIPTION	QTY. (PER INST.)
SC1	[illegible]	2" BLIND FLANGE WITH 1/2" NPT HOLE	A/R
SC4	SS316	1/2" TEE 1/2" O.D. WITH COMPRESSION FITTINGS	A/R
SC1	SS316	HEX 1/2" O.D.	A/R
SC2	SS316	CAP 1/2" NPT	A/R
SC6	SS316	BALL VALVE SIZE 1/2" NPT	A/R
SC7	SS316	VALVE CONNECTOR 1/2" NPT x 1/2" O.D. COMPRESSION FITTINGS	A/R
SC2	SS316	THREE WAY VALVE MANIFOLD 1/2" x 1/2" x 1/2" NPT	A/R
SC1	SS316	HEX 1/2" O.D. WITH ONE END NPT	A/R

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cation or transmition to third parties is forbidden without its prior approval.

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Kumar Yadav
Date: 2026.09.11 18:16:52 IST

NT SUPPORT AND MOUNTING DETAILS
FOINT GAS DETECTOR



CF MATERIAL–FGD

SPECIFICATION	MATERIAL
	M.S
	M.S
	M.S

ISSUED FOR CONSTRUCTION

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2	[illegible]	[illegible] FOR CONSTRUCTION	[illegible]	[illegible]	[illegible]	[illegible]

parties is forbidden without its prior approval.

ISSUED FOR CONSTRUCTION

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Date: 2026.09.11 18:16:52 IST

2	29.08.2025	ISSUED FOR CONSTRUCTION	[illegible]	[illegible]	SMK	[illegible]
1	[illegible]	[illegible] CONSTRUCTION	[illegible]	[illegible]	SMK	[illegible]

o third parties is forbidden wi thout its prior approval.

Sr.No	Name of ITEM/Package	Recommended Vendor List
1	**COALESCENT FILTER / REGULATORS**	ASEA BROWN BOVERI LTD.
2	COALESCENT FILTER / REGULATORS	BLUE STAR LTD
3	COALESCENT FILTER / REGULATORS	PLACKA INSTRUMENTS & CONTROLS PVT. LTD
4	COALESCENT FILTER / REGULATORS	SHAH PNEUMATICS
5	COALESCENT FILTER / REGULATORS	SHAVO NORGREN (I) PVT. LTD
6	COALESCENT FILTER / REGULATORS	PARKER
7	COALESCENT FILTER / REGULATORS	WEH
8	COALESCENT FILTER / REGULATORS	V AUTOMAT & INSTRUMENTS PVT. LTD.
9	COALESCENT FILTER / REGULATORS	VELJAN HYDRAIR PVT. LTD.
10	COALESCENT FILTER / REGULATORS	COMPAC NEWZEALAND
11	COALESCENT FILTER / REGULATORS	GASOREX
12	COALESCENT FILTER / REGULATORS	OEM
13	**PRESSURE RELIEF VALVE**	ALSTHOM FLUIDS SAPAG
14	PRESSURE RELIEF VALVE	ANDERSON GREENWOOD CROSBY
15	PRESSURE RELIEF VALVE	BHEL (TRICHY)
16	PRESSURE RELIEF VALVE	DRESSER INC.
17	PRESSURE RELIEF VALVE	FUKUI SEISAKUSHO CO. LTD.
18	PRESSURE RELIEF VALVE	INSTRUMENTATION LTD. (PALGHAT)
19	PRESSURE RELIEF VALVE	NAKAKITA SEISAKUSHO CO LTD.
20	PRESSURE RELIEF VALVE	PARCOL SPA
21	PRESSURE RELIEF VALVE	SAFETY SYSTEMS UR LTD.
22	PRESSURE RELIEF VALVE	SARASIN RSBD
23	PRESSURE RELIEF VALVE	SEBIN VALVES INDIA PVT. LTD.
24	PRESSURE RELIEF VALVE	TAI MILANO SPA
25	PRESSURE RELIEF VALVE	TYCO SANMAR LTD.
26	PRESSURE RELIEF VALVE	TYCO VALVES & CONTROLS INDIA PVT. LTD
27	PRESSURE RELIEF VALVE	SWAGELOK
28	PRESSURE RELIEF VALVE	PARKER
29	PRESSURE RELIEF VALVE	COMPAC NEWZEALAND
30	PRESSURE RELIEF VALVE	ASPRO
31	PRESSURE RELIEF VALVE	NUOVO PIGNONE SPA (ITALY)
32	PRESSURE RELIEF VALVE	FARINOSLA
33	PRESSURE RELIEF VALVE	FAINGER LASER
34	PRESSURE RELIEF VALVE	MERCER
35	PRESSURE RELIEF VALVE	FISHER ROSEMOUNT (EMERSON)
36	PRESSURE RELIEF VALVE	OFE & OE GROUP KEYSTONE VALVES PVT. LTD
37	PRESSURE RELIEF VALVE	HALOL
38	PRESSURE RELIEF VALVE	M/s Nirmal
39	PRESSURE RELIEF VALVE (PRV)	FMC SANMAR LTD.
40	PRESSURE RELIEF VALVE (PRV)	PROTEGO INDIA PVT. LTD.
41	PRESSURE RELIEF VALVE (PRV)	L&T VALVES LTD.
42	PRESSURE RELIEF VALVE (PRV)	MEKASTER (FORMERLY SEBIM) VALVES INDIA PVT. LTD.
43	PRESSURE RELIEF VALVE (PRV)	RMG REGAL + MESSTECH GMBH, GERMANY
44	PRESSURE RELIEF VALVE (PRV)	TYCO VALVES
45	**HOSES**	PARKER
46	HOSES	EATON
47	HOSES	SWAGELOK

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Sr.No	Name of ITEM/Package	Recommended Vendor List
48	HOSES	TRANSFER OIL
49	HOSES	M/s. ZEC S.p.A Italy
50	**BREAKAWAY COUPLING**	OPW
51	BREAKAWAY COUPLING	STAUBLI
52	BREAKAWAY COUPLING	WEH
53	BREAKAWAY COUPLING	PARKER
54	BREAKAWAY COUPLING	OASIS
55	**FLAMEPROOF GLANDS**	COMET/OEM MAKE
56	**SURGE PROTECTOR**	PHONEX
57	SURGE PROTECTOR	MTL
58	SURGE PROTECTOR	P&F
59	SURGE PROTECTOR	OEM MAKE
60	SURGE PROTECTOR	MEGGITT AVIONICS
61	SURGE PROTECTOR	GENERAL MONITORS/ MSA
62	SURGE PROTECTOR	SPECTREX
63	SURGE PROTECTOR	DETRONICS
64	SURGE PROTECTOR	HONEYWELL
65	SURGE PROTECTOR	NET SAFETY
66	SURGE PROTECTOR	CROW ON
67	SURGE PROTECTOR	SIEGER
68	SURGE PROTECTOR	ISOLATORS
69	SURGE PROTECTOR	BARRIERS
70	SURGE PROTECTOR	ESP
71	SURGE PROTECTOR	Schneider
72	SURGE PROTECTOR	ASPRO
73	**NGV NOZZLES**	OPW
74	NGV NOZZLES	WEH
75	NGV NOZZLES	STAUBLI
76	NGV NOZZLES	PARKER
77	NGV NOZZLES	COMPAC
78	NGV NOZZLES	SHEREX
79	NGV NOZZLES	OASIS
80	**STATION PIPE**	MAHARASHTRA SEAMLESS LTD.
81	STATION PIPE	INDIAN SEAMLESS METAL TUBES
82	STATION PIPE	SURYA GLOBAL STEEL & TUBES
83	STATION PIPE	INTERFORGE
84	STATION PIPE	HEAVY METAL & TUBES LTD.
85	STATION PIPE	JINDAL SAW LTD.
86	STATION PIPE	MAHA LAKSHMI SEAMLESS LTD.
87	STATION PIPE	RATANAMANI METAL TUBES LTD.
88	**BALL VALVES**	FLOW CHEM
89	BALL VALVES	L&T VALVES LIMITED
90	BALL VALVES	MICROFINISH VALVES PVT. LTD.
91	BALL VALVES	STEEL STRONG VALVES (I) PVT LTD.
92	BALL VALVES	OSWAL INDUSTRIES LTD.
93	BALL VALVES	NILON VALVES PVT LTD.

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94	BALL VALVES	PETRO VALVES PVT. LTD.

Sr.No	Name of ITEM/Package	Recommended Vendor List
95	BALL VALVES	ZED VALVES CO. PVT LTD.
96	BALL VALVES	HAWA ENGINEERING LTD. INDIA
97	BALL VALVES	GM ENGINEERING
98	BALL VALVES	LEADER VALVES LTD.
99	BALL VALVES	VIRGO VLAVES
100	BALL VALVES	AUDCO
101	BALL VALVES	ROTEX
102	BALL VALVES	TUBEFIT
103	**INSULATING JOINTS**	IGP ENGINEERS PVT. LTD., CHENNAI, TAMIL NADU, INDIA
104	INSULATING JOINTS	ADVANCE ELECTRONICS SYSTEM, GUJARAT, INDIA
105	INSULATING JOINTS	NUPROS INC. GUJRAT
106	INSULATING JOINTS	VEE KAY VIKRAM & CO. LLP, AHMEDABAD - 380054 ,GUJARAT, INDIA
107	**GLOBE VALVES**	NSSL
108	GLOBE VALVES	OSWAL INDUSTRIES LTD.
109	GLOBE VALVES	L&T VALVES LIMITED
110	GLOBE VALVES	ZED VALVES CO. PVT LTD.
111	GLOBE VALVES	STEEL STRONG VALVES (I) PVT LTD.
112	GLOBE VALVES	LEADER VALVES LTD.
113	GLOBE VALVES	NILON VALVES PVT LTD.
114	GLOBE VALVES	NITON VALVES PVT. LTD.
115	GLOBE VALVES	PETRO VALVES PVT. LTD.
116	GLOBE VALVES	FLOWCHEM INDUSTRIES
117	GLOBE VALVES	GM ENGINEERING
118	GLOBE VALVES	WEIR BDK VALVES
119	**CHECK VALVES**	ECONO VALVES PVT. LTD.
120	CHECK VALVES	L&T VALVES LTD.
121	CHECK VALVES	OSWAL INDUSTRIES LTD
122	CHECK VALVES	NILON VALVES PVT LTD.
123	CHECK VALVES	WEIR BDK VALVES
124	CHECK VALVES	FLOWCHEM INDUSTRIES
125	CHECK VALVES	NSSL LIMITED
126	CHECK VALVES	LEADER VALVES LTD.
127	CHECK VALVES	NITON VALVES IND. PVT. LTD.
128	**TWO WAY / THREE WAY VALVES/ 2-WAY DRAIN VALVES**	**SWAGELOK**
129	TWO WAY / THREE WAY VALVES/ 2-WAY DRAIN VALVES	PARKER
130	TWO WAY / THREE WAY VALVES/ 2-WAY DRAIN VALVES	COMPAC
131	TWO WAY / THREE WAY VALVES/ 2-WAY DRAIN VALVES	HAMLET
132	TWO WAY / THREE WAY VALVES/ 2-WAY DRAIN VALVES	HYLOCK
133	TWO WAY / THREE WAY VALVES/ 2-WAY DRAIN VALVES	SEALEXCEL
134	TWO WAY / THREE WAY VALVES/ 2-WAY DRAIN VALVES	OASIS
135	TWO WAY / THREE WAY VALVES/ 2-WAY DRAIN VALVES	SSP
136	TWO WAY / THREE WAY VALVES/ 2-WAY DRAIN VALVES	DK-LOK
137	TWO WAY / THREE WAY VALVES/ 2-WAY DRAIN VALVES	OASIS
138	**INSTRUMENT SS FITTINGS/ VALVES**	SWAGELOK
139	INSTRUMENT SS FITTINGS/ VALVES	PARKER

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140	INSTRUMENT SS FITTINGS/ VALVES	HAMLET
141	INSTRUMENT SS FITTINGS/ VALVES	HYLOK

Sr.No	Name of ITEM/Package	Recommended Vendor List
142	INSTRUMENT SS FITTINGS/ VALVES	DKLOK
143	INSTRUMENT SS FITTINGS/ VALVES	SEALEXCEL
144	INSTRUMENT SS FITTINGS/ VALVES	SSP
145	INSTRUMENT SS FITTINGS/ VALVES	M/s SR Greentech(Manufacturer-BMT SuperLOK)
146	INSTRUMENT SS FITTINGS/ VALVES	ABAC
147	INSTRUMENT SS FITTINGS/ VALVES	STAUFF
148	INSTRUMENT SS FITTINGS/ VALVES	M/s Fluid Controls
149	INSTRUMENT SS FITTINGS/ VALVES	M/s Astec
150	INSTRUMENT SS FITTINGS/ VALVES	-
151	**SS TUBING**	SANDVIK
152	SS TUBING	FAE
153	SS TUBING	TUBACEX
154	SS TUBING	PARKER
155	SS TUBING	RATANAMANI
156	SS TUBING	JINDAL SAW LTD.
157	**PIPE FITTINGS (SEAMLESS / WELDED)**	TEEKAY TUBE
158	PIPE FITTINGS (SEAMLESS / WELDED)	AMFORGE INDUSTRIES
159	PIPE FITTINGS (SEAMLESS / WELDED)	PIPEFIT ENGINEERS PVT. LTD.
160	PIPE FITTINGS (SEAMLESS / WELDED)	C D ENGINEERING CO. GHAZIABAD
161	PIPE FITTINGS (SEAMLESS / WELDED)	CHW FORGE PVT LTD., GHAZIABAD
162	PIPE FITTINGS (SEAMLESS / WELDED)	SANGHVI FORGING & ENGINEERING, VADODARA
163	PIPE FITTINGS (SEAMLESS / WELDED)	GOOD LUCK ENGINEERING CO. / GOOD LUCK INDIA LTD., GHAZIABAD
164	PIPE FITTINGS (SEAMLESS / WELDED)	UTSAH ENGINEERING PVT. LTD, GHAZIABAD
165	PIPE FITTINGS (SEAMLESS / WELDED)	JINDAL FORGINGS PVT LTD
166	PIPE FITTINGS (SEAMLESS / WELDED)	SHAKTI FORGE INDUSTRIES
167	PIPE FITTINGS (SEAMLESS / WELDED)	A.M. ENGINEERS
168	PIPE FITTINGS (SEAMLESS / WELDED)	KUNJ FORGING (P) LTD GHAZIABAD
169	PIPE FITTINGS (SEAMLESS / WELDED)	VIVIAL FORGE (P) LTD.
170	PIPE FITTINGS (SEAMLESS / WELDED)	PIPEFIT ENGINEERS PVT. LTD.
171	PIPE FITTINGS (SEAMLESS / WELDED)	UNITED FORGE INDUSTRIES
172	PIPE FITTINGS (SEAMLESS / WELDED)	SKY FORGE PVT. LTD.
173	PIPE FITTINGS (SEAMLESS / WELDED)	SAWAN ENGINEERS PVT. LTD.
174	PIPE FITTINGS (SEAMLESS / WELDED)	DEE PIPING SYSTEM (EARLIER DEE DEVLOPMENT ENGINEERS PVT. LTD.)
175	PIPE FITTINGS (SEAMLESS / WELDED)	SIDDHARTH & GAUTAM INDIA
176	PIPE FITTINGS (SEAMLESS / WELDED)	M.S. FITTINGS MANUFACTURING COMPANY PVT. LTD.
177	PIPE FITTINGS (SEAMLESS / WELDED)	GUJRAT INFRA PIPES PVT. LTD.
178	PIPE FITTINGS (SEAMLESS / WELDED)	TOPAZ PIPING INDUSTRIES
179	PIPE FITTINGS (SEAMLESS / WELDED)	COMMERCIAL SUPPLYING AGENCY, MUMBAI
180	PIPE FITTINGS (SEAMLESS / WELDED)	EBY INDUSTRIES, MUMBAI
181	**PIPE FITTINGS (FORGED)**	SIDDHARTH & GAUTAM
182	PIPE FITTINGS (FORGED)	C D ENGINEERING CO. GHAZIABAD
183	PIPE FITTINGS (FORGED)	CHW FORGE PVT LTD., GHAZIABAD
184	PIPE FITTINGS (FORGED)	SANGHVI FORGING & ENGINEERING, VADODARA
185	PIPE FITTINGS (FORGED)	AMFORGE INDUSTRIES

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186	PIPE FITTINGS (FORGED)	GOOD LUCK ENGINEERING CO. /GOOD LUCK INDIA LTD., GHAZIABAD
187	PIPE FITTINGS (FORGED)	UTSAH ENGINEERING PVT. LTD, GHAZIABAD
188	PIPE FITTINGS (FORGED)	JINDAL FORGINGS PVT LTD

Sr.No	Name of ITEM/Package	Recommended Vendor List
189	PIPE FITTINGS (FORGED)	SHAKTI FORGE INDUSTRIES
190	PIPE FITTINGS (FORGED)	A.M. ENGINEERS
191	PIPE FITTINGS (FORGED)	KUNJ FORGING (P) LTD GHAZIABAD
192	PIPE FITTINGS (FORGED)	VIVIAL FORGE (P) LTD.
193	PIPE FITTINGS (FORGED)	PIPEFIT ENGINEERS PVT. LTD.
194	PIPE FITTINGS (FORGED)	UNITED FORGE INDUSTRIES
195	PIPE FITTINGS (FORGED)	SKY FORGE PVT. LTD.
196	PIPE FITTINGS (FORGED)	DEE PIPING SYSTEM (EARLIER DEE DEVLOPMENT ENGINEERS PVT. LTD.)
197	**FLOW TEES**	TECHNOGORGE- ITALY (INTERNATIONAL PIPING GROUP)
198	FLOW TEES	PIPEFIT ENGINEERS PVT. LTD.
199	FLOW TEES	VIVIAL FORGE PVT LTD
200	FLOW TEES	UNITED FORGE PVT LTD
201	FLOW TEES	MULTITEX FILTRATIONS
202	FLOW TEES	SAWAN ENGINEERS PVT. LTD.
203	**FLANGES**	ECHJAY INDUSTRIES PVT. LTD.
204	FLANGES	CD INDUSTRIES
205	FLANGES	CHW FORGE (CHOUDHARY HAMMER WORKS)
206	FLANGES	METAL FORGINS (P) LTD.
207	FLANGES	PUNJAB STEEL WORKS
208	FLANGES	AMFORGE INDUSTRIES
209	FLANGES	JAV FORGINGS PVT. LTD.
210	FLANGES	C D ENGINEERING CO.
211	FLANGES	GOOD LUCK ENGINEERING CO. /
212	FLANGES	GOOD LUCK INDIA LTD., GHAZIABAD
213	FLANGES	UTSAH ENGINEERING PVT. LTD, GHAZIABAD
214	FLANGES	JINDAL FORGINGS PVT LTD
215	FLANGES	SHAKTI FORGE INDUSTRIES
216	FLANGES	A.M. ENGINEERS
217	FLANGES	KUNJ FORGING (P) LTD GHAZIABAD
218	FLANGES	VIVIAL FORGE (P) LTD.
219	FLANGES	J K FORGINGS
220	FLANGES	SANGHVI FORGING & ENGINEERING LTD.
221	FLANGES	PIPEFIT ENGINEERS PVT. LTD.
222	FLANGES	SAWAN ENGINEERS PVT. LTD.
223	**WELDING ELECTRODE**	FOR MAINLINE- LINCOLN / BOHLER MAKE
224	WELDING ELECTRODE	FOR TERMINAL / STATION PIPING- LINCOLN/D&H
225	WELDING ELECTRODE	FOR Mainline/Terminal/Station Piping- M/s. ITW HOBART
226	**NDT AGENCIES**	NDT SERVICES, AHMEDABAD
227	NDT AGENCIES	RTD , MUMBAI
228	NDT AGENCIES	SIEVERT, MUMBAI
229	NDT AGENCIES	X-TECH - VIZAG
230	NDT AGENCIES	GEECY INDUSTRIAL SERVICES PVT. LTD. MUMBAI

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231	**FASTENERS**	MULTI FASTENERS PVT. LTD.
232	FASTENERS	PRECISION ENGINEERING INDUSTRIES
233	FASTENERS	PRECISION AUTO ENGINEERS
234	FASTENERS	NITIN FASTENERS
235	FASTENERS	DEEPAK FASTENERS LTD.

Sr.No	Name of ITEM/Package	Recommended Vendor List
236	FASTENERS	FIX FIT FASTING MFG. PVT. LTD.
237	FASTENERS	PACIFIC FORGING & FASTNERS PVT LTD., MUMBAI
238	FASTENERS	MULTI FASTNERS PVT LTD., VADODARA
239	FASTENERS	AEP COMPANY, ANAND
240	FASTENERS	HARDWIN FASTENERS PVT LTD., MUMBAI
241	FASTENERS	SYNDICATE ENGINEERING INDUSTRIES, MUMBAI
242	FASTENERS	PIONEER NUTS AND BOLTS PVT. LTD., LUDHIANA
243	FASTENERS	MULTI THREAD FASTENERS, VADODARA
244	FASTENERS	PRESIDENT ENGINEERING WORKS, MUMBAI
245	FASTENERS	UDHERA FASTNERS LTD. LUDHIANA
246	FASTENERS	NEXO INDUSTRIES LIMITED, LUDHIANA
247	FASTENERS	CONSOL ENGINEERING & FASTENERS INDUSTRIES, HOWRAH
248	FASTENERS	NIREKA ENGG CO. PVT. LTD.
249	**GASKETS**	GOODRICH GASKETS. PVT. LTD.
250	GASKETS	IGP ENGINEERS PVT. LTD., CHENNAI, TAMIL NADU, INDIA
251	GASKETS	MADRAS INDUSTRIAL PRODUCTS
252	GASKETS	BANCO PRODUCTS (P) LTD.
253	GASKETS	UNI KLINGER LIMITED, NEW DELHI
254	GASKETS	GASKET INDIA PRIVATE LTD., CHENNAI
255	GASKETS	STARFLEX SEALING INDIA PVT. LTD.
256	**HEAT SHRINKABLE SLEEVES**	SHRI NARAYAN IMPAC INDIA LLP (SNI) (HSS and HDD Sleeves)
257	HEAT SHRINKABLE SLEEVES	DENSO GMBH
258	HEAT SHRINKABLE SLEEVES	SEAL FOR LIFE INDUSTRIES HTLP-80 (HSS) & DIREX SLEEVE (HDD)
259	HEAT SHRINKABLE SLEEVES	CYG CHANGTONG NEW MATERIAL CO. LTD., CHINA
260	**COLD APPLIED TAPES**	BERRY PLASTICS CORPORATION, BELGIUM- COVALENCE BRAND
261	COLD APPLIED TAPES	DENSO GMBH
262	COLD APPLIED TAPES	CANUSA-CPS A DIVISION OF SHAWCOR INC.
263	**PUR (TAR-FREE) COATING**	DENSO GMBH
264	PUR (TAR-FREE) COATING	BERRY PLASTICS CORPORATION, OMAN/ HOUSTON- POWERCRETE BRAND
265	**CASING END CLOSURE**	RAYCHEM RPG LIMITED
266	CASING END CLOSURE	SEAL FOR LIFE INDUSTRIES
267	CASING END CLOSURE	RACI, ITLAY
268	**ROCKSHIELD**	RAYCHEM RPG LIMITED
269	ROCKSHIELD	SEAL FOR LIFE
270	ROCKSHIELD	DENSO GMBH
271	**SPACER / INSULATOR**	RAYCHEM RPG LIMITED
272	SPACER / INSULATOR	MALON TECHNICAL PRODUCTS
273	SPACER / INSULATOR	ADVANCE PRODUCTS & SYSTEM INC.
274	SPACER / INSULATOR	RACI, ITLAY
275	**WARNING MAT**	AMBICA PLASTIC INDUSTRIES
276	WARNING MAT	SPARCO MULTIPLAST PVT. LTD.

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277	WARNING MAT	SHRI VIJAY WIRE PVT. LTD.
278	WARNING MAT	SINGHAL INDUSTRIES PVT LTD
279	WARNING MAT	BINA ENTERPRISE
280	**GI PIPES**	TATA BSL LTD
281	GI PIPES	SWASTIK PIPE LTD.
282	GI PIPES	JINDAL INDUSTRIES LTD.

Sr.No	Name of ITEM/Package	Recommended Vendor List
283	GI PIPES	VISHAL PIPES LTD.
284	GI PIPES	INDUS TUBES LTD.
285	GI PIPES	ADVANCE STEEL TUBES LTD.
286	GI PIPES	SURYA ROSHNI LIMITED
287	GI PIPES	RAMA STEEL TUBES
288	GI PIPES	P S STEEL TUBES
289	GI PIPES	M/s Goodluck India Ltd
290	**GI FITTINGS**	SARIN INDUSTRIES LTD.
291	GI FITTINGS	JUPITER METAL INDUSTRIES LTD.
292	GI FITTINGS	JAINSONS INDUSTRIES LTD.
293	GI FITTINGS	JINAN MEIDE
294	GI FITTINGS	GREEN MALLEABLE PVT LTD
295	GI FITTINGS	RAJNESH MALLEABLE LTD., DELHI
296	GI FITTINGS	INDUSTRIAL VALVES & COMPONENTS, DELHI
297	GI FITTINGS	EXCEL METAL & ENGINEERING INDUSTRIES,MUMBAI
298	GI FITTINGS	MODERN STORES & ENGINEERING CONCERN, KOLKATA
299	GI FITTINGS	CHOKHAWALA DISTRIBUTORS (FOR JINAN MEIDE)
300	**FORGED FITTINGS**	JAINSONS INDUSTRIES LTD JALANDHAR
301	FORGED FITTINGS	MODERN STORES & ENGINEERING CONCERN, KOLKATA
302	FORGED FITTINGS	BHARAT FORGE & PRESS INDUSTRIES BARODA
303	FORGED FITTINGS	B M METERS PVT LTD, JALANDHAR
304	**ISOLATION BALL VALVE & APPLIANCE VALVE**	ENOLOGAS BONOMI S.P.A.
305	ISOLATION BALL VALVE & APPLIANCE VALVE	NINGBO ZHIQING INDUSTRIAL CO. LIMITED
306	ISOLATION BALL VALVE & APPLIANCE VALVE	ZHEJIANG VALOGIN TECHNOLOGY CO. LTD.
307	ISOLATION BALL VALVE & APPLIANCE VALVE	UMESH ENTERPRISES
308	ISOLATION BALL VALVE & APPLIANCE VALVE	PARKER HANNIFIN S.P.A.
309	ISOLATION BALL VALVE & APPLIANCE VALVE	CHANDAN ENTERPRISES
310	ISOLATION BALL VALVE & APPLIANCE VALVE	ZHEJIANG YIFAN TECHNOLOGY CO., LTD.
311	**PE (FITTING/VALVES/TRANSITION FITTINGS)**	GEORG FISCHER PIPING SYSTEM
312	PE (FITTING/VALVES/TRANSITION FITTINGS)	KIMPLAS PIPING SYSTEMS
313	PE (FITTING/VALVES/TRANSITION FITTINGS)	INNOGAZ & M/S FRIALEN OF M/S ALIAXIS UTILITIES & INDUSTRY PVT. LTD. (FORMERLY GLYNWED PIPE SYSTEMS)
314	PE (FITTING/VALVES/TRANSITION FITTINGS)	RMG AUTOMETERS GAS TECHNOLOGIES
315	PE (FITTING/VALVES/TRANSITION FITTINGS)	FRIATECH AG, GERMANY (REPRESENTED BY SHERMAN SALES IN INDIA)
316	PE (FITTING/VALVES/TRANSITION FITTINGS)	AL-AZIZ PLASTICS (P) LTD.
317	**STEEL REINFORCED RUBBER HOSE (TYPE-4)**	SUPER SEAL FLEXIBLE HOSE LTD.
318	STEEL REINFORCED RUBBER HOSE (TYPE-4)	SURAKSHA PRODUCTS PVT. LTD.
319	STEEL REINFORCED RUBBER HOSE (TYPE-4)	VANSH INDUSTRIES
320	STEEL REINFORCED RUBBER HOSE (TYPE-4)	T & L GASES
321	**CORRUGATED FLEXIBLE METAL HOSE (ANACONDA)**	KPC FLEX TUBES

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322	CORRUGATED FLEXIBLE METAL HOSE (ANACONDA)	VESTAS HOSE DIVISION
323	CORRUGATED FLEXIBLE METAL HOSE (ANACONDA)	ALFA HOSES & BELLOWS MFG. CO.
324	CORRUGATED FLEXIBLE METAL HOSE (ANACONDA)	ALPHA FLEXI TUBES
325	CORRUGATED FLEXIBLE METAL HOSE (ANACONDA)	CHANDAN ENTERPRISES
326	CORRUGATED FLEXIBLE METAL HOSE (ANACONDA)	VIKRAM & CO.
327	**MDPE PIPE**	HARI UDYOG PVT. LTD
328	MDPE PIPE	JAIN IRRIGATION SYSTEMS LTD.

Sr.No	Name of ITEM/Package	Recommended Vendor List
329	MDPE PIPE	ORI PLAST LTD.
330	MDPE PIPE	VISHAKHA IRRIGATION PVT. LTD.
331	MDPE PIPE	DURALINE INDIAN PVT. LTD.
332	MDPE PIPE	KRITI INDUSTRIES (I) LTD., INDORE
333	MDPE PIPE	VEEKAY PLAST
334	MDPE PIPE	M/s Venuka Polymers Pvt. Ltd
335	**COPPER TUBES & FITTINGS**	RAJCO METAL
336	COPPER TUBES & FITTINGS	MEHTA TUBES
337	COPPER TUBES & FITTINGS	JAY BANAS METALS PVT. LTD
338	COPPER TUBES & FITTINGS	PARAS INDUSTRIES LTD. (ONLY FOR FITTINGS)
339	COPPER TUBES & FITTINGS	CHANDAN ENTERPRISE
340	COPPER TUBES & FITTINGS	JANYA EXTRUSIONS PVT LTD.
341	**BRASS FITTINGS**	PARAS INDUSTRIES LTD.
342	BRASS FITTINGS	CHANDAN ENTERPRISES
343	BRASS FITTINGS	PARAS INDUSTRIES LTD.
344	BRASS FITTINGS	OM BRASS ENTERPRISES
345	BRASS FITTINGS	CHOKHAWALA DISTRIBUTORS
346	**THIRD PARTY INSPECTION AGENCY**	AMERICAN BUREAU SERVICES
347	THIRD PARTY INSPECTION AGENCY	TECHNISCHE ULIERWACHUNGS VEREIN (TUV)
348	THIRD PARTY INSPECTION AGENCY	DNV-GL
349	THIRD PARTY INSPECTION AGENCY	MS EDLIPSE ENGINEERING GLOBAL PVT. LTD
350	THIRD PARTY INSPECTION AGENCY	INTERNATIONAL CERTIFICATION SERVICES PVT LTD
351	THIRD PARTY INSPECTION AGENCY	BUREAU VERITAS
352	THIRD PARTY INSPECTION AGENCY	CERTIFICATION ENGINEERS INTERNATIONALLIMITED (CEIL)
353	THIRD PARTY INSPECTION AGENCY	LLOYD REGISTER OF INDUSTRIAL SERVICES
354	THIRD PARTY INSPECTION AGENCY	SGS
355	THIRD PARTY INSPECTION AGENCY	TUV INDIA PVT. LTD. (TUV - NORD)
356	THIRD PARTY INSPECTION AGENCY	TUV-SUD SOUTH ASIA
357	THIRD PARTY INSPECTION AGENCY	M/s. Industrial Inspection & Verification Services (I) Pvt. Ltd
358	THIRD PARTY INSPECTION AGENCY	M/s Hertz Inspection Services pvt. Ltd
359	**HDPE Pipe**	DURALINE INDIA
360	HDPE Pipe	JAIN IRRIGATION SYSTEMS LIMITED
361	HDPE Pipe	KRITI INDUSTRIES INDIA LTD.
362	HDPE Pipe	ORIPLAST LTD.
363	HDPE Pipe	VEE KAY PLAST
364	HDPE Pipe	VISHAKHA IRRIGATION PVT. LTD.
365	HDPE Pipe	HARI PLAST
366	HDPE Pipe	CLIMAX SYNTHETICS (P) LTD., VADODRA

367	HDPE Pipe	SANGIR PLASTICS (P) LTD., MUMBAI
368	HDPE Pipe	HIMALYAN PIPE INDUSTRIES, SOLAN
369	HDPE Pipe	DUTRON POLYMERS LTD.
370	HDPE Pipe	PARIXIT IRRIGATION LIMITED
371	HDPE Pipe	VEEKAY PLAST
372	**HDPE DUCT FOR OFC**	JAIN IRRIGATION SYSTEM LTD
373	HDPE DUCT FOR OFC	KIRTI INDUSTRIES
374	HDPE DUCT FOR OFC	ORIPLAST
375	HDPE DUCT FOR OFC	DURA-LINE

Sr.No	Name of ITEM/Package	Recommended Vendor List
376	HDPE DUCT FOR OFC	VEEKAY PLAST
377	HDPE DUCT FOR OFC	VEDANTA POLYMER PVT LTD
378	HDPE DUCT FOR OFC	HARIPLAST
379	HDPE DUCT FOR OFC	PARIXIT INDUSTRIES LTD
380	HDPE DUCT FOR OFC	PENNWALT AGRU PLASTIC LT
381	**CARBON STEEL PIPE (ASTM A106 Gr. B , A333 Gr.6 Station Pipe)**	HEAVY METAL & TUBES LTD., MEHSANA
382	CARBON STEEL PIPE (ASTM A106 Gr. B , A333 Gr.6 Station Pipe)	ISMT LIMITED
383	CARBON STEEL PIPE (ASTM A106 Gr. B , A333 Gr.6 Station Pipe)	JINDAL SAW LTD.
384	CARBON STEEL PIPE (ASTM A106 Gr. B , A333 Gr.6 Station Pipe)	MAHARASHTRA SEAMLESS LIMITED
385	CARBON STEEL PIPE (ASTM A106 Gr. B , A333 Gr.6 Station Pipe)	MAHALAXMI METAL CORPORATION
386	CARBON STEEL PIPE (ASTM A106 Gr. B , A333 Gr.6 Station Pipe)	SAINEST TUBES PVT. LTD.
387	CARBON STEEL PIPE (ASTM A106 Gr. B , A333 Gr.6 Station Pipe)	RATNADEEP METAL & TUBES LTD.
388	CARBON STEEL PIPE (ASTM A106 Gr. B , A333 Gr.6 Station Pipe)	JFE STEEL CORPORATION
389	CARBON STEEL PIPE (ASTM A106 Gr. B , A333 Gr.6 Station Pipe)	MANNESMANN S.A.
390	CARBON STEEL PIPE (ASTM A106 Gr. B , A333 Gr.6 Station Pipe)	ARCELORMITTAL TUBULAR PRODUCTS ROMAN SA
391	CARBON STEEL PIPE (ASTM A106 Gr. B , A333 Gr.6 Station Pipe)	SUMITOMO METAL IND.LTD
392	CARBON STEEL PIPE (ASTM A106 Gr. B , A333 Gr.6 Station Pipe)	NIPPON METAL INDUSTRY CO
393	CARBON STEEL PIPE (ASTM A106 Gr. B , A333 Gr.6 Station Pipe)	TENARIS
394	**CARBON STEEL PIPES (API 5L GRADE - PSL2)**	RATNAMANI METALS & TUBES LTD. - FOR UP TO 18” ERW PIPES & SAW PIPES OF 18” & ABOVE.
395	CARBON STEEL PIPES (API 5L GRADE - PSL 2)	TATA BHUSHAN STEEL LIMITED- FOR UP TO 18” ERW PIPES
396	CARBON STEEL PIPES (API 5L GRADE - PSL 2)	JINDAL INDIA LTD - FOR UP TO 18” ERW PIPES
397	CARBON STEEL PIPES (API 5L GRADE - PSL 2)	JINDAL SAW – FOR 16” & ABOVE SAW PIPES
398	CARBON STEEL PIPES (API 5L GRADE - PSL 2)	SURYA ROSHINI LTD-- FOR UP TO 16” ERW PIPES & SAW PIPES OF 18” & ABOVE
399	CARBON STEEL PIPES (API 5L GRADE - PSL 2)	MAHARASHTRA SEAMLESS LIMITED - SEAMLESS PIPES, ERW PIPES,
400	CARBON STEEL PIPES (API 5L GRADE - PSL 2)	WELSPUN CORP LTD - ERW PIPES & SAW PIPES
401	**QUICK CONNECT BODY & STEM**	PARKER
402	QUICK CONNECT BODY & STEM	SWAGELOK
403	**QUICK CONNECT BODY & STEM**	PSL LTD.
404	QUICK CONNECT BODY & STEM	JINDAL SAW LIMITED
405	**HOT INDUCTION BEND**	WELSPUN GUJRAT STAHAL ROHERN LTD
406	HOT INDUCTION BEND	SAWAN ENGINEERS PVT LTD
407	HOT INDUCTION BEND	FABRICOM
408	HOT INDUCTION BEND	LALIT ROHR FITTINGS PVT LTD
409	**FLAME ARRESTOR**	FLUIDYNE INSTRUMENTS PVT. LTD.
410	FLAME ARRESTOR	PROTEGO India Pvt. Ltd.
411	FLAME ARRESTOR	NIRMAL INDUSTRIAL CONTROLS PVT. LTD.
412	FLAME ARRESTOR	SUPER SAFETY SERVICES

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413	FLAME ARRESTOR	A PLUS PROJECTS & TECHNOLOGY (P) LTD.
414	**ON OFF SS BALL/NEEDLE /NON RETURN VALVE FOR CNG APPLICATION**	PARKER
415	ON OFF SS BALL/NEEDLE /NON RETURN VALVE	SWAGELOK
416	ON OFF SS BALL/NEEDLE /NON RETURN VALVE	ABAC
417	ON OFF SS BALL/NEEDLE /NON RETURN VALVE	SPIRAX SARCO
418	ON OFF SS BALL/NEEDLE /NON RETURN VALVE	WORCESTER
419	ON OFF SS BALL/NEEDLE /NON RETURN VALVE	WAREE / BAUMER
420	ON OFF SS BALL/NEEDLE /NON RETURN VALVE	STAUFF
421	ON OFF SS BALL/NEEDLE /NON RETURN VALVE	SSP
422	ON OFF SS BALL/NEEDLE /NON RETURN VALVE	L&T

Sr.No	Name of ITEM/Package	Recommended Vendor List
423	ON OFF SS BALL/NEEDLE /NON RETURN VALVE	SANKEY CONTROLS
424	ON OFF SS BALL/NEEDLE /NON RETURN VALVE	ROTEX
425	ON OFF SS BALL/NEEDLE /NON RETURN VALVE	AUDCO
426	**SPLIT TEES FOR HOT TAPPING**	TD WILLIAMSON
427	SPLIT TEES FOR HOT TAPPING	ADVANTICA
428	SPLIT TEES FOR HOT TAPPING	FURMANITE INTERNATIONAL LTD - UK
429	**QUICK OPENING END CLOSURE**	FORAIN SRL, ITALY
430	QUICK OPENING END CLOSURE	G.D.ENGINEERING
431	QUICK OPENING END CLOSURE	PERRY EQUIPMENT CORPORATION
432	QUICK OPENING END CLOSURE	PIPELINE ENGINEERING
433	QUICK OPENING END CLOSURE	SIIRTEC NIGI S.P.A
434	QUICK OPENING END CLOSURE	GROUPE GENOYER (PHOCEENNE)
435	QUICK OPENING END CLOSURE	ROSEN GROUP
436	QUICK OPENING END CLOSURE	TD WILLIAMSON
437	**PIG SIGNALLER / PIG ALERTS**	G.D.ENGINEERING
438	PIG SIGNALLER / PIG ALERTS	FORAIN S.R.L
439	PIG SIGNALLER / PIG ALERTS	TD WILLIAMSON
440	PIG SIGNALLER / PIG ALERTS	GROUPE GENOYER (PHOCEENNE)
441	**EGP/ INTELLIGENT PIGGING**	ROSEN GROUP
442	EGP/ INTELLIGENT PIGGING	PIPELINE ENGINEERING
443	EGP/ INTELLIGENT PIGGING	SPETSNEFTEGAZ NPO JSC (NGKS), RUSSIA
444	EGP/ INTELLIGENT PIGGING	TD WILLIAMSON
445	**VACCUM DRYING**	CORRTECH INTERNATIONAL PVT. LTD.
446	VACCUM DRYING	TOTALINE, AUSTRALIA
447	**PAINTS FOR INTERNAL COATING**	DUPONT, INDIA
448	PAINTS FOR INTERNAL COATING	PERFORMANCE COATING GMBH
449	PAINTS FOR INTERNAL COATING	COPAN
450	**FIRE EXTINGUISHER**	SAFEX FIRE SERVICES
451	FIRE EXTINGUISHER	BRIJBASI HI-TECH UDYOG
452	FIRE EXTINGUISHER	NITIN FIRE PROTECTION INDUSTRIES LTD.
453	FIRE EXTINGUISHER	SUPERMEX EQUIPMENTS
454	FIRE EXTINGUISHER	KOOVERJI DEVSHI & CO.
455	**HIRE HYDRANT, MONITORS, DELUGE VALVES & NOZZLES**	MINIMAX
456	HIRE HYDRANT, MONITORS, DELUGE VALVES & NOZZLES	VIJAY FIRE
457	HIRE HYDRANT, MONITORS, DELUGE VALVES & NOZZLES	NEWAGE
458	HIRE HYDRANT, MONITORS, DELUGE VALVES & NOZZLES	ZENITH

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459	HIRE HYDRANT, MONITORS, DELUGE VALVES & NOZZLES	NITIN FIRE PROTECTION INDUSTRIES LTD.
460	**HOSES & HOSES ACCESSORIES**	GAYATRI INDUSTRIAL CORPORATION
461	HOSES & HOSES ACCESSORIES	ROYAL INDIA CORPORATION
462	HOSES & HOSES ACCESSORIES	BRIJBASI HI-TECH UDYOG
463	HOSES & HOSES ACCESSORIES	NITIN FIRE PROTECTION INDUSTRIES LTD.
464	HOSES & HOSES ACCESSORIES	ZAVERCHAND MARKETING PVT. LTD.
465	HOSES & HOSES ACCESSORIES	NEWAGE
466	HOSES & HOSES ACCESSORIES	SIMPLEX RUBBER PRODUCTS
467	**CONTRACTORS FOR HDD WORK**	CHERINGTON ASIA (INDIA) PVT. LTD.
468	CONTRACTORS FOR HDD WORK	ESSAR CONSTRUCTION LTD.
469	CONTRACTORS FOR HDD WORK	MERSING CONSTRUCTION AND ENGINEERING SDN BHD., SELANGOR (MALAYSIA)

Sr.No	Name of ITEM/Package	Recommended Vendor List
470	CONTRACTORS FOR HDD WORK	HERRENKNECHT (ASIA) LTD. (THAILAND)
471	CONTRACTORS FOR HDD WORK	MID EAST PIPELINE
472	CONTRACTORS FOR HDD WORK	N.R. PATEL & CO.,
473	CONTRACTORS FOR HDD WORK	TRENCHLESS
474	**CONTRACTORS FOR VACCUM DRYING**	CORRTECH INTERNATIONAL PVT. LTD.
475	CONTRACTORS FOR VACCUM DRYING	TOTALINE, AUSTRALIA
476	**PAINTS FOR OUTER SURFACE**	ASIAN PAINTS LTD.
477	PAINTS FOR OUTER SURFACE	SIGMA PAINTS S.A. LTD.
478	PAINTS FOR OUTER SURFACE	BERGER PAINTS INDIA LTD.
479	PAINTS FOR OUTER SURFACE	KANSAI NEROLAC PAINTS LTD.
480	**VITREOUS CHINA SANITARYWARE**	PARRYWARE
481	VITREOUS CHINA SANITARYWARE	HINDUSTAN
482	VITREOUS CHINA SANITARYWARE	CERA
483	**STAINLESS STEEL SINKS**	AMC
484	STAINLESS STEEL SINKS	NEELKANTH
485	**C.P FITTINGS**	PARCO
486	C.P FITTINGS	GEM
487	**C.P ACCESSORIES, WASTE FITTINGS**	ESS
488	C.P ACCESSORIES, WASTE FITTINGS	LOTUS
489	C.P ACCESSORIES, WASTE FITTINGS	ORIENT
490	**PVC PIPES**	SUPREME
491	PVC PIPES	PRINCE
492	**COMPOSITE PIPES & FITTINGS**	KITEC
493	**GUN METAL VALVES AND LOCKS**	LEADER
494	GUN METAL VALVES AND LOCKS	ZOLOTE
495	**CI DOUBLE FLANGED SLUICE VALVES, NON**	KIRLOSKAR
496	**STONE WARE PIPE AND GULLY TRAPS**	PERFECT
497	**WATER TANKS**	SINTEX
498	**ALUMINIUM HARDWARE**	EARIBIHARI
499	**GLASS**	MODIGUARD
500	GLASS	ATUL
501	**ALUMINIUM DOOR/WINDOW SECTION**	HINDALCO
502	ALUMINIUM DOOR/WINDOW SECTION	ULTRATECH CEMENTS
503	**CEMENT**	AMBUJA
504	CEMENT	ACC

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505	CEMENT	BIRLA
506	**PAINTS**	ASIAN
507	PAINTS	BERGER
508	PAINTS	NEROLAC
509	PAINTS	SHALIMAR
510	PAINTS	BOMBAY
511	**CERAMIC/VITRIFILED/VITREOUS TILES**	KAJARIA
512	CERAMIC/VITRIFILED/VITREOUS TILES	JOHNSON
513	CERAMIC/VITRIFILED/VITREOUS TILES	SOMANY
514	STRUCTURAL STEEL	SAIL
515	**REINFORCEMENT STEEL**	TISCO
516	REINFORCEMENT STEEL	SAIL

Sr.No	Name of ITEM/Package	Recommended Vendor List
517	**MIXED METAL OXIDE (MMO) ANODES**	TITANOR COMPONENTS LTD., GOA
518	**SPARK GAP ARRESTOR / SURGE DIVERTER**	DHEN, GERMANY
519	SPARK GAP ARRESTOR / SURGE DIVERTER	MC MILLER
520	SPARK GAP ARRESTOR / SURGE DIVERTER	DAIRY LAND ELECTRICAL INDUSTRIES
521	**CU/CUSO4 REFERENCE CELLS**	MC MILLER, USA
522	CU/CUSO4 REFERENCE CELLS	BORIN, USA
523	CU/CUSO4 REFERENCE CELLS	KRICK
524	**THERMIT WELD MATERIAL**	ERICO EUROPA
525	**PETROLEUM COKE BREEZE**	GOA CARBON , GOA
526	PETROLEUM COKE BREEZE	INDIA CARBON, DURGAPUR(WB)
527	**MG/ZN ANODE**	CORTECH INTERNATIONAL PVT. LTD.
528	MG/ZN ANODE	TITANOR COMPONENT LTD., GOA
529	MG/ZN ANODE	SCIENTIFIC METAL ENGINEERS KARAIKUDI
530	**PIN BRAZING**	BAC
531	PIN BRAZING	SAFETRACK
532	**CABLE LUGS**	ISMAIL, RANCHI
533	CABLE LUGS	DOWELS, MUMBAI
534	**CABLE GLANDS**	FLEXPRO ELECTRICAL PVT. LTD., MUMBAI
535	CABLE GLANDS	FLAMEPROOF EQUIPMENT PVT. LTD., MUMBAI
536	CABLE GLANDS	BALIGA LIGHTING EQUIPMENT LTD., CHENNAI
537	**BACKFILL**	INDIA CARBON
538	BACKFILL	GOA CARBON
539	**POLARIZATION CELL**	MC MILLER
540	POLARIZATION CELL	KRIK ENGINEERING
541	JUNCTION BOX	FLEXPRO
542	JUNCTION BOX	FELP CONTROL GEARS
543	**TEST STATION/ JUNCTION BOX (WEATHERPROOF)**	UNDTS
544	TEST STATION/ JUNCTION BOX (WEATHERPROOF)	CORRTECH INTERNATIONAL
545	TEST STATION/ JUNCTION BOX (WEATHERPROOF)	CCS, MUMBAI
546	TEST STATION/ JUNCTION BOX (WEATHERPROOF)	RAYCHEM RPG PVT LTD
547	**MIXED METAL OXIDE (MMO) ANODES**	TITANOR COMPONENTS LTD., GOA
548	**SOLID STATE DECOUPLER**	KRISTRON SYSTEMS
549	SOLID STATE DECOUPLER	DEHN GERMANY

550	SOLID STATE DECOUPLER	RUSTROL, USA
551	SOLID STATE DECOUPLER	DAIRYLAND ELECTRICALS,USA
552	**GAS OVER OIL ACTUATORS**	BIFFI ITALIA S.R.L, ITALY
553	GAS OVER OIL ACTUATORS	ROTORK FLUID SYTEM S.R.L
554	GAS OVER OIL ACTUATORS	SHAFER ACTUATORS
555	GAS OVER OIL ACTUATORS	SCHUCK
556	GAS OVER OIL ACTUATORS	BETTIS CORPORATION (EMERSON GROUP)
557	GAS OVER OIL ACTUATORS	LEEDEN
558	GAS OVER OIL ACTUATORS	NELES
559	**AIR FILTER REGULATORS**	ASEA BROWN BOVERI LTD.
560	AIR FILTER REGULATORS	BLUE STAR LTD
561	AIR FILTER REGULATORS	DIVYA CONTROL ELEMENTS PVT. LTD.
562	AIR FILTER REGULATORS	PLACKA INSTRUMENTS & CONTROLS PVT. LTD
563	AIR FILTER REGULATORS	SHAH PNEUMATICS

Sr.No	Name of ITEM/Package	Recommended Vendor List
564	AIR FILTER REGULATORS	SHAVO NORGREN (I) PVT. LTD
565	AIR FILTER REGULATORS	VELJAN HYDRAIR PVT. LTD.
566	AIR FILTER REGULATORS	PARKER
567	AIR FILTER REGULATORS	SWAGELOK
568	AIR FILTER REGULATORS	VANAZ ENGINEERS LIMITED
569	PRESSURE RELIEF/SAFETY VALVE	ANDERSON GREENWOOD CROSBY
570	PRESSURE RELIEF/SAFETY VALVE	BHEL (TRICHY)
571	PRESSURE RELIEF/SAFETY VALVE	ASPRO
572	PRESSURE RELIEF/SAFETY VALVE	DRESSER INC.
573	PRESSURE RELIEF/SAFETY VALVE	FUKUI SEISAKUSHO CO. LTD.
574	PRESSURE RELIEF/SAFETY VALVE	INSTRUMENTATION LTD. (PALGHAT)
575	PRESSURE RELIEF/SAFETY VALVE	NAKAKITA SEISAKUSHO CO LTD.
576	PRESSURE RELIEF/SAFETY VALVE	NUOVO PIGNONE SPA (ITALY)
577	PRESSURE RELIEF/SAFETY VALVE	PARCOL SPA
578	PRESSURE RELIEF/SAFETY VALVE	SAFETY SYSTEMS UR LTD.
579	PRESSURE RELIEF/SAFETY VALVE	SARASIN RSBD
580	PRESSURE RELIEF/SAFETY VALVE	SEBIN VALVES INDIA PVT. LTD.
581	PRESSURE RELIEF/SAFETY VALVE	TAI MILANO SPA
582	PRESSURE RELIEF/SAFETY VALVE	TYCO SANMAR LTD.
583	PRESSURE RELIEF/SAFETY VALVE	TYCO VALVES & CONTROLS INDIA PVT. LTD
584	PRESSURE RELIEF/SAFETY VALVE	FARINOSLA
585	PRESSURE RELIEF/SAFETY VALVE	FAINGER LASER
586	PRESSURE RELIEF/SAFETY VALVE	MERCER
587	PRESSURE RELIEF/SAFETY VALVE	FISHER ROSEMOUNT (EMERSON)
588	PRESSURE RELIEF/SAFETY VALVE	OFE & OE GROUP KEYSTONE VALVES PVT. LTD
589	PRESSURE RELIEF/SAFETY VALVE	BARODA SEBIM VALVES PVT. LTD.
590	PRESSURE RELIEF/SAFETY VALVE	HALOL
591	**SUCTION & DISCHARGE FILTER**	BEKO FILTER
592	SUCTION & DISCHARGE FILTER	ULTRA FILTER
593	SUCTION & DISCHARGE FILTER	FILTERATION AND SEPERATION TECHNOLOGY
594	SUCTION & DISCHARGE FILTER	FILTERATION TECHNIQUE

595	SUCTION & DISCHARGE FILTER	PARKER
596	**CARTRIDGE FILTERS**	BEKO FILTER
597	CARTRIDGE FILTERS	FILTERATION & SEPERATION TECHNOLOGY
598	CARTRIDGE FILTERS	ULTRA FILTER
599	CARTRIDGE FILTERS	FILTRATION TECHNIQUE
600	CARTRIDGE FILTERS	ZANDER GMBH (GERMANY)
601	CARTRIDGE FILTERS	GRAND PRIX FAB (PVT.) LTD., NEW DELHI
602	CARTRIDGE FILTERS	MULTITEX FILTRATION ENERGY PVT. LTD.,
603	**AIR COMPRESSOR**	C (IR)
604	AIR COMPRESSOR	ELGI
605	AIR COMPRESSOR	ANESTA IWATA MOTHERSON
606	AIR COMPRESSOR	CHICAGO PNEUMATICS
607	AIR COMPRESSOR	ATLAS COPCO/INGERSOL RAND
608	**CO2 CYLINDER VALVE WITH ACTUATORFOR CO2 FLODDING SYSTEM**	GINGEKERR
609	CO2 CYLINDER VALVE WITH ACTUATORFOR CO2 FLODDING SYSTEM	CEODUEX (ROTAREX)
610	CO2 CYLINDER VALVE WITH ACTUATORFOR CO2 FLODDING SYSTEM	KIDDE

Sr.No	Name of ITEM/Package	Recommended Vendor List
611	CO2 CYLINDER VALVE WITH ACTUATORFOR CO2 FLODDING SYSTEM	FIKE
612	CO2 CYLINDER VALVE WITH ACTUATORFOR CO2 FLODDING SYSTEM	ANSUL
613	CO2 CYLINDER VALVE WITH ACTUATORFOR CO2 FLODDING SYSTEM	LPG
614	CO2 CYLINDER VALVE WITH ACTUATORFOR CO2 FLODDING SYSTEM	VTI
615	CO2 CYLINDER VALVE WITH ACTUATORFOR CO2 FLODDING SYSTEM	ROTEX
616	CO2 CYLINDER VALVE WITH ACTUATORFOR CO2 FLODDING SYSTEM	KEW
617	**FLP SWITCH**	BALIGA
618	FLP SWITCH	FCG
619	FLP SWITCH	FPE
620	FLP SWITCH	FLEXPRO
621	**SWITCHES/FUSES/CONTRACTORS**	L&T
622	SWITCHES/FUSES/CONTRACTORS	GEC
623	SWITCHES/FUSES/CONTRACTORS	SIEMENS
624	RTDs	ALTOP
625	**PLUG VALVE**	AIR & NORDSTROM VALVES INC
626	PLUG VALVE	XOMOX
627	PLUG VALVE	SANMAR INDIA LTD, NEW DELHI
628	PLUG VALVE	AIR & NORDSTROM VALVES INC
629	PLUG VALVE	SERCK AUDCO VALVES
630	PLUG VALVE	SUMITOMO CORPORATION
631	PLUG VALVE	FISHER XOMOX SANMAR
632	PLUG VALVE	L&T (AUDCO INDIA LTD, CHENNAI)
633	PLUG VALVE	PARKER
634	PLUG VALVE	STAUFF
635	**GAS ENGINE**	CUMMINS
636	GAS ENGINE	CATERPILLAR
637	**PRESSURE RELIEF/SAFETY VALVE**	SWAGELOK
638	PRESSURE RELIEF/SAFETY VALVE	PARKER
639	PRESSURE RELIEF/SAFETY VALVE	STAUFF
640	PRESSURE RELIEF/SAFETY VALVE	M/s Nirmal

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641	**PRESSURE SAFETY VALVE**	BESTOBELL / HEROSE / AUDCO VALVES / FORBES MARSHALL
642	**AIR COMPRESSOR**	EMTEX
643	AIR COMPRESSOR	KPCL
644	**COMPRESSOR MAIN MOTOR**	CROMPTON GREAVES
645	COMPRESSOR MAIN MOTOR	SIEMENS
646	COMPRESSOR MAIN MOTOR	WEG
647	COMPRESSOR MAIN MOTOR	ABB
648	COMPRESSOR MAIN MOTOR	LHP
649	COMPRESSOR MAIN MOTOR	KIRLOSKAR
650	COMPRESSOR MAIN MOTOR	BHARAT BIJLEE
651	**MAIN MOTOR VFD STARTER**	SIEMENS
652	MAIN MOTOR VFD STARTER	SCHNIEIDER
653	MAIN MOTOR VFD STARTER	FUJI
654	MAIN MOTOR VFD STARTER	ABB
655	**SOFT STARTER**	SIEMENS
656	SOFT STARTER	SCHNEIDER
657	SOFT STARTER	ABB

Sr.No	Name of ITEM/Package	Recommended Vendor List
658	SOFT STARTER	FUJI
659	**INSTRUMENTATION**	
660	**FIELD INSTRUMENTS TRANSMITTERS (P, DP, F,L,T)**	ABB AUTOMATION LTD.
661	FIELD INSTRUMENTS TRANSMITTERS (P, DP, F,L,T)	FISHER ROSEMOUNT SINGAPORE PTE LTD.
662	FIELD INSTRUMENTS TRANSMITTERS (P, DP, F,L,T)	FUJI ELECTRIC CO. LTD.
663	FIELD INSTRUMENTS TRANSMITTERS (P, DP, F,L,T)	HONEYWELL INC.
664	FIELD INSTRUMENTS TRANSMITTERS (P, DP, F,L,T)	HONEYWELL
665	FIELD INSTRUMENTS TRANSMITTERS (P, DP, F,L,T)	YOKOGAWA ELECTRIC CORPORATION
666	FIELD INSTRUMENTS TRANSMITTERS (P, DP, F,L,T)	YOKOGAWA BLUE STAR LTD.
667	FIELD INSTRUMENTS TRANSMITTERS (P, DP, F,L,T)	ASHCROFT
668	FIELD INSTRUMENTS TRANSMITTERS (P, DP, F,L,T)	MURPHY
669	FIELD INSTRUMENTS TRANSMITTERS (P, DP, F,L,T)	WIKA
670	FIELD INSTRUMENTS TRANSMITTERS (P, DP, F,L,T)	DRUCK
671	FIELD INSTRUMENTS TRANSMITTERS (P, DP, F,L,T)	WAREE
672	**CORIOLIS MASS FLOW METERS**	EMERSON PROCESS MANAGEMENT
673	CORIOLIS MASS FLOW METERS	COMPAC,NEW ZELAND
674	CORIOLIS MASS FLOW METERS	ENDRESS & HAUSER CMBH & COMPANY
675	THERMAL MASS FLOW METER	MAGNETROL
676	THERMAL MASS FLOW METER	PROCESS CONTROL DEVICES (PCD)
677	**PRESSURE GAUGES**	AN INSTRUMENTS PVT. LTD.
678	PRESSURE GAUGES	ALTOP
679	PRESSURE GAUGES	GENERAL INSTRUMENTS CONSORTIUM
680	PRESSURE GAUGES	WAAREE INSTRUMNETS CONSORTIUM
681	PRESSURE GAUGES	GENERAL INSTRUMENTS CONSORTIUM
682	PRESSURE GAUGES	MANOMETER (INDIA) PVT. LTD.
683	PRESSURE GAUGES	WIKA INSTRUMENTS INDIA PVT. LTD.
684	PRESSURE GAUGES	DRUCK
685	PRESSURE GAUGES	BADOTHERM PROCESS INSTRUMENTS B. V.

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686	PRESSURE GAUGES	BOURDON HAENNI S.A
687	PRESSURE GAUGES	BRITISH ROTOTHERM CO. LTD
688	PRESSURE GAUGES	BUDENBERG GUAGE CO. LTD.
689	PRESSURE GAUGES	DRESSER INC.
690	PRESSURE GAUGES	NAGANO KEIKI SEISAKUSHO LTD.
691	PRESSURE GAUGES	BAUMER
692	PRESSURE GAUGES	WALCHANDNAGER INDUSTRIES LTD.
693	PRESSURE GAUGES	WIKA ALEXANDER WIEGAND & CO GMBH
694	PRESSURE GAUGES	ASHCROFT /PRECISON MASS
695	PRESSURE GAUGES	H. GURU
696	**TEMPERATURE GAUGE WITH THERMOWELL**	PRECISON MASS
697	TEMPERATURE GAUGE WITH THERMOWELL	AN INSTRUMENTS PVT. LTD.
698	TEMPERATURE GAUGE WITH THERMOWELL	GENERAL INSTRUMENTS LTD
699	TEMPERATURE GAUGE WITH THERMOWELL	WIKA INSTRUMENTS INDIA PVT. LTD.
700	TEMPERATURE GAUGE WITH THERMOWELL	BAUMER TECHNOLOGIES INDIA
701	TEMPERATURE GAUGE WITH THERMOWELL	ALTO INDUSTRIES
702	**RTD WITH THERMOWELL AND SKIN TYPE**	A.N.INSTRUMENTS
703	RTD WITH THERMOWELL AND SKIN TYPE	GENERAL INSTRUMENTS PVT LTD
704	RTD WITH THERMOWELL AND SKIN TYPE	NAGMAN SENSORS PVT LTD

Sr.No	Name of ITEM/Package	Recommended Vendor List
705	RTD WITH THERMOWELL AND SKIN TYPE	PYRO ELECTRIC INSTRUMENTS
706	RTD WITH THERMOWELL AND SKIN TYPE	WIKA
707	RTD WITH THERMOWELL AND SKIN TYPE	WAREE
708	RTD WITH THERMOWELL AND SKIN TYPE	BAUMER
709	RTD WITH THERMOWELL AND SKIN TYPE	ALTOP
710	RTD WITH THERMOWELL AND SKIN TYPE	TEMPSENS INSTRUMENTS INDIA PVT LTD, INDIA
711	RTD WITH THERMOWELL AND SKIN TYPE	THERMO ELECTRIC COMPANY INDIA PVT. LTD, INDIA
712	RTD WITH THERMOWELL AND SKIN TYPE	TECHNO INSTRUMENTS, INDIA
713	RTD WITH THERMOWELL AND SKIN TYPE	TM TECNOMATIC SPA, ITALY
714	RTD WITH THERMOWELL AND SKIN TYPE	THERMAL INSTRUMENT (I) P LTD
715	**PRESSURE/DIFFERENTIAL /TEMP SWITCH**	SWITZER
716	PRESSURE/DIFFERENTIAL /TEMP SWITCH	DELTA
717	PRESSURE/DIFFERENTIAL /TEMP SWITCH	UNITED ELECTRIC
718	PRESSURE/DIFFERENTIAL /TEMP SWITCH	SOR
719	PRESSURE/DIFFERENTIAL /TEMP SWITCH	GAUGE BOURDON
720	PRESSURE/DIFFERENTIAL /TEMP SWITCH	DRESSER
721	PRESSURE/DIFFERENTIAL /TEMP SWITCH	INFOS
722	**ULTRASONIC FLOW METER**	DANIEL MEASUREMENT AND CONTROLS PVT LTD (EMERSON)
723	ULTRASONIC FLOW METER	SICK , INDIA
724	ULTRASONIC FLOW METER	RMG,
725	ULTRASONIC FLOW METER	ELSTER- HONEYWELL
726	ULTRASONIC FLOW METER	KROHNE
727	ULTRASONIC FLOW METER	ENDRESS & HAUSER (E&H)
728	ULTRASONIC FLOW METER	FLEXIM
729	ULTRASONIC FLOW METER	GE
730	**RPD Meter**	DRESSER

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731	RPD Meter	ROMET
732	RPD Meter	ELSTER-HONEYWELL
733	RPD Meter	RMG REGEL + MESSTECHNIL GmbH
734	RPD Meter	ITRON
735	RPD Meter	RAYCHEM RPG LTD
736	RPD Meter	CAMERON
737	RPD Meter	FMG
738	**TURBIN FLOW METER**	DRESSER
739	TURBIN FLOW METER	ROCKWIN
740	TURBIN FLOW METER	ELSTER-HONEYWELL
741	TURBIN FLOW METER	RMG REGEL + MESSTECHNIL GmbH
742	TURBIN FLOW METER	DANIEL/EMERSON
743	TURBIN FLOW METER	ITRON
744	TURBIN FLOW METER	VEMTECH
745	**FLOW COMPUTER**	DANIEL/EMERSON
746	FLOW COMPUTER	OMNI
747	FLOW COMPUTER	FMC
748	FLOW COMPUTER	HONEYWELL
749	FLOW COMPUTER	ELSTER
750	FLOW COMPUTER	SCHNEIDER

Sr.No	Name of ITEM/Package	Recommended Vendor List
751	FLOW COMPUTER	ABB
752	**ELECTRONIC VOLUME CONVERTER**	PLUM
753	ELECTRONIC VOLUME CONVERTER	ELGAS
754	**SELF ACTUATED PR. CONTROL VALVE**	DANIEL INDUSTRIES INC
755	SELF ACTUATED PR. CONTROL VALVE	DRESSER PRODUITS INDUSTRIES
756	SELF ACTUATED PR. CONTROL VALVE	ESME VALVES LTD.
757	SELF ACTUATED PR. CONTROL VALVE	FISHER ROSEMOUNT SINGAPORE PTE LTD.
758	SELF ACTUATED PR. CONTROL VALVE	FISHER EXMOX SANMAR LIMTED
759	SELF ACTUATED PR. CONTROL VALVE	GORTER CONTROLS B.V.
760	SELF ACTUATED PR. CONTROL VALVE	INSTROMET INTERNATIONAL NV
761	SELF ACTUATED PR. CONTROL VALVE	KEYE & MACDONALD INC
762	SELF ACTUATED PR. CONTROL VALVE	NUOVO PIGNONE SPA (ITALY)
763	SELF ACTUATED PR. CONTROL VALVE	PIETRO FIORENTINI SPA
764	SELF ACTUATED PR. CONTROL VALVE	RICHARDS INDUSTRIES (FORMERLY TRELOAR)
765	SELF ACTUATED PR. CONTROL VALVE	RMG REGEL + MESSTECHNIK GMBH
766	SELF ACTUATED PR. CONTROL VALVE	COMPAC INDUSTRIES LTD., NZL.
767	SELF ACTUATED PR. CONTROL VALVE	ASPRO
768	SELF ACTUATED PR. CONTROL VALVE	VANAZ
769	SELF ACTUATED PR. CONTROL VALVE	NIRMAL INDUSTRIES LIMITED
770	**SOLENOID VALVES**	ALCON ALEXANDER CONTROLS LIMITED
771	SOLENOID VALVES	JEFFERSONS
772	SOLENOID VALVES	ASCO (INDIA) LIMITED
773	SOLENOID VALVES	ASCO JOUCOMATIC LTD.
774	SOLENOID VALVES	ASCO JOUCOMATIC SA

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775	SOLENOID VALVES	PARKER HANNIFIN, USA
776	SOLENOID VALVES	AVCON CONTROLS PVT. LTD.
777	SOLENOID VALVES	BARKSDALE INC.
778	SOLENOID VALVES	BLUE STAR LTD.
779	SOLENOID VALVES	HERION WERKE
780	SOLENOID VALVES	SCHRADER SCOVILL DUNCAN LIMITED
781	SOLENOID VALVES	SEITZ AG
782	SOLENOID VALVES	COMPAC NEW ZEALAND
783	SOLENOID VALVES	ROTEX AUTOMATION LIMITED
784	SOLENOID VALVES	OPERATED VALVES ASCO
785	SOLENOID VALVES	HABONIM VASS
786	SOLENOID VALVES	FESTO
787	SOLENOID VALVES	MICROMECANICA
788	**SPECIAL CONTROL VALVES**	FISHER ROSEMOUNT SIGAPORE PTE. LTD.
789	SPECIAL CONTROL VALVES	FLOWSERVE PTE. LTD. (FORMERLY DURIRON)
790	SPECIAL CONTROL VALVES	HOPKINSONS LIMITED
791	SPECIAL CONTROL VALVES	METSO AUTOMATION PTE LTD. (FORMERLY NELES)
792	SPECIAL CONTROL VALVES	NUOVO PIGNONE SPA (ITALY
793	SPECIAL CONTROL VALVES	SPX VALVES & CONTROLS (FORMERLY DEXURIK)
794	SPECIAL CONTROL VALVES	COMPAC IND. LTD. NZL
795	**REGULATORS**	COMPAC IND. LTD.
796	REGULATORS	FISHER ROSEMOUNT SIGAPORE PTE. LTD

Sr.No	Name of ITEM/Package	Recommended Vendor List
797	REGULATORS	FLOWSERVE PTE. LTD. (FORMERLY DURIRON)
798	REGULATORS	SWAGELOK
799	REGULATORS	PARKER
800	REGULATORS	COMPAC
801	REGULATORS	HAMLET
802	REGULATORS	HYLOCK
803	REGULATORS	DK-LOK
804	REGULATORS	SEALEXCEL
805	REGULATORS	SSP
806	REGULATORS	OASIS
807	**GAS DETECTOR SYSTEM**	DETRONICS
808	GAS DETECTOR SYSTEM	HONEYWELL
809	GAS DETECTOR SYSTEM	NET SAFETY
810	GAS DETECTOR SYSTEM	GENERAL MONITORS/ MSA
811	GAS DETECTOR SYSTEM	CROW ON
812	GAS DETECTOR SYSTEM	SIEGER
813	GAS DETECTOR SYSTEM	ESP SAFETY
814	GAS DETECTOR SYSTEM	SENSITRON
815	GAS DETECTOR SYSTEM	ROSEMOUNT EARLIER KNOWN AS NET SEFETY
816	GAS DETECTOR SYSTEM	DRAEGER SAFETY
817	GAS DETECTOR SYSTEM	EMERSON PROCESS MANAGEMENT INDIA PVT LTD
818	GAS DETECTOR SYSTEM	RESPO PRODUCTS
819	GAS DETECTOR SYSTEM	DET-TRONICS

820	**FIRE DETECTION/ALARM SYSTEM**	APOIIO
821	FIRE DETECTION/ALARM SYSTEM	AGNI PVT LTD
822	FIRE DETECTION/ALARM SYSTEM	ASES/IRIS
823	FIRE DETECTION/ALARM SYSTEM	HONEYWELL
824	FIRE DETECTION/ALARM SYSTEM	RAVEL
825	FIRE DETECTION/ALARM SYSTEM	NEW FIRE ENGINEERS (P) LTD, INDIA
826	**FLAME DETECTOR/ SURGE PROTECTORS**	GENERAL MONITORS/ MSA
827	FLAME DETECTOR/ SURGE PROTECTORS	SPECTREX
828	FLAME DETECTOR/ SURGE PROTECTORS	DETRONICS
829	FLAME DETECTOR/ SURGE PROTECTORS	HONEYWELL
830	FLAME DETECTOR/ SURGE PROTECTORS	NET SAFETY
831	FLAME DETECTOR/ SURGE PROTECTORS	CROW ON
832	FLAME DETECTOR/ SURGE PROTECTORS	SIEGER
833	FLAME DETECTOR/ SURGE PROTECTORS	ESP SAFETY
834	**SURGE PROTECTORS/BARRIER/ISOLATORS/SIGNAL MULTIPLYER**	PHOENIX
835	SURGE PROTECTORS/BARRIER/ISOLATORS/SIGNAL MULTIPLYER	P&F
836	SURGE PROTECTORS/BARRIER/ISOLATORS/SIGNAL MULTIPLYER	MTL
837	SURGE PROTECTORS/BARRIER/ISOLATORS/SIGNAL MULTIPLYER	HANS TURCK GMBH & CO. KG INDIA / GERMANY
838	**RELAYS**	OMRON
839	RELAYS	OEN
840	RELAYS	JYOTI
841	RELAYS	PHOENIX
842	**PLC/RTU**	ALLEN BRADLEY

Sr.No	Name of ITEM/Package	Recommended Vendor List
843	PLC/RTU	GE FANUC
844	PLC/RTU	BRISTOL BABCOCK INC.
845	PLC/RTU	HONEYWELL
846	PLC/RTU	SCHNIEDER
847	PLC/RTU	ABB
848	PLC/RTU	SIEMENS
849	PLC/RTU	EMERSON
850	PLC/RTU	SYNERGY
851	PLC/RTU	INVENSYS
852	PLC/RTU	ELECTRONIC CORPORATION OF INDIA
853	PLC/RTU	M/s. Phoenix Contact India Pvt Ltd
854	**MCT**	NEIMEX
855	MCT	SIGNET INTERNATIONAL
856	MCT	G.K Gmbh, GERMANY
857	MCT	ROTEX
858	**OFC**	FINOLEX CABLE
859	OFC	BIRLA ERICSSION OPTICAL LTD
860	OFC	RPG CABLE LTD
861	OFC	TAMILNADU TELECOMMUNICATION LTD
862	OFC	U M Cables
863	OFC	HIMACHAL FUTURISTIC COMMUNICATION LTD

864	OFC	STERLITE INDUSTRIESLTD
865	OFC	KEC INTERNATIONAL LTD,INDIA
866	**ELECTRONIC MARKER AND LOCATOR**	3M
867	ELECTRONIC MARKER AND LOCATOR	MOELLER
868	**FIBER TERMINAL CLOSER (FTC)**	RAYCHEM
869	FIBER TERMINAL CLOSER (FTC)	3M
870	FIBER TERMINAL CLOSER (FTC)	SIEMENS
871	FIBER TERMINAL CLOSER (FTC)	F&G
872	FIBER TERMINAL CLOSER (FTC)	KEPTEL
873	FIBER TERMINAL CLOSER (FTC)	ALCOA FUJIKURLA LTD
874	**INSTRUMENT PANEL**	RITTAL
875	INSTRUMENT PANEL	ACCUSONIC CONTROLS PVT LTD, INDIA
876	INSTRUMENT PANEL	INSTRUMENTATION LTD, INDIA
877	INSTRUMENT PANEL	INDUSTRIAL CONTROLS & APPLIANCES PVT LTD,INDIA
878	INSTRUMENT PANEL	POSITRONICS PVT LTD,INDIA
879	INSTRUMENT PANEL	RADHA KRISHNA CONTROLS,INDIA
880	INSTRUMENT PANEL	ICA SOLUTIONS LTD, U.K
881	INSTRUMENT PANEL	PYROTECH CONTROLS, INDIA
882	INSTRUMENT PANEL	ENCLOTEK, INDIA
883	INSTRUMENT PANEL	CONTROL SYSTEM ENGINEERS
884	INSTRUMENT PANEL	IRIS AUTOMATION PVT. LTD.
885	**JUNCTION BOX**	BALIGA LIGHTING EQUIPMENT (P) LTD, INDIA
886	JUNCTION BOX	FLEXPRO ELECTRICALS PVT.LTD ,INDIA
887	JUNCTION BOX	FLAMEPROOF EQUIPMENT PVT.LTD, INDIA
888	JUNCTION BOX	FCG POWER INDUSTRIES PVT. LTD,INDIA
889	JUNCTION BOX	FCG FLAMEPROOF CONTROL GEARS PVT. LTD, INDIA

Sr.No	Name of ITEM/Package	Recommended Vendor List
890	JUNCTION BOX	SUDHIR SWITCHGEARS PVT.LTD, INDIA
891	JUNCTION BOX	EXPROTECTA
892	**CABLE GLAND/PLUGS**	BALIGA LIGHTING EQUIPMENTS PVT. LTD, INDIA
893	CABLE GLAND/PLUGS	COMET BRASS PRODUCTS , INDIA
894	CABLE GLAND/PLUGS	COMET INDUSTRIES, INDIA
895	CABLE GLAND/PLUGS	FLEXPRO ELECTRICALS PVT.LTD,INDIA
896	CABLE GLAND/PLUGS	FLAMEPROOF EQUIPMENTS (P) LTD, INDIA
897	CABLE GLAND/PLUGS	FCG POWER INDUSTRIES PVT.LTD, INDIA
898	CABLE GLAND/PLUGS	FCG FLAMEPROOF CONTROL GEARS PVT LTD, INDIA
899	CABLE GLAND/PLUGS	STANDARD METAL INDUSTRIES,INDIA
900	CABLE GLAND/PLUGS	SUDHIR SWITCHGEARS PVT.LTD, INDIA
901	CABLE GLAND/PLUGS	KAYSONS TECHNO EQUIPMENT P LTD.
902	CABLE GLAND/PLUGS	STANDARD METAL INDUSTRIES
903	**INSTRUMENT CABLES**	CORDS CABLES INDUSTRIES
904	INSTRUMENT CABLES	ASSOCIATED CABLES
905	INSTRUMENT CABLES	INCAB
906	INSTRUMENT CABLES	UNIVERSAL CABLES LTS/OEM Cables
907	INSTRUMENT CABLES	ASEAN
908	INSTRUMENT CABLES	CCI
909	INSTRUMENT CABLES	FORT GLOSTER

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910	INSTRUMENT CABLES	FINOLEX
911	INSTRUMENT CABLES	KEI
912	INSTRUMENT CABLES	POLYCAB
913	INSTRUMENT CABLES	HAVELLS
914	INSTRUMENT CABLES	THERMO CABLES LTD, INDIA
915	INSTRUMENT CABLES	UDEY PYROCABLES PVT.LTD, INDIA
916	INSTRUMENT CABLES	SUYOG ELECTRICALS LTD, INDIA
917	**TELECOM SYSTEM**	COMMTEL NETWORK
918	TELECOM SYSTEM	ECI TELECOM LTD
919	TELECOM SYSTEM	FIBCOM INDIA LTD
920	TELECOM SYSTEM	TEJAS NETWORK LTD
921	TELECOM SYSTEM	ABB LTD
922	**LANSWITCH/ROUTER/FIRE WALL**	3COM
923	LANSWITCH/ROUTER/FIRE WALL	CISCO
924	LANSWITCH/ROUTER/FIRE WALL	NORTEL
925	LANSWITCH/ROUTER/FIRE WALL	DELL
926	LANSWITCH/ROUTER/FIRE WALL	CHECK POINT
927	LANSWITCH/ROUTER/FIRE WALL	PALO ALTO
928	LANSWITCH/ROUTER/FIRE WALL	IBM
929	**CCTV**	PELCO
930	CCTV	AXIS
931	CCTV	SAMSUNG
932	CCTV	PANASONIC
933	CCTV	HONEYWELL
934	CCTV	CP PLUS
935	**CORROSIVE MONITORING SYSTEM (CMS)**	CAPROCO, UK
936	CORROSIVE MONITORING SYSTEM (CMS)	CORRPRO, SHARJA

Sr.No	Name of ITEM/Package	Recommended Vendor List
937	CORROSIVE MONITORING SYSTEM (CMS)	METAL SAMPLES, USA
938	CORROSIVE MONITORING SYSTEM (CMS)	CORMON, UK
939	CORROSIVE MONITORING SYSTEM (CMS)	ATEL, ITALY
940	CORROSIVE MONITORING SYSTEM (CMS)	KOROSI SPECINDO
941	**VIBRATION SWITCH**	MURPHY
942	VIBRATION SWITCH	METRIX
943	VIBRATION SWITCH	ROBERTSHAW CONTROL
944	**TELEPHONES/EPABX SYSTEM**	ALCATEL
945	TELEPHONES/EPABX SYSTEM	AVAYA
946	TELEPHONES/EPABX SYSTEM	ERICSSION
947	TELEPHONES/EPABX SYSTEM	SIEMENS
948	TELEPHONES/EPABX SYSTEM	PANASONIC
949	TELEPHONES/EPABX SYSTEM	TATA
950	TELEPHONES/EPABX SYSTEM	SAMSUNG
951	**PRESSURE SWITCHES**	ASCO JOUCOMATIC LTD,UK, C/O ASCO (INDIA) LTD, INDIA
952	PRESSURE SWITCHES	DAG PROCESS INSTRUMENTS PVT LTD, INDIA
953	PRESSURE SWITCHES	DELTA CONTROLS LTD, UK
954	PRESSURE SWITCHES	INDFOS INDUSTRIES LIMITED, INDIA
955	PRESSURE SWITCHES	KAUSTUBHA UDYOG, INDIA

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956	PRESSURE SWITCHES	PYROPRESS ENGG CO LTD, UK
957	PRESSURE SWITCHES	ROBERTSHAW CONTROLS CO, USA
958	PRESSURE SWITCHES	REGULATEURS GEORGIN S.A, FRANCE
959	PRESSURE SWITCHES	SWITZER INSTRUMENT LTD, INDIA
960	PRESSURE SWITCHES	SOR INC, USA
961	PRESSURE SWITCHES	SIRCO CONTROLS LIMITED, UK
962	PRESSURE SWITCHES	UNITED ELECTRIC CONTROLS CO, USA, C/O UNITED
963	PRESSURE SWITCHES	ELECTRIC CONTROLS CO., INDIA
964	PRESSURE SWITCHES	INDFOS,ASCHCROFT
965	**LEVEL GAUGE GLASSES & COCKS**	BLISS ANAND PVT LTD, INDIA
966	LEVEL GAUGE GLASSES & COCKS	CHEMTROLS SAMIL (INDIA) PVT LTD, INDIA
967	LEVEL GAUGE GLASSES & COCKS	CESARE BONNETTI S.P.A., ITALY, C/O BONETTI WAAREE (I) PVT.
968	LEVEL GAUGE GLASSES & COCKS	GAUGES BURDON (I) PVT. LTD.(GENERAL INSTRUMENTS)
969	LEVEL GAUGE GLASSES & COCKS	JERGUSON GAUGE & VALVE,USA
970	LEVEL GAUGE GLASSES & COCKS	KLINGER SPA, ITALY
971	LEVEL GAUGE GLASSES & COCKS	LEVCON INSTRUMENTS PVT LTD,INDIA
972	LEVEL GAUGE GLASSES & COCKS	NIHON KLINGAGE CO LTD, JAPAN
973	LEVEL GAUGE GLASSES & COCKS	PRATOLINA INSTRUMENTS PVT LTD, INDIA
974	LEVEL GAUGE GLASSES & COCKS	SIGMA INSTRUMENTS CO, INDIA
975	LEVEL GAUGE GLASSES & COCKS	NISAN SCIENTIFIC PROCESS EQUIP. P LTD
976	LEVEL GAUGE GLASSES & COCKS	PUNE TECHTROL PVT LTD
977	LEVEL GAUGE GLASSES & COCKS	PRATOLINA INSTRUMENTS PVT LTD
978	**LEVEL INSTRUMENT**	ABB INC,USA, C/O ABB LTD, INDIA
979	LEVEL INSTRUMENT	EMERSON PROCESS MANAGEMENT INDIA PVT LTD, INDIA
980	LEVEL INSTRUMENT	ENDRESS+HAUSER (I) PVT. LTD, INDIA
981	LEVEL INSTRUMENT	KROHNE MESSTECHNIK GMBH & CO KG, GERMANY
982	LEVEL INSTRUMENT	L & J TECHNOLOGIES, USA, C/O L&J TECHNOLOGIES INC,

Sr.No	Name of ITEM/Package	Recommended Vendor List
983	LEVEL INSTRUMENT	MAGNETROL INTERNATIONAL
984	LEVEL INSTRUMENT	VEGA GRIESHABER KG, GERMANY, C/O VEGA INDIA LEVEL AND PRESSURE MGMT PVT. LTD, INDIA
985	**Panel mounted 24 V DC Power supply**	SITOP, INDIA
986	Panel mounted 24 V DC Power supply	PHEONIX, INDIA
987	Panel mounted 24 V DC Power supply	WAGO
988	Panel mounted 24 V DC Power supply	COSEL
989	**CABLE – FIRE ALARM & COMMUNICATION CABLES**	CORDS CABLE INDUSTRIES LTD.
990	CABLE – FIRE ALARM & COMMUNICATION CABLES	CMI
991	CABLE – FIRE ALARM & COMMUNICATION CABLES	DELTON CABLES LTD.
992	CABLE – FIRE ALARM & COMMUNICATION CABLES	ELKAY TELELINKS
993	CABLE – FIRE ALARM & COMMUNICATION CABLES	KEI INDUSTRIES LTD.
994	CABLE – FIRE ALARM & COMMUNICATION CABLES	RELIANCE ENGINEERS LTD.
995	**CABLE – LT POWER & CONTROL(XPLE)**	CORDS CABLE INDUSTRIES LTD.
996	CABLE – LT POWER & CONTROL(XPLE)	UNIVERSAL CABLE LTD.
997	CABLE – LT POWER & CONTROL(XPLE)	KEI INDUSTRIES LTD.
998	CABLE – LT POWER & CONTROL(XPLE)	HAVELLS

999	CABLE – LT POWER & CONTROL(XPLE)	DELTON
1000	CABLE – LT POWER & CONTROL(XPLE)	ELKAY TELELINKS
1001	CABLE – LT POWER & CONTROL(XPLE)	EVERSHINE ELECTRICALS
1002	CABLE – LT POWER & CONTROL(XPLE)	ECKO
1003	CABLE – LT POWER & CONTROL(XPLE)	RAVIN
1004	CABLE – LT POWER & CONTROL(XPLE)	RALLISON
1005	CABLE – LT POWER & CONTROL(XPLE)	SUYOG
1006	CABLE – LT POWER & CONTROL(XPLE)	NETCO
1007	CABLE – LT POWER & CONTROL(XPLE)	UNIFLEX
1008	CABLE – LT POWER & CONTROL(XPLE)	PARAMOUNT
1009	CABLE – LT POWER & CONTROL(XPLE)	GLOSTER
1010	CABLE – LT POWER & CONTROL(XPLE)	ASSOCIATED CABLES PVT. LTD.
1011	CABLE – LT POWER & CONTROL(XPLE)	CMI
1012	CABLE – LT POWER & CONTROL(XPLE)	GEMSCAB
1013	CABLE – LT POWER & CONTROL(XPLE)	INDUSTRIAL CABLES
1014	CABLE – LT POWER & CONTROL(XPLE)	NICCO
1015	CABLE – LT POWER & CONTROL(XPLE)	POLYCAB
1016	CABLE – LT POWER & CONTROL(XPLE)	TORRENT
1017	CABLE – LT POWER & CONTROL(XPLE)	FASCO GUARDON
1018	CABLE – LT POWER & CONTROL(XPLE)	Swadeshi Cable
1019	**CABLE – GLAND**	BALIGA
1020	CABLE – GLAND	COMET
1021	CABLE – GLAND	FLEXPRO
1022	CABLE – GLAND	FLAMEPROOF
1023	CABLE – GLAND	FCG
1024	CABLE – GLAND	ELECTRO WERKE
1025	CABLE – GLAND	DOWELS
1026	CABLE – GLAND	CCI
1027	CABLE – GLAND	IVECO GUARDPLUS
1028	**CABLE – LUGS**	DOWELS

Sr.No	Name of ITEM/Package	Recommended Vendor List
1029	CABLE – LUGS	JAINSON
1030	CABLE – LUGS	ISMAL
1031	CABLE – LUGS	IVECO GUARDPLUS
1032	CABLE – LUGS	Guardplus
1033	**CABLE – TRAY**	ERCON COMPOSITES
1034	CABLE – TRAY	YAMUNA POWER & INFRASTRUCTURE LTD.
1035	CABLE – TRAY	IVECO RENO
1036	**EARTHING MATERIALS**	RUKMANI ELECTRICAL & COMPONENTS PVT LTD.
1037	EARTHING MATERIALS	INDIANA GRATING PVT LTD.
1038	EARTHING MATERIALS	JEF TECHNO SOLUTIONS PVT LTD
1039	EARTHING MATERIALS	IVECO-RENO
1040	**FLAME PROOF LDB'S/ JB,S/CONTROL STATION/ SWITCHES**	FCG
1041	FLAME PROOF LDB'S/ JB,S/CONTROL STATION/ SWITCHES	SUDHIR
1042	FLAME PROOF LDB'S/ JB,S/CONTROL STATION/ SWITCHES	PROMPT ENGINEERING WORKS
1043	FLAME PROOF LDB'S/ JB,S/CONTROL STATION/ SWITCHES	FLAME PROOF EQUIPMENTS PVT. LTD.

1044	FLAME PROOF LDB'S/ JB,S/CONTROL STATION/ SWITCHES	BALIGA LIGHTING EQUIPMENTS PVT. LTD.
1045	FLAME PROOF LDB'S/ JB,S/CONTROL STATION/ SWITCHES	FLEXPRO ELECTRICALS PVT. LTD.
1046	FLAME PROOF LDB'S/ JB,S/CONTROL STATION/ SWITCHES	ERGON
1047	FLAME PROOF LDB'S/ JB,S/CONTROL STATION/ SWITCHES	Equipments Pvt. Ltd
1048	**LIGHTING FIXTURES**	GE LIGHTING PVT. LTD.
1049	LIGHTING FIXTURES	BAJAJ ELECTRICALS LTD.
1050	LIGHTING FIXTURES	CROMPTON GREAVES LTD.
1051	LIGHTING FIXTURES	PHILIPS INDIA LTD.
1052	LIGHTING FIXTURES	HAVELL'S
1053	**LIGHTING FIXTURES (FLAMEPROOF)**	BAJAJ ELECTRICALS LTD.
1054	LIGHTING FIXTURES (FLAMEPROOF)	BALIGA LIGHTING EQUIPMENT PVT. LTD.
1055	LIGHTING FIXTURES (FLAMEPROOF)	CROMPTON GREAVES LTD.
1056	LIGHTING FIXTURES (FLAMEPROOF)	CEAG FLAMEPROOF CONTROLGEAR PVT. LTD.
1057	LIGHTING FIXTURES (FLAMEPROOF)	FLEXPRO ELECTRICALS PVT. LTD.
1058	LIGHTING FIXTURES (FLAMEPROOF)	PHILIPS INDIA LTD.
1059	LIGHTING FIXTURES (FLAMEPROOF)	SUDHIR SWITCHGEARS PVT. LTD.
1060	LIGHTING FIXTURES (FLAMEPROOF)	FCG
1061	**GI-OCTOGONAL POLE**	BAJAJ
1062	GI-OCTOGONAL POLE	TRANSRAIL
1063	GI-OCTOGONAL POLE	WIPRO
1064	GI-OCTOGONAL POLE	IVECO ROSHNI
1065	**LOW VOLTAGE POWER CONTROL CENTER (PCC)/ MCC/ PDB/ MLDB/ LDB**	ABB
1066	LOW VOLTAGE POWER CONTROL CENTER (PCC)/ MCC/ PDB/ MLDB/ LDB	BCH
1067	LOW VOLTAGE POWER CONTROL CENTER (PCC)/ MCC/ PDB/ MLDB/ LDB	C&S
1068	LOW VOLTAGE POWER CONTROL CENTER (PCC)/ MCC/ PDB/ MLDB/ LDB	ELECMECH SWITCHGEAR & INSTRUMENTATION
1069	LOW VOLTAGE POWER CONTROL CENTER (PCC)/ MCC/ PDB/ MLDB/ LDB	KMG ATOZ
1070	LOW VOLTAGE POWER CONTROL CENTER (PCC)/ MCC/ PDB/ MLDB/ LDB	L&T
1071	LOW VOLTAGE POWER CONTROL CENTER (PCC)/ MCC/ PDB/ MLDB/ LDB	PYROTECH ELECTRONICS PVT. LTD.
1072	LOW VOLTAGE POWER CONTROL CENTER (PCC)/ MCC/ PDB/ MLDB/ LDB	RISHA CONTROL ENGINEERS PVT. LTD.
1073	LOW VOLTAGE POWER CONTROL CENTER (PCC)/ MCC/ PDB/ MLDB/ LDB	SIEMENS LTD.
1074	LOW VOLTAGE POWER CONTROL CENTER (PCC)/ MCC/ PDB/ MLDB/ LDB	TRICOLITE ELECTRICAL INDUSTRIES
1075	LOW VOLTAGE POWER CONTROL CENTER (PCC)/ MCC/ PDB/ MLDB/ LDB	UNILEC ENGINEERS LTD.

Sr.No	Name of ITEM/Package	Recommended Vendor List
1076	LOW VOLTAGE POWER CONTROL CENTER (PCC)/ MCC/ PDB/ MLDB/ LDB	VIDYUT CONTROL INDIA PVT. LTD.
1077	LOW VOLTAGE POWER CONTROL CENTER (PCC)/ MCC/ PDB/ MLDB/ LDB	CONTROL AND SCHEMATIC
1078	LOW VOLTAGE POWER CONTROL CENTER (PCC)/ MCC/ PDB/ MLDB/ LDB	ZENITH ENGINEERING
1079	LOW VOLTAGE POWER CONTROL CENTER (PCC)/ MCC/ PDB/ MLDB/ LDB	NATURGY CONTRA
1080	LOW VOLTAGE POWER CONTROL CENTER (PCC)/ MCC/ PDB/ MLDB/ LDB	EXPERT ENGINEERS
1081	LOW VOLTAGE POWER CONTROL CENTER (PCC)/ MCC/ PDB/ MLDB/ LDB	SYNERGY SYSTEMS
1082	LOW VOLTAGE POWER CONTROL CENTER (PCC)/ MCC/ PDB/ MLDB/ LDB	M/S SHOREY E SOLUTION
1083	**MINIATURE CIRCUIT BREAKERS (MCBS) AND LIGHTING DB**	ABB
1084	MINIATURE CIRCUIT BREAKERS (MCBS) AND LIGHTING DB	HAGGER
1085	MINIATURE CIRCUIT BREAKERS (MCBS) AND LIGHTING DB	HAVELL'S INDIA LTD.
1086	MINIATURE CIRCUIT BREAKERS (MCBS) AND LIGHTING DB	INDO ASIAN FUSEGEAR LTD.
1087	MINIATURE CIRCUIT BREAKERS (MCBS) AND LIGHTING DB	LEGRAND
1088	MINIATURE CIRCUIT BREAKERS (MCBS) AND LIGHTING DB	MDS SWITCHGEAR LTD.
1089	MINIATURE CIRCUIT BREAKERS (MCBS) AND LIGHTING DB	SCHNEIDER

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1090	MINIATURE CIRCUIT BREAKERS (MCBS) AND LIGHTING DB	SIEMENS LTD.
1091	MINIATURE CIRCUIT BREAKERS (MCBS) AND LIGHTING DB	HPL
1092	**MOULDED CASE CIRCUIT BREAKER (MCCBS)**	ABB
1093	MOULDED CASE CIRCUIT BREAKER (MCCBS)	ANDREW YULE
1094	MOULDED CASE CIRCUIT BREAKER (MCCBS)	LARSEN & TOUBRO
1095	MOULDED CASE CIRCUIT BREAKER (MCCBS)	SCHNEIDER
1096	MOULDED CASE CIRCUIT BREAKER (MCCBS)	SIEMENS
1097	MOULDED CASE CIRCUIT BREAKER (MCCBS)	CONTROL & SWITCHGEAR
1098	**INDICATING METERS**	ABB
1099	INDICATING METERS	AMCO
1100	INDICATING METERS	AE
1101	INDICATING METERS	ALSTOM LTD.
1102	INDICATING METERS	CONZERV/SCHNEIDER
1103	INDICATING METERS	ELECON MEASUREMENT PVT. LTD.
1104	INDICATING METERS	HPL ELECTRIC & POWER PVT. LTD.
1105	INDICATING METERS	MECO INSTRUMENTS LTD.
1106	INDICATING METERS	MINILEC
1107	INDICATING METERS	RISHABH INSTRUMENTS PVT. LTD.
1108	INDICATING METERS	TRINITY ENERGY SYSTEM
1109	INDICATING METERS	KAYCEE
1110	INDICATING METERS	SALZER
1111	**CONTRACTORS – AC POWER**	ANDREW YULE
1112	CONTRACTORS – AC POWER	ABB
1113	CONTRACTORS – AC POWER	BHEL
1114	CONTRACTORS – AC POWER	C&S
1115	CONTRACTORS – AC POWER	HAVELL'S
1116	CONTRACTORS – AC POWER	L&T
1117	CONTRACTORS – AC POWER	SCHNEIDER
1118	CONTRACTORS – AC POWER	SIEMENS LTD.
1119	CONTRACTORS – AC POWER	TELEMECHANIQUE
1120	**CONTROL TRANSFORMER**	AE
1121	CONTROL TRANSFORMER	INDUSHREE
1122	CONTROL TRANSFORMER	INTRA VIDYUT
1123	CONTROL TRANSFORMER	KALPA ELECTRIKALS

Sr.No	Name of ITEM/Package	Recommended Vendor List
1124	CONTROL TRANSFORMER	TRANSPOWER INDUSTRIES LTD.
1125	CONTROL TRANSFORMER	SIEMENS
1126	**INDICATING LAMPS**	ALSTOM LTD.
1127	INDICATING LAMPS	BCH
1128	INDICATING LAMPS	L&T
1129	INDICATING LAMPS	SIEMENS LTD.
1130	INDICATING LAMPS	VAISHNO ELECTRICALS
1131	**PROTECTION RELAYS – THERMAL**	BCH
1132	PROTECTION RELAYS – THERMAL	L&T LTD.
1133	PROTECTION RELAYS – THERMAL	SIEMENS LTD.
1134	PROTECTION RELAYS – THERMAL	TELEMENCHANIQUE & CONTROLS (INDIA) LTD.
1135	**PUSH BUTTONS**	BCH

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1136	PUSH BUTTONS	ALSTOM LTD.
1137	PUSH BUTTONS	L&T
1138	PUSH BUTTONS	SIEMENS LTD.
1139	PUSH BUTTONS	TELEMENCHANIQUE & CONTROLS (INDIA) LTD.
1140	PUSH BUTTONS	VAISHNO ELECTRICALS
1141	**SWITCHES – CONTROL**	BCH
1142	SWITCHES – CONTROL	EASUM REYROLLE RELAYS & DEVICES LTD.
1143	SWITCHES – CONTROL	ALSTOM
1144	SWITCHES – CONTROL	KAYCEE INDUSTRIES LTD.
1145	SWITCHES – CONTROL	L&T
1146	SWITCHES – CONTROL	SIEMENS LTD.
1147	**SWITCHES – 5/15A PIANO/ PLATE, SWITCH SOCKET**	ANCHOR ELECTRONICS & ELECTRICALS PVT. LTD.
1148	SWITCHES – 5/15A PIANO/ PLATE, SWITCH SOCKET	KINGAL ELECTRICALS PVT. LTD.
1149	SWITCHES – 5/15A PIANO/ PLATE, SWITCH SOCKET	NORTH-WEST SWITCHGEAR LTD.
1150	**SWITCH SOCKET OUTLETS (INDUSTRIAL)**	ALSTOM LTD.
1151	SWITCH SOCKET OUTLETS (INDUSTRIAL)	BEST & CROMPTION ENGINEERING LTD.
1152	SWITCH SOCKET OUTLETS (INDUSTRIAL)	BCH
1153	SWITCH SOCKET OUTLETS (INDUSTRIAL)	CROMPTON GREAVES LTD.
1154	SWITCH SOCKET OUTLETS (INDUSTRIAL)	ESSEN ENGINEERING COMPANY PVT. LTD.
1155	**TERMINALS BLOCKS**	CONNECTWELL
1156	TERMINALS BLOCKS	CONTROLS & SWITCHGEAR CO. LTD.
1157	TERMINALS BLOCKS	ELMEX CONTROLS PVT. LTD.
1158	TERMINALS BLOCKS	ESSEN ENGINEERING CO. PVT. LTD.
1159	**UPS SYSTEM AND INVERTER**	VERTIV (EARLIER DB POWER & EMERSON)
1160	UPS SYSTEM AND INVERTER	APLAB
1161	UPS SYSTEM AND INVERTER	KELTRON
1162	UPS SYSTEM AND INVERTER	HI-REL
1163	UPS SYSTEM AND INVERTER	DUBAS
1164	UPS SYSTEM AND INVERTER	TOSHIBA CORPORATION
1165	UPS SYSTEM AND INVERTER	FUZI ELECTRIC CO LTD
1166	UPS SYSTEM AND INVERTER	SYNERGY SYSTEMS
1167	UPS SYSTEM AND INVERTER	IVECO PLUS
1168	UPS SYSTEM AND INVERTER	BPE
1169	UPS SYSTEM AND INVERTER	M/S SHOREY E SOLUTION
1170	**BATTERIES**	AMCO BATTERIES LTD.

Sr.No	Name of ITEM/Package	Recommended Vendor List
1171	BATTERIES	HBLNIFE POWER SYSTEMS LTD.
1172	BATTERIES	EXIDE INDUSTRIES LTD
1173	BATTERIES	AMARA RAJA
1174	BATTERIES	ERGON GREEN
1175	**CHANGE OVER SWITCH**	CGM
1176	CHANGE OVER SWITCH	L&T
1177	CHANGE OVER SWITCH	SIEMENS
1178	**SOLAR STREET LIGHTING**	TATA BP SOLAR (I) LTD.
1179	SOLAR STREET LIGHTING	REIL, JAIPUR.
1180	SOLAR STREET LIGHTING	CEIL, SAHIBABAD.
1181	SOLAR STREET LIGHTING	HBL POWER

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1182	SOLAR STREET LIGHTING	NATURGY GREENS
1183	**AVR AND STABLISERS**	JINDAL
1184	AVR AND STABLISERS	ERGON POWER
1185	**CHEMICAL/PLATE/G.I. EARTHINGS/G.I. PATTI/LCV EARTHING SYSTEM**	IVECO RENO
1186	CHEMICAL/PLATE/G.I. EARTHINGS/G.I. PATTI/LCV EARTHING SYSTEM	JEF TECH EARTHINGS
1187	CHEMICAL/PLATE/G.I. EARTHINGS/G.I. PATTI/LCV EARTHING SYSTEM	INDIANA GRATINGS
1188	**GEG SET**	CHROMA-ATOR
1189	GEG SET	MAHINDRA
1190	GEG SET	KIRLOSKAR
1191	**TRANSFORMER**	ABB
1192	TRANSFORMER	GE
1193	TRANSFORMER	CROMPTON GREAVES
1194	TRANSFORMER	SIEMENS
1195	TRANSFORMER	TRANFORMERS & RECTIFIERS INDIA LTD
1196	TRANSFORMER	KIRLOSKAR ELECTRIC
1197	TRANSFORMER	GUJARAT TRANSFORMER
1198	TRANSFORMER	KOTSONS PVT LTD
1199	**AIR CONDITIONING SYSTEM**	CARRIER
1200	AIR CONDITIONING SYSTEM	HITACHI
1201	AIR CONDITIONING SYSTEM	DAIKIN
1202	AIR CONDITIONING SYSTEM	BLUE STAR
1203	AIR CONDITIONING SYSTEM	VOLTAS
1204	**VENTILATION FAN**	ADVANCE VENTILATION PVT LTD.
1205	VENTILATION FAN	CB DOCTOR INDIA PVT.LTD.
1206	VENTILATION FAN	SK SYSTEMS PRIVATE LIMITED
1207	VENTILATION FAN	SARALA (Suburban Industrial Works)
1208	**VENTILATION INTAKE LOUVER, BACK DRAFT DAMPER**	ADVANCE VENTILATION PVT LTD.
1209	VENTILATION INTAKE LOUVER, BACK DRAFT DAMPER	RUSKIN TITUS INDIA PVT. LIMITED
1210	**LNG STORAGE TANK**	INOX
1211	LNG STORAGE TANK	VRV
1212	LNG STORAGE TANK	CHART
1213	LNG STORAGE TANK	TAYLOR WHARTON
1214	LNG STORAGE TANK	CRYOGAS
1215	LNG STORAGE TANK	New Field Industrial Equipment Pvt Ltd
1216	**MANUAL CRYOGENICC GLOBE /CHECK VALVE**	BESTOBELL
1217	MANUAL CRYOGENICC GLOBE /CHECK VALVE	HEROSE

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1218	**EP OPERATED CRYOGENIC VALVES**	HEROSE
1219	EP OPERATED CRYOGENIC VALVES	HABONIM
1220	EP OPERATED CRYOGENIC VALVES	BESTOBELL
1221	EP OPERATED CRYOGENIC VALVES	MECAINOX
1222	**ESD VALVES**	BESTOBELL
1223	ESD VALVES	HEROSE
1224	ESD VALVES	MECAINOX
1225	**INSTRUMENT VALVES FITTING, TUBE FITTINGS & AIR MANIFOLD**	SWAGELOK
1226	INSTRUMENT VALVES FITTING, TUBE FITTINGS & AIR MANIFOLD	PARKER
1227	**LEVEL GAUGE**	WIKA

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1228	LEVEL GAUGE	CHEMTROL
1229	LEVEL GAUGE	KRONE
1230	**CRYO REGULATOR & PRESSURE REGULATOR**	SAMSON
1231	CRYO REGULATOR & PRESSURE REGULATOR	CASH
1232	CRYO REGULATOR & PRESSURE REGULATOR	BESTOBELL
1233	CRYO REGULATOR & PRESSURE REGULATOR	REGO
1234	**PRESSURE CONTROL REGULATOR**	NIRMAL INDIA
1235	PRESSURE CONTROL REGULATOR	PIETRO FIORENTIN
1236	PRESSURE CONTROL REGULATOR	REGO
1237	**SAFETY VALVE**	HEROSE
1238	SAFETY VALVE	LESSER
1239	SAFETY VALVE	ROCKWOOD
1240	**THERMAL RELIEF VALVE**	HEROSE
1241	THERMAL RELIEF VALVE	REGO
1242	**PRESSURE GAUGE & DIFFERENTIAL PRESSURE GAUGES**	WIKA
1243	PRESSURE GAUGE & DIFFERENTIAL PRESSURE GAUGES	GENERAL INSTRUMENT
1244	PRESSURE GAUGE & DIFFERENTIAL PRESSURE GAUGES	WAREE INSTRUMENTS LTD
1245	PRESSURE GAUGE & DIFFERENTIAL PRESSURE GAUGES	A.N. INSTRUMENTS PVT. LTD
1246	**TEMPERATURE ELEMENTT**	GENERAL INSTRUMENT
1247	TEMPERATURE ELEMENTT	TEMPSEN
1248	TEMPERATURE ELEMENTT	PYROELECTRIC
1249	**PRESSURE/ DIFFERENTIAL PRESSURE /TEMPERATURE TRANSMITTER**	EMERSON
1250	PRESSURE/ DIFFERENTIAL PRESSURE /TEMPERATURE TRANSMITTER	SIEMENS
1251	PRESSURE/ DIFFERENTIAL PRESSURE /TEMPERATURE TRANSMITTER	YOKOGAWA
1252	PRESSURE/ DIFFERENTIAL PRESSURE /TEMPERATURE TRANSMITTER	HONEYWELL
1253	**JUNCTION BOX**	BALIGA
1254	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.
1255	JUNCTION BOX	EXPROTECTA ELECTRICALS
1256	**FIRE & GAS DETECTION SYSTEM**	DETECTION ELECTRONIC
1257	FIRE & GAS DETECTION SYSTEM	HONEYWELL
1258	FIRE & GAS DETECTION SYSTEM	TYCO
1259	FIRE & GAS DETECTION SYSTEM	CHEMTROL ENGINEERING
1260	**PLC SYSTEM HARDWARE WITH COMPLETE CONTROL PANEL**	ALLEN BRADLEY
1261	PLC SYSTEM HARDWARE WITH COMPLETE CONTROL PANEL	SIEMENS
1262	PLC SYSTEM HARDWARE WITH COMPLETE CONTROL PANEL	HONEYWELL
1263	PLC SYSTEM HARDWARE WITH COMPLETE CONTROL PANEL	YOKOGAWA
1264	**CONTROL CONSOLE**	EVAN

Sr.No	Name of ITEM/Package	Recommended Vendor List
1265	CONTROL CONSOLE	PYROTECH
1266	**SCADA**	HONEYWELL
1267	SCADA	YOKOGAWA
1268	SCADA	SIEMENS
1269	SCADA	ALLEN BRADLEY
1270	**MASS FLOW METER**	EMERSON
1271	MASS FLOW METER	E&H
1272	MASS FLOW METER	SICK
1273	**USM METER**	Daniel/ Insromet International/ Krohne

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1274	USM METER	Insromet International
1275	USM METER	Krohne
1276	**LAN SWITCH**	CISCO
1277	LAN SWITCH	NORTEL
1278	LAN SWITCH	MOXA
1279	**LASER JET COLOUR PRINTER**	HP
1280	LASER JET COLOUR PRINTER	Canon
1281	LASER JET COLOUR PRINTER	Epson
1282	**ZENER BARRIERS/ISOLATORS**	MTL
1283	ZENER BARRIERS/ISOLATORS	P & F
1284	**POWER SUPPLY UNIT**	ELNOVA
1285	POWER SUPPLY UNIT	APLAB
1286	**SERVER & HMI**	DELL
1287	SERVER & HMI	HP
1288	**PRIORITY PANEL**	PARKER
1289	PRIORITY PANEL	TULSA
1290	**LEL NG GAS DETECTOR /DETECTION SYSTEM**	CROWCON DETECTION INSTRUMENTS LTD
1291	LEL NG GAS DETECTOR /DETECTION SYSTEM	DETECTION INSTRUMENTS (I) PVT LTD
1292	LEL NG GAS DETECTOR /DETECTION SYSTEM	DETECTOR ELECTRONICS CORPORATION
1293	LEL NG GAS DETECTOR /DETECTION SYSTEM	DRAGER SAFETY AG & CO.
1294	LEL NG GAS DETECTOR /DETECTION SYSTEM	KGAA MSA MINESSAFETY APPLIANCES
1295	LEL NG GAS DETECTOR /DETECTION SYSTEM	OLDHAM FRANCE S.A. HO
1296	LEL NG GAS DETECTOR /DETECTION SYSTEM	HONEYWELL
1297	**EMERGENCY STOP PUSH BUTTON STATION NEAR TANK**	BALIGA/KAYSON/SUDHIR
1298	**ELECTRICAL CABLES**	M/S ASSOCIATED CABLES/
1299	ELECTRICAL CABLES	M/S DELTON CABLES LTD, INDIA /
1300	ELECTRICAL CABLES	M/S KEI INDUSTRIES LTD INDIA /
1301	ELECTRICAL CABLES	M/S - CORDS CABLE INDUSTRIES LTD, INDIA
1302	ELECTRICAL CABLES	M/S POLYCAB WIRES PVT LTD, INDIA
1303	ELECTRICAL CABLES	T. C. COMMUNICATION PVT. LTD., DELHI
1304	ELECTRICAL CABLES	M/S SUYOG
1305	ELECTRICAL CABLES	M/S THERMO CABLES
1306	**CONTROL & INSTRUMENT CABLES**	KEI
1307	CONTROL & INSTRUMENT CABLES	CORDS
1308	CONTROL & INSTRUMENT CABLES	POLYCAB
1309	CONTROL & INSTRUMENT CABLES	DELTON
1310	**CRYOGENIC PUMP CENTRIFUGAL / SUBMERGED**	CRYOSTAR
1311	CRYOGENIC PUMP CENTRIFUGAL / SUBMERGED	ACD NIKISSO

Sr.No	Name of ITEM/Package	Recommended Vendor List
1312	CRYOGENIC PUMP CENTRIFUGAL / SUBMERGED	VANZETTI
1313	CRYOGENIC PUMP CENTRIFUGAL / SUBMERGED	CRYOMECH
1314	CRYOGENIC PUMP CENTRIFUGAL / SUBMERGED	ICL
1315	**LNG DISPENSER**	CRYOSTAR
1316	LNG DISPENSER	ACD NIKISSO
1317	LNG DISPENSER	CRYOGAS
1318	LNG DISPENSER	INOX

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1319	**CNG DISPENSER**	TULSA
1320	CNG DISPENSER	PARKER
1321	**MOTOR**	ABB
1322	MOTOR	SIEMENS
1323	MOTOR	CGL
1324	MOTOR	BBL
1325	MOTOR	MARATHON
1326	**VFD**	ABB
1327	VFD	SIEMENS
1328	VFD	HITACHI
1329	VFD	SCHNEIDER
1330	**FIRE PUMP**	LUBI
1331	FIRE PUMP	KIRLOSKAR
1332	FIRE PUMP	WILO
1333	FIRE PUMP	FLOWMORE
1334	FIRE PUMP	VARAT PUMPS
1335	**HYDRANT VALVE / WATER MONITOR / HOSE BOX / FIRE HOSE / BRIGADE INLET / BRANCH PIPE**	NEWAGE
1336	HYDRANT VALVE / WATER MONITOR / HOSE BOX / FIRE HOSE / BRIGADE INLET / BRANCH PIPE	SBJ
1337	HYDRANT VALVE / WATER MONITOR / HOSE BOX / FIRE HOSE / BRIGADE INLET / BRANCH PIPE	WINCO
1338	HYDRANT VALVE / WATER MONITOR / HOSE BOX / FIRE HOSE / BRIGADE INLET / BRANCH PIPE	VIMAL FIRE
1339	HYDRANT VALVE / WATER MONITOR / HOSE BOX / FIRE HOSE / BRIGADE INLET / BRANCH PIPE	SUKAN
1340	HYDRANT VALVE / WATER MONITOR / HOSE BOX / FIRE HOSE / BRIGADE INLET / BRANCH PIPE	SUPREMEX
1341	HYDRANT VALVE / WATER MONITOR / HOSE BOX / FIRE HOSE / BRIGADE INLET / BRANCH PIPE	UNITED FIRE
1342	**FIRE EXTINGUISHERS**	MINIMAX
1343	FIRE EXTINGUISHERS	CEASE FIRE
1344	FIRE EXTINGUISHERS	KANEX
1345	FIRE EXTINGUISHERS	SUPREMEX
1346	**FIRE WATER PIPES (MS)**	TATA
1347	FIRE WATER PIPES (MS)	JINDAL
1348	FIRE WATER PIPES (MS)	SURYA ROSHNI
1349	FIRE WATER PIPES (MS)	WELSPUN
1350	FIRE WATER PIPES (MS)	RATNAMANI
1351	FIRE WATER PIPES (MS)	MAHARASHTRA SEAMLESS
1352	FIRE WATER PIPES (MS)	SWASTIK

Sr.No	Name of ITEM/Package	Recommended Vendor List
1353	FIRE WATER PIPES (MS)	ESSAR
1354	FIRE WATER PIPES (MS)	GOODLUCK
1355	**OS & Y GATE VALVES**	KARTAR
1356	OS & Y GATE VALVES	KIRLOSKAR
1357	OS & Y GATE VALVES	HD FIRE

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1358	OS & Y GATE VALVES	L&T
1359	OS & Y GATE VALVES	OSWAL
1360	**BUTTERFLY VALVES (FIRE SERVICE)**	TYCO / INTERVALVE / L&T / FOURESS / AV VALVES / ADVANCE / DELVAL / LEADER
1361	BUTTERFLY VALVES (FIRE SERVICE)	INTERVALVE
1362	BUTTERFLY VALVES (FIRE SERVICE)	L&T
1363	BUTTERFLY VALVES (FIRE SERVICE)	FOURESS
1364	BUTTERFLY VALVES (FIRE SERVICE)	AV VALVES
1365	BUTTERFLY VALVES (FIRE SERVICE)	ADVANCE
1366	BUTTERFLY VALVES (FIRE SERVICE)	DELVAL
1367	BUTTERFLY VALVES (FIRE SERVICE)	LEADER
1368	**NON-RETURN VALVES (FIRE SERVICE)**	TYCO
1369	NON-RETURN VALVES (FIRE SERVICE)	L&T
1370	NON-RETURN VALVES (FIRE SERVICE)	WEIR BDK
1371	NON-RETURN VALVES (FIRE SERVICE)	OSWAL
1372	NON-RETURN VALVES (FIRE SERVICE)	FLOTEK
1373	NON-RETURN VALVES (FIRE SERVICE)	STEEL STRONG
1374	NON-RETURN VALVES (FIRE SERVICE)	FLUIDLINE
1375	**STRAINERS (FIRE SERVICE)**	SANT
1376	STRAINERS (FIRE SERVICE)	TELEFLOW
1377	STRAINERS (FIRE SERVICE)	FLAIR
1378	STRAINERS (FIRE SERVICE)	VENUS
1379	STRAINERS (FIRE SERVICE)	LEADER
1380	**FIRE PUMP TEST METER**	TYCO
1381	FIRE PUMP TEST METER	RAPIDROP
1382	**PIPE FITTINGS (FIRE SERVICE)**	UNIK
1383	PIPE FITTINGS (FIRE SERVICE)	ZOLOTO
1384	PIPE FITTINGS (FIRE SERVICE)	VENUS
1385	PIPE FITTINGS (FIRE SERVICE)	FITWELL
1386	PIPE FITTINGS (FIRE SERVICE)	WELDFIT
1387	PIPE FITTINGS (FIRE SERVICE)	JK FORGE
1388	PIPE FITTINGS (FIRE SERVICE)	OMEGA
1389	PIPE FITTINGS (FIRE SERVICE)	HB
1390	PIPE FITTINGS (FIRE SERVICE)	DRP-M
1391	PIPE FITTINGS (FIRE SERVICE)	GREENLINE
1392	PIPE FITTINGS (FIRE SERVICE)	HARDIK FORGING
1393	PIPE FITTINGS (FIRE SERVICE)	METRO METAL
1394	**LEVEL GAUGE FOR FIRE WATER APPLICATION**	LEVCON
1395	LEVEL GAUGE FOR FIRE WATER APPLICATION	SIGMA
1396	LEVEL GAUGE FOR FIRE WATER APPLICATION	CHEMTROL
1397	LEVEL GAUGE FOR FIRE WATER APPLICATION	DK INSTRUMENT
1398	LEVEL GAUGE FOR FIRE WATER APPLICATION	V AUTOMAT
1399	**FLOW DIVERTER**	BESTOBELL

Sr.No	Name of ITEM/Package	Recommended Vendor List
1400	FLOW DIVERTER	REGO
1401	**CONTROL ROOM EQUIPMENT CONTROL PANEL & ACCESSORIES**	M/S KELTRON CONTROLS LTD
1402	CONTROL ROOM EQUIPMENT CONTROL PANEL & ACCESSORIES	M/S ITTAL
1403		M/S PYROTECH

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1404	CONTROL ROOM EQUIPMENT CONTROL PANEL & ACCESSORIES	M/S POSITRONICS PVT. LTD.
1405	CONTROL ROOM EQUIPMENT CONTROL PANEL & ACCESSORIES	RITTAL
1406	CONTROL ROOM EQUIPMENT CONTROL PANEL & ACCESSORIES CONTROL ROOM EQUIPMENT CONTROL PANEL & ACCESSORIES	PYROTECH CONTROLS
1407	**INDICATORS**	M/S ABB
1408	INDICATORS	M/S EUROTHERN
1409	INDICATORS	M/S TATA HONEYWELL
1410	INDICATORS	M/S MASIBUS
1411	**LIGHTING FIXTURES (NORMAL)**	HAVELLS INDIA/ GE LIGHTING PVT. LTD/ PHILIPS INDIA LTD/ BAJAJ ELECTRICALS LTD/ CROMPTON GREAVES LTD
1412	LIGHTING FIXTURES (NORMAL)	GE LIGHTING PVT. LTD
1413	LIGHTING FIXTURES (NORMAL)	PHILIPS INDIA LTD
1414	LIGHTING FIXTURES (NORMAL)	BAJAJ ELECTRICALS LTD
1415	LIGHTING FIXTURES (NORMAL)	CROMPTON GREAVES LTD
1416	**DIESEL ENGINE**	CUMMIN
1417	DIESEL ENGINE	GREAVES
1418	DIESEL ENGINE	EICHER
1419	DIESEL ENGINE	KOEL
1420	**VAPORIZER**	CRYOGAS
1421	VAPORIZER	INOX
1422	VAPORIZER	VRV
1423	VAPORIZER	ACD NIKISSO
1424	**DEWATERING PUMP**	CROMPTON
1425	DEWATERING PUMP	KIRLOSKAR
1426	DEWATERING PUMP	LUBI
1427	DEWATERING PUMP	VARAT PUMPS
1428	**STEEL PLATES**	Arcelor Mittal, Romania/ France/ Germany
1429	STEEL PLATES	Azovstahl, Ukraine
1430	STEEL PLATES	Nippon Steel Corporation, Japan [Formerly known as Nippon Steel & Sumitomo Metal Corp. (NSSMC)]
1431	STEEL PLATES	Baoshan Iron & Steel Co. Ltd., Shanghai, China
1432	STEEL PLATES	Dillinger, Germany
1433	STEEL PLATES	Essar Steel, India
1434	STEEL PLATES	Ilva (Riva Group), Italy
1435	STEEL PLATES	JFE Steel, Japan
1436	STEEL PLATES	Jindal Steel & Power Ltd. (upto 20.6 mm)
1437	STEEL PLATES	JSW Steel, USA
1438	STEEL PLATES	Mannesmann Salzgitter Roehrenwerke, Germany
1439	STEEL PLATES	POSCO, South Korea
1440	STEEL PLATES	SAIL, Rourkela Steel Plant (up to 23.8 mm)
1441	STEEL PLATES	Usiminas, Brazil
1442	STEEL PLATES	Voestalpine, Austria
1443	STEEL PLATES	Welspun PCMD, India
1444	**STEEL COILS**	AHMSA (Altos Hornos De Mexico), Mexico
1445	STEEL COILS	Angang Steel Co.Ltd., China

Sr.No	Name of ITEM/Package	Recommended Vendor List
1446	STEEL COILS	Anyang Iron & Steel Group Co.Ltd. China

1447	STEEL COILS	Arcelor Mittal,France/ Germany
1448	STEEL COILS	Baoshan Iron & Steel Co. Ltd., Shanghai, China
1449	STEEL COILS	Benxi Iron & Steel, China
1450	STEEL COILS	Erdemir, Turkey
1451	STEEL COILS	Essar Steel, India
1452	STEEL COILS	Hadeed Saudi Iron & Steel Co., Saudi Arabia/ UAE
1453	STEEL COILS	HBIS Hebei Iron & Steel Group Co.Ltd, China
1454	STEEL COILS	Hunan Valin Lianyuan Steel Co. Ltd. China (Arcelor Mittal Group)
1455	STEEL COILS	Hyundai Steel, South Korea
1456	STEEL COILS	Jiangsu Shagang (Group), China
1457	STEEL COILS	Jinan Iron & Steel Co. Ltd., China
1458	STEEL COILS	JSW steel limited, Dolvi (earlier Ispat (upto X-70, WT-11.7mm)
1459	STEEL COILS	JSW, Bellary India
1460	STEEL COILS	Lloyd Steel, India (upto X-70, WT-11.7mm)
1461	STEEL COILS	Maanshan Iron & Steel Co. Ltd., China
1462	STEEL COILS	Megasteel, Malaysia (upto X-70, WT-10.3mm)
1463	STEEL COILS	POSCO, South Korea
1464	STEEL COILS	SAIL, Bokaro (uptoX-70, WT-11.1mm)
1465	STEEL COILS	Shou-gang Qian Iron & Steel Co. Ltd., China
1466	STEEL COILS	ThyssenKrupp, Germany
1467	STEEL COILS	TISCO (Group) Co. Ltd, China
1468	STEEL COILS	US Steel Kosice, Slovak Republic
1469	STEEL COILS	Wuhan Iron & Steel, China
1470	STEEL COILS	Tata Steel Ltd., Jamshedpur (upto API 5L X-60 & WT upto 9.35 mm)
1471	STEEL COILS	Tata Steel Ltd., Kalinganagar (upto API 5L X-70 & WT upto 16.0 mm)
1472	STEEL COILS	Tata Steel BSL Ltd., Meramandali (upto API 5L X-70 & WT upto 12.7 mm)
1473	**TEMPORARY CATHODIC PROTECTION**	
1474	CATHODIC PROTECTION AGENCY	Corrtech , Ahemdabad
1475	CATHODIC PROTECTION AGENCY	Corrosion Technology Services Pvt. Ltd., Mumbai
1476	CATHODIC PROTECTION AGENCY	Sark EPC, Ahmedadbad
1477	CATHODIC PROTECTION AGENCY	UNDTS, Noida
1478	CATHODIC PROTECTION AGENCY	Mitcorr, Baroda
1479	CATHODIC PROTECTION AGENCY	BSS Tech, Mumbai
1480	CATHODIC PROTECTION AGENCY	Vijaya Engineering
1481	CATHODIC PROTECTION AGENCY	Universal Corrosion Prevention India , Kolkata
1482	CATHODIC PROTECTION AGENCY	AMR Engineering Products , Mumbai
1483	CATHODIC PROTECTION AGENCY	Himoya Corrosion Technology , Kolkata
1484	CATHODIC PROTECTION AGENCY	Consultech ,Baroda
1485	CATHODIC PROTECTION AGENCY	M.Tech Engineers , Surat
1486	CATHODIC PROTECTION AGENCY	Cortigo Technologies Pvt. Ltd , Ahmedabad
1487	CATHODIC PROTECTION AGENCY	AA Projects Cathodic Protection
1488	**JUNCTION BOXES (CLASSIFIED TYPE)**	Flame Proof Equipment Pvt. Ltd.(FEPL), Bombay
1489	JUNCTION BOXES (CLASSIFIED TYPE)	Baliga Lighting, Chennai
1490	JUNCTION BOXES (CLASSIFIED TYPE)	CEAG Flame Proof Control Gears, Bombay
1491	JUNCTION BOXES (CLASSIFIED TYPE)	Flexpro Electricals, Navsari, Gujarat
1492	JUNCTION BOXES (CLASSIFIED TYPE)	Sudhir Switchgear

Sr.No	Name of ITEM/Package	Recommended Vendor List

1493	JUNCTION BOXES (CLASSIFIED TYPE)	FCG flame proof control gears P. Ltd., Daman
1494	JUNCTION BOXES (CLASSIFIED TYPE)	Pepperl & Fuchs manufacturing (I) Pvt. Ltd.,Kanchipuram
1495	JUNCTION BOXES (CLASSIFIED TYPE)	Kaysons Techno equipments Pvt. Ltd., India
1496	JUNCTION BOXES (CLASSIFIED TYPE)	R Stahl Pvt. Ltd. Kanchipuram
1497	JUNCTION BOXES/ TEST STATION (NON- CLASSIFIED TYPE)	Kristron systems, Mumbai
1498	JUNCTION BOXES/ TEST STATION (NON- CLASSIFIED TYPE)	Raychem RPG Pvt Limited
1499	JUNCTION BOXES/ TEST STATION (NON- CLASSIFIED TYPE)	Corrtech International Pvt Ltd
1500	JUNCTION BOXES/ TEST STATION (NON- CLASSIFIED TYPE)	Sukrit Industries Ahemdabad
1501	JUNCTION BOXES/ TEST STATION (NON- CLASSIFIED TYPE)	Silverline Integrity Services
1502	JUNCTION BOXES/ TEST STATION (NON- CLASSIFIED TYPE)	UNDTS
1503	JUNCTION BOXES/ TEST STATION (NON- CLASSIFIED TYPE)	SARK EPC
1504	**CABLES**	Netco Cable
1505	CABLES	KEI
1506	CABLES	Fort Gloster
1507	CABLES	Polycab
1508	CABLES	Universal
1509	CABLES	CCI
1510	CABLES	CMIL
1511	CABLES	Suyog Electricals
1512	CABLES	Victor cables
1513	CABLES	Finolex cables
1514	CABLES	Asian Cables
1515	CABLES	Radiant Cables
1516	CABLES	Icon cables
1517	CABLES	Gemscab
1518	CABLES	Torrent
1519	CABLES	Nicco
1520	CABLES	KEC International
1521	CABLES	Uniflex
1522	CABLES	Havells
1523	CABLES	Crystal Cable Corporation
1524	CABLES	Ravin
1525	**PORTABLE/ PERMANENT REFERENCE ELECTRODES**	Permacell/Harco, USA
1526	PORTABLE/ PERMANENT REFERENCE ELECTRODES	Borin Manufacturer, USA
1527	PORTABLE/ PERMANENT REFERENCE ELECTRODES	M.C.Miller, USA
1528	PORTABLE/ PERMANENT REFERENCE ELECTRODES	Tinker & Rasor, USA
1529	PORTABLE/ PERMANENT REFERENCE ELECTRODES	Ceranoda Technologies, USA
1530	PORTABLE/ PERMANENT REFERENCE ELECTRODES	Telpro USA
1531	PORTABLE/ PERMANENT REFERENCE ELECTRODES	Grouppo De nora, Goa
1532	PORTABLE/ PERMANENT REFERENCE ELECTRODES	Oranzio De nora, Italy
1533	PORTABLE/ PERMANENT REFERENCE ELECTRODES	Silvion, UK
1534	PORTABLE/ PERMANENT REFERENCE ELECTRODES	Harco, USA
1535	PORTABLE/ PERMANENT REFERENCE ELECTRODES	Electrochemical devices, USA
1536	**SURGE DIVERTOR (EX-d type)**	Dehn (Germany)
1537	SURGE DIVERTOR (EX-d type)	OBO Betterman (Germany)
1538	**SOLID STATE POLARISTATION CELL**	Dairyland
1539	SOLID STATE POLARISTATION CELL	Metricorr, Denmark

Sr.No	Name of ITEM/Package	Recommended Vendor List
1540	SOLID STATE POLARISTATION CELL	Rustrol
1541	SOLID STATE POLARISTATION CELL	Dehn, Germany
1542	SOLID STATE POLARISTATION CELL	Kristron Systems, Mumbai
1543	SOLID STATE POLARISTATION CELL	Corrpro system
1544	SOLID STATE POLARISTATION CELL	Caltech
1545	**THERMIT WELDS**	Erico, USA
1546	THERMIT WELDS	Thermoweld, USA
1547	THERMIT WELDS	Erico,Europe
1548	THERMIT WELDS	Bac, UK
1549	**PINBRAZING**	Safe Track
1550	PINBRAZING	Bac, UK
1551	**MAGNESIUM & ZINC ANODES**	Sargam Metal , Chennai
1552	MAGNESIUM & ZINC ANODES	Scientific Metal, Chennai
1553	MAGNESIUM & ZINC ANODES	Shakti enterprises, Ahemdabad
1554	MAGNESIUM & ZINC ANODES	PSL Holding Pvt. Ltd., Mumbai
1555	MAGNESIUM & ZINC ANODES	Cathodic Controls, Bangalore
1556	MAGNESIUM & ZINC ANODES	Impalloy International
1557	MAGNESIUM & ZINC ANODES	Electro protection services, India
1558	MAGNESIUM & ZINC ANODES	Cathodic Control Company Pvt. Ltd., India
1559	MAGNESIUM & ZINC ANODES	Nippon Corrosion, Japan
1560	MAGNESIUM & ZINC ANODES	AFIC, KSA
1561	MAGNESIUM & ZINC ANODES	Platt Bros. and Company, USA
1562	MAGNESIUM & ZINC ANODES	Impalloy International, UK
1563	MAGNESIUM & ZINC ANODES	Corrpro International, Canada
1564	MAGNESIUM & ZINC ANODES	Nakabohtec, Japan
1565	MAGNESIUM & ZINC ANODES	Metal Founder, Mumbai
1566	MAGNESIUM & ZINC ANODES	Corrosion Matters, Hyderabad
1567	**ANODE BACKFILL MATERIAL**	Goa carbon, Goa
1568	ANODE BACKFILL MATERIAL	India Carbon, Kolkata
1569	ANODE BACKFILL MATERIAL	Petrocarbon & Chemical Company, Kolkata
1570	ANODE BACKFILL MATERIAL	Loresco, USA
1571	**PERMANENT CATHODIC PROTECTION SYSTEM**	Corrtech , Ahemdabad
1572	PERMANENT CATHODIC PROTECTION SYSTEM	Corrosion Technology Services Pvt. Ltd., Mumbai
1573	PERMANENT CATHODIC PROTECTION SYSTEM	Sark EPC, Ahmedadbad
1574	PERMANENT CATHODIC PROTECTION SYSTEM	UNDTS, Noida
1575	PERMANENT CATHODIC PROTECTION SYSTEM	Mitcorr, Baroda
1576	PERMANENT CATHODIC PROTECTION SYSTEM	BSS Tech, Mumbai
1577	PERMANENT CATHODIC PROTECTION SYSTEM	Vijaya Engineering
1578	PERMANENT CATHODIC PROTECTION SYSTEM	Cortigo Technologies Pvt. Ltd., Ahmedabad
1579	**TRANSFORMER- RECTIFIER UNITS**	Raychem RPG Pvt Ltd.(Canara Electric), Mumbai
1580	TRANSFORMER- RECTIFIER UNITS	Kristron Systems Mumbai
1581	TRANSFORMER- RECTIFIER UNITS	Cathodic Control Co Pvt. Ltd,
1582	TRANSFORMER- RECTIFIER UNITS	Golconda Corrosion Control Pvt. Ltd., India
1583	TRANSFORMER- RECTIFIER UNITS	Hind Rectifiers Ltd., India
1584	**JUNCTION BOXES (CLASSIFIED TYPE)**	Flame Proof Equipment Pvt. Ltd.(FEPL), Bombay
1585	JUNCTION BOXES (CLASSIFIED TYPE)	Baliga Lighting, Chennai
1586	JUNCTION BOXES (CLASSIFIED TYPE)	Ceag Flame Proof Control Gears, Bombay

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Sr.No	Name of ITEM/Package	Recommended Vendor List
1587	JUNCTION BOXES (CLASSIFIED TYPE)	Flexpro Electricals, Navsari, Gujarat
1588	JUNCTION BOXES (CLASSIFIED TYPE)	Sudhir Switchgear
1589	JUNCTION BOXES (CLASSIFIED TYPE)	FCG flame proof control gears P. Ltd., Daman
1590	JUNCTION BOXES (CLASSIFIED TYPE)	Pepperl & Fuchs manufacturing (I) Pvt. Ltd.,Kanchipuram
1591	JUNCTION BOXES (CLASSIFIED TYPE)	Kaysons Techno equipments Pvt. Ltd., India
1592	JUNCTION BOXES (CLASSIFIED TYPE)	R Stahl Pvt. Ltd. Kanchipuram
1593	**JUNCTION BOXES/ Test Stations (NON- CLASSIFIED TYPE)**	Kristron systems, Mumbai
1594	JUNCTION BOXES/ Test Stations (NON- CLASSIFIED TYPE)	Raychem RPG Pvt Limited
1595	JUNCTION BOXES/ Test Stations (NON- CLASSIFIED TYPE)	Corrtech International Pvt Ltd
1596	JUNCTION BOXES/ Test Stations (NON- CLASSIFIED TYPE)	Sukrit Industries Ahemdabad
1597	JUNCTION BOXES/ Test Stations (NON- CLASSIFIED TYPE)	Silverline Integrity Services
1598	JUNCTION BOXES/ Test Stations (NON- CLASSIFIED TYPE)	UNDTS
1599	JUNCTION BOXES/ Test Stations (NON- CLASSIFIED TYPE)	SARK EPC
1600	**CABLES**	Netco Cable
1601	CABLES	KEI
1602	CABLES	Fort Gloster
1603	CABLES	Polycab
1604	CABLES	Universal
1605	CABLES	Cable Corporation of India
1606	CABLES	CMIL
1607	CABLES	Suyog Electricals
1608	CABLES	Victor cables
1609	CABLES	Finolex cables
1610	CABLES	Asian Cables
1611	CABLES	Radiant Cables
1612	CABLES	Icon cables
1613	CABLES	Gemscab
1614	CABLES	Torrent
1615	CABLES	Nicco
1616	CABLES	KEC International
1617	CABLES	Uniflex
1618	CABLES	Havells
1619	CABLES	Crystal Cable Corporation
1620	CABLES	Ravin
1621	**PORTABLE/ PERMANENT REFERENCE ELECTRODES**	Permacell/Harco, USA
1622	PORTABLE/ PERMANENT REFERENCE ELECTRODES	Borin Manufacturer, USA
1623	PORTABLE/ PERMANENT REFERENCE ELECTRODES	M.C.Miller, USA
1624	PORTABLE/ PERMANENT REFERENCE ELECTRODES	Tinker & Rasor, USA
1625	PORTABLE/ PERMANENT REFERENCE ELECTRODES	Ceranoda Technologies, USA
1626	PORTABLE/ PERMANENT REFERENCE ELECTRODES	Telpro USA
1627	PORTABLE/ PERMANENT REFERENCE ELECTRODES	Grouppo De nora, Goa
1628	PORTABLE/ PERMANENT REFERENCE ELECTRODES	Oranzio De nora, Italy
1629	PORTABLE/ PERMANENT REFERENCE ELECTRODES	Silvion, UK
1630	PORTABLE/ PERMANENT REFERENCE ELECTRODES	Harco, USA
1631	PORTABLE/ PERMANENT REFERENCE ELECTRODES	Electrochemical devices, USA
1632	**SURGE DIVERTOR (EX-d)**	Dehn (Germany)
1633	SURGE DIVERTOR (EX-d)	OBO Betterman (Germany)

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Sr.No	Name of ITEM/Package	Recommended Vendor List
1634	**AC CORROSION COUPON**	MC Miller
1635	AC CORROSION COUPON	Farwest Corrosion
1636	**THERMIT WELDS**	Erico, USA
1637	THERMIT WELDS	Thermoweld, USA
1638	THERMIT WELDS	Erico,Europe
1639	THERMIT WELDS	Bac, UK
1640	**PINBRAZING**	Safe Track,Sweden
1641	PINBRAZING	Bac, UK
1642	**ER PROBE**	Rose Corrosion Service, UK
1643	ER PROBE	Metal Samples. USA
1644	ER PROBE	Roharbak Cosasco, USA
1645	ER PROBE	Caproco, UK
1646	ER PROBE	Korosi Specindo, Indonesia
1647	**MMO WIRE ANODE**	Titanor Components Ltd., Goa
1648	MMO WIRE ANODE	Oranzio De Nora, Italy
1649	MMO WIRE ANODE	Eltech System, USA
1650	MMO WIRE ANODE	Ceranode Technologies, USA
1651	MMO WIRE ANODE	Matcor, USA
1652	MMO WIRE ANODE	Covalence, USA
1653	MMO WIRE ANODE	Berry Plastics
1654	MMO WIRE ANODE	Grouppo De nora, Goa
1655	MMO WIRE ANODE	Telpro USA
1656	**MMO TUBULAR /STRIP/RIBBON ANODE**	Titanor Components Ltd., Goa
1657	MMO TUBULAR /STRIP/RIBBON ANODE	Oranzio De Nora, Italy
1658	MMO TUBULAR /STRIP/RIBBON ANODE	Magnetocheme, Holland
1659	MMO TUBULAR /STRIP/RIBBON ANODE	Actel Ltd., UK
1660	MMO TUBULAR /STRIP/RIBBON ANODE	Eltech System, USA
1661	MMO TUBULAR /STRIP/RIBBON ANODE	Ceranode Technologies, USA
1662	MMO TUBULAR /STRIP/RIBBON ANODE	Matcor, USA
1663	MMO TUBULAR /STRIP/RIBBON ANODE	Grouppo De nora, Goa
1664	MMO TUBULAR /STRIP/RIBBON ANODE	Cathodic Control Co Pvt. Ltd, India
1665	MMO TUBULAR /STRIP/RIBBON ANODE	Electro Protection Services India P Ltd
1666	MMO TUBULAR /STRIP/RIBBON ANODE	Emirates Techno Casting, UAE
1667	MMO TUBULAR /STRIP/RIBBON ANODE	Corrosion Matters, Hyderabad
1668	**SOLID STATE POLARISTATION CELL**	Dairyland
1669	SOLID STATE POLARISTATION CELL	Metricorr, Denmark
1670	SOLID STATE POLARISTATION CELL	Rustrol
1671	SOLID STATE POLARISTATION CELL	Dehn, Germany
1672	SOLID STATE POLARISTATION CELL	Kristron Systems, Mumbai
1673	SOLID STATE POLARISTATION CELL	Corrpro system
1674	**HEAT SHRINK CAP FOR ANODE TO CABLE JOINT**	Raychem, USA
1675	HEAT SHRINK CAP FOR ANODE TO CABLE JOINT	Matcor, USA
1676	**MAGNESIUM & ZINC ANODE'S**	Sargam Metal , Chennai

1677	MAGNESIUM & ZINC ANODE'S	Scientific Metal, Chennai
1678	MAGNESIUM & ZINC ANODE'S	Shakti enterprises, Ahemdabad
1679	MAGNESIUM & ZINC ANODE'S	PSL Holding Pvt. Ltd., Mumbai

Sr.No	Name of ITEM/Package	Recommended Vendor List
1680	MAGNESIUM & ZINC ANODE'S	Cathodic Controls, Bangalore
1681	MAGNESIUM & ZINC ANODE'S	Impalloy International
1682	MAGNESIUM & ZINC ANODE'S	Electro protection services, India
1683	MAGNESIUM & ZINC ANODE'S	Cathodic Control Company Pvt. Ltd., India
1684	MAGNESIUM & ZINC ANODE'S	Nippon Corrosion, Japan
1685	MAGNESIUM & ZINC ANODE'S	AFIC, KSA
1686	MAGNESIUM & ZINC ANODE'S	Platt Bros. and Company, USA
1687	MAGNESIUM & ZINC ANODE'S	Impalloy International, UK
1688	MAGNESIUM & ZINC ANODE'S	Corrpro International, Canada
1689	MAGNESIUM & ZINC ANODE'S	Nakabohtec, Japan
1690	MAGNESIUM & ZINC ANODE'S	Metal Founder, Mumbai
1691	MAGNESIUM & ZINC ANODE'S	Corrosion Matters, Hyderabad
1692	**ANODE BACKFILL MATERIAL**	Goa carbon, Goa
1693	ANODE BACKFILL MATERIAL	India Carbon, Kolkata
1694	ANODE BACKFILL MATERIAL	Petrocarbon & Chemical Company, Kolkata
1695	ANODE BACKFILL MATERIAL	Loresco, USA
1696	**INSTRUMENTS, TOOLS AND SPARES**	
1697	HAND HELD DATA LOGGER	ECD, Mumbai
1698	HAND HELD DATA LOGGER	M C Miller, USA
1699	HAND HELD DATA LOGGER	Cath-tech
1700	**GSM BASED DIGITAL DATA LOGGER**	Raychem, USA
1701	GSM BASED DIGITAL DATA LOGGER	M C Miller, USA
1702	GSM BASED DIGITAL DATA LOGGER	Kriston, Mumbai
1703	**CORROSION VOLTMETER**	Rishabh
1704	CORROSION VOLTMETER	MECO
1705	CORROSION VOLTMETER	Fluke
1706	CORROSION VOLTMETER	Yokogawa
1707	**MULTI-COMBINATION METER**	Rishabh
1708	MULTI-COMBINATION METER	MECO
1709	MULTI-COMBINATION METER	Fluke
1710	**CPL SURVEY DATA LOGGER**	MC Miller
1711	CPL SURVEY DATA LOGGER	Roger
1712	**DCVG SURVEY KIT**	DCVG
1713	**HOLIDAY DETECTOR**	Associate Electronics
1714	**PIPE LOCATOR**	Radio Detection
1715	PIPE LOCATOR	Vivax
1716	**ELCOMETER FOR COATING THICKNESS MEASUREMENT**	Olympus
1717	**4 PIN SOIL RESISTIVITY METER**	Tinkor & Rasor
1718	4 PIN SOIL RESISTIVITY METER	Nillson

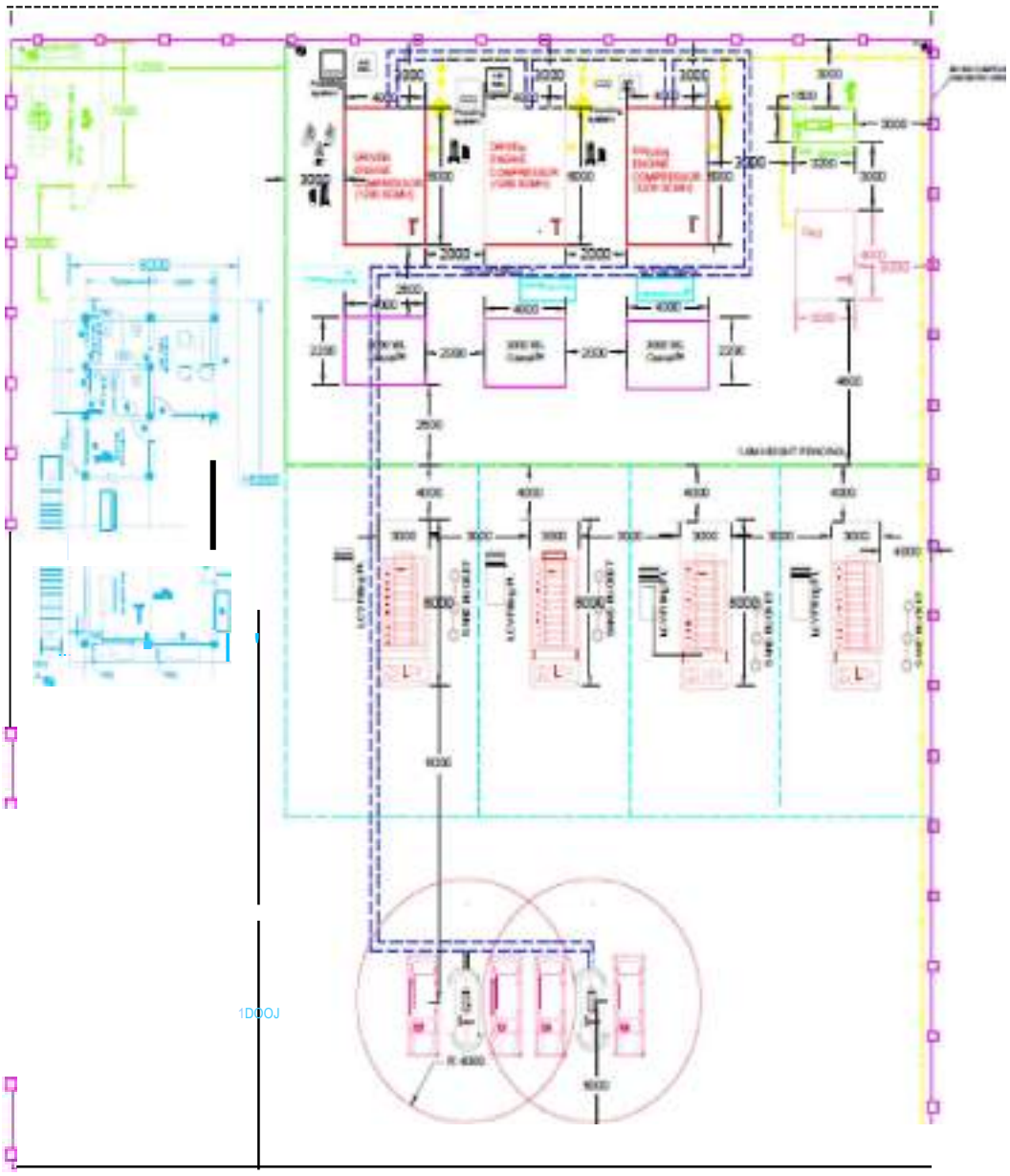
1719	4 PIN SOIL RESISTIVITY METER	Fluke
1720	**SINCORDER**	MC Miller
1721	**CP SOFTWARE(FOR REMOTE MONITORING)**	Kristron
1722	**ELECTRICIAN TOOL BOX WITH TOOL SET**	Taparia
1723	ELECTRICIAN TOOL BOX WITH TOOL SET	Stanley
1724	**CAT /CAT A FRAME SURVEY EQUIPMENT**	Radio Detection
1725	CAT /CAT A FRAME SURVEY EQUIPMENT	Vivax
1726	**AC/DC INTERFRENCE SURVEY AGENCY**	Jeff Techno Solutions Pvt. Ltd.

Sr.No	Name of ITEM/Package	Recommended Vendor List
1727	AC/DC INTERFRENCE SURVEY AGENCY	Dehn India Pvt. Ltd.

1. Any other vendor(s) apart from as mentioned above may be accepted subject to approval by Owner/Owners representative on submission of refusal letter from the existing approved vendor, non-responsiveness of existing approved vendor, existing approved vendor not complying with the project delivery schedule etc. Evidence of such reasons must be provided with the request and based on past track record (PTR). PTR document shall be submitted by the contractor for review. PTR must contain at least 3 nos. past executed purchase order copy.

2. For the vendors of items not covered in above vendor list, but required for completion of project successfully, supplier shall take approval form Owner/Owners representative for the same during project execution. Bidder shall submit the required certifications, documents, PTR and Performance letters from clients for the same.

3. Refer approved vendor list for applicable items of the subject tender.



Tentative Layout of Mother stations

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SECTION-08

SCHEDULE OF RATES

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PART-A

INDRESHAM

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SCHEDULE OF RATE (SOR) FOR INDRESHAM (PART-A)

TENDER NAME: CIVIL AND ARCHITECTURAL WORKS FOR MOTHER STATION IN BGL AUTHROISED GA

TENDER NO.- BGL/780/2025-26

Name of the Bidder:

ITEM NO.	Description	Unit	Qty	UNIT RATE - INCLUSIVE OF ALL TAXES AND DUTIES, LEVIES, FREIGHT, INSURANCE INCLUDING TRANSIT INSURANCE OF FREE ISSUE MATERIALS AS DEFINED IN BID DOCUMENT (EXCLUDING GST)	GST	Unit rate including GST	TOTAL RATE - INCLUSIVE OF ALL TAXES AND DUTIES, LEVIES, FREIGHT, INSURANCE INCLUDING TRANSIT INSURANCE OF FREE ISSUE MATERIALS AS DEFINED IN BID DOCUMENT (INCLUDING GST)
PART A - Indresham							
A	**CIVIL**						
	CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS						
	Area Cleaning and Striping						
	Earth work in surface excavation (striping) not exceeding 15 cm in depth but exceeding 1.5 m in width as well as 10 sqm on plan including clearing jungle, uprooting of rank vegetation, grass, brush wood, trees and saplings, getting out and disposal of excavated earth, rubbish outside the property line, as directed by the Engineer-in-Charge :						
10.00	All kinds of soil	SQM	1200	44.15	18%	52.10	62,516.40
	Excavation						
	Earth work in excavation by mechanical means (Hydraulic excavator)/ manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth outside the property line, as directed by the Engineer-in-Charge.						
20.00	All kinds of soil- Excavation up to 1.5m Depth	CUM	1000	164.65	18%	194.29	1,94,287.00
30.00	All kinds of soil-Excavation beyond 1.5m and up to and inclusive of 3.0m	CUM	150	202.36	18%	238.78	35,817.72
	Earth work in excavation by mechanical means (Hydraulic excavator)/ manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1 .5 m, as directed by Engineer-in-charge.						
40.00	Hard rock	CUM	250	1,400.00	18%	1,652.00	4,13,000.00
	Backfilling and area filling with excavated soil						
50.00	Backfilling/Area filling with available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, including compacted up to 95% to its MDD carrying field density test to a certain compaction of soil complete in all respect as per scope of work, detailed construction drawing, as per technical specification as directed by the Engineer in charge.	CUM	650	203.28	18%	239.87	1,55,915.76
	Area filling with Borrowed soil						
60.00	Supplying and filling of local earth (including royalty) by mechanical transport, also including ramming and watering of the earth in layers not exceeding 20 cm in trenches, plinth, sides of foundation etc. complete including compacted up to 95% to its MDD carrying field density test to a certain compaction of soil complete in all respect as per scope of work, detailed construction drawing, as per technical specification as directed by the Engineer in charge.	CUM	400	297.10	18%	350.58	1,40,231.20
	Anti-termite treatment						
70.00	Supplying chemical emulsion (Chlorpyriphos/ Lindane emulsifiable concentrate of 20%) in sealed containers and applying as follow: Post construction treatment along the external wall below concrete or masonry apron using chemical emulsion @ 2.25 litres per linear metre with 1% concentration including drilling and plugging holes etc. as per Techinal specifications and direction of engineering in charge.	SQM	200	125.00	18%	147.50	29,500.00
80.00	Making plinth protection 50 mm thick of cement concrete 1:3:6 (1 cement : 3 coarse sand (zone-ill) derived from natural sources :6 graded stone aggregate 20 mm nominal size derived from natural sources) over 75 mm thick bed of dry brick ballast 40 mm nominal size, well rammed and consolidated and grouted with fine sand, including necessary excavation, levelling & dressing & finishing the top smooth.	SQM	72	627.31	18%	740.23	53,296.26
	Plain Cement Concrete						
	Providing and laying in position cement concrete of specified grade including the cost of cantering and shuttering all work for **coping, base slab of storm drains, concrete posts of fencing and other locations** as per detail engineering drawings.						
90.00	**1:2:4** (1 cement : 2 coarse sand (Zone-III) : 4 graded stone aggregate 20 mm nominal size)	CUM	12	5,881.23	18%	6,939.85	83,278.22

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	Providing and laying in position cement concrete of specified grade including the cost of cantering and shuttering all work **under the grade slabs, plinth protections of buildings, brick masonry steps and other locations** as per detail engineering drawings.						
100.00	**1:3:6** (1 cement : 3 coarse sand (Zone-III) : 6 graded stone aggregate 40 mm nominal size)	CUM	4	5,299.00	18%	6,252.82	25,011.28
	Providing and laying in position cement concrete of specified grade including the cost of centering and shuttering all work below all the foundations or as specified in detail drawings.including curing						
110.00	**1:4:8** (1 cement : 4 coarse sand (Zone-III) : 8 graded stone aggregate 40 mm nominal size)	CUM	115	5,051.57	18%	5,960.85	6,85,498.05
	Reinforcement Steel						
120.00	Suppy of Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete - Thermo-Mechanically Treated EQR & HCR bars of grade Fe-500D or more	KG	38000	71.75	18%	84.67	32,17,270.00
	Design Mix Concrete- Substructure						
	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying, **centering, shuttering**, finishing, admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-Charge. This cost is excluding the cost of reinforcement steel. (**Note :** Minimum cement content shall be @ 330 kg/cum.Less cement used as per design mix (if any) will be recoverable separately. No extra payment against extra cement if used shall be payable..).						
130.00	**All works up to plinth level**	CUM	343	7,496.40	18%	8,845.75	30,34,092.94
	Design Mix Concrete- Superstructure						
	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying, **centering, shuttering**, finishing, admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-Charge. This cost is excluding the cost of reinforcement steel. (**Note** : Minimum cement content shall be @ 330 kg/cum.Less cement used as per design mix (if any) will be recoverable separately. No extra payment against extra cement if used shall be payable.).						
140.00	**All works above plinth level**	CUM	85	10,278.81	18%	12,129.00	10,30,964.64
	Brick Masonry						
150.00	Brick work with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 for **drains/below plinth** in: Cement mortar 1:4 (1 cement : 4 coarse sand).	CUM	45	5,495.83	18%	6,485.08	2,91,828.57
10.00	Brick work with non modular **fly ash bricks** conforming to IS:12894, class designation 10 average compressive strength in super structure above plinth level up to floor V level in : Cement mortar 1:4 (1 cement : 4 coarse sand)	CUM	90	6,286.87	18%	7,418.51	6,67,665.59
160.00	Supply and Laying of **Brick bats** of size 80 mm to 40 mm in soak Pit	CUM	40	446.25	18%	526.58	21,063.00
20.00	Providing and laying autoclaved aerated cement blocks masonry with 150mm/230mm/300 mm thick AAC blocks in super structure (Control Room/Electric Room) above plinth level up to floor V level with RCC band at sill level and lintel level with approved block laying polymer modified adhesive mortar all complete as per direction of Engineer-in-Charge. (The payment of RCC band and reinforcement shall be made for seperately). Cement Mortar 1:6 (1 Cement : 6 coarse sand)	CUM	80	5,585.06	18%	6,590.37	5,27,229.66
170.00	Providing and applying white cement based putty of average thickness 1 mm, of approved brand and manufacturer, over the plastered wall surface to prepare the surface even and smooth complete.	SQM	1400	114.06	18%	134.59	1,88,427.12
	Internal Plaster						
180.00	Providing 12 mm cement plaster of mix 1:4 (1 cement: 4 fine sand) complete as per drawing, specifications and direction of EIC.	SQM	850	246.51	18%	290.88	2,47,249.53
	Ceiling Plaster						
190.00	Providing 6 mm cement plaster of mix : 1:3 (1 cement : 3 fine sand) complete as per drawing, specifications and direction of EIC.	SQM	200	202.36	18%	238.78	47,756.96
	External Plaster						
200.00	Providing 18 mm cement plaster in two coats under layer 12 mm thick cement plaster 1:5 (1 cement : 5 coarse sand) and a top layer 6 mm thick cement plaster 1:3 (1 cement : 3 coarse sand) finished complete as per drawing, specifications and direction of EIC.	SQM	700	245.59	18%	289.80	2,02,857.34
	Chicken wire mesh						
210.00	Providing and fixing 150 mm wide chicken wire mesh between junctions of column/beam and walls, fixed with u nails 150 mm center to center before plastering the junction. Chicken wire mesh shall be of diameter 0.6 to 2 mm and mesh size 13 to 50 mm.	SQM	120	241.29	18%	284.72	34,166.66
	Neat punning for drains						

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220.00	Providing neat cement punning on inner side of drains and other areas complete as per drawing, specifications and direction of EIC.	SQM	85	54.27	18%	64.04	5,443.28
	Interior Finishing						
230.00	Applying one coat of water thinnable cement **primer** of approved brand and manufacture on wall surface: Water thinnable cement primer	SQM	850	51.51	18%	60.78	51,664.53
	Wall **painting** with premium acrylic emulsion paint of interior grade, having VOC (Volatile Organic Compound) content less than 50 grams/ litre of approved brand and manufacture, including applying additional coats wherever required to achieve even shade and colour.						
240.00	Two coats	SQM	600	92.90	18%	109.62	65,773.20
	Exterior Finishing						
250.00	Surface preparation, Supply and painting water proofing cement paint of required shade on walls :Two or more coats applied @ 3.84 kg/10 sqm of approved brand.	SQM	1100	78.19	18%	92.26	1,01,490.62
260.00	Painting foundation concrete in contact with soil and ground water with black anti-corrosive bitumastic paint of approved brand and manufacture to give an even shade : Two or more coats.	SQM	0.01	106.70	18%	125.91	1.26
	Granite for counter top						
	Providing and fixing 18 mm thick gang saw cut, mirror polished, premoulded and prepolished, machine cut for kitchen platforms, vanity counters, window sills, facias and similar locations of required size, approved shade, colour and texture laid over 20 mm thick base cement mortar 1:4 (1 cement : 4 coarse sand), joints treated with white cement, mixed with matching pigment, epoxy touch ups, including rubbing, curing, moulding and polishing to edges to give high gloss finish etc. complete at all levels. :						
270.00	Granite of any colour and shade :	SQM	8	3,533.89	18%	4,169.99	33,359.92
	Structural Steel						
280.00	Supplying, fabricating, erecting, placing and fixing in position Structural steel work riveted, bolted or welded in built up sections, trusses and framed work, tubes including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer all complete as per drawings, specifications and directions of the Engineer-in-Charge. (Excluding the cost of concrete work).	Ton (MT)	3	92,719.01	18%	1,09,408.43	3,28,225.30
	Structural Steel Paint						
290.00	Finishing with Deluxe Multi surface paint system for interiors and exteriors using Primer as per manufacturers specifications: Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @ 0.80 ltr/10 sqm of approved brand and manufacture	SQM	250	112.22	18%	132.42	33,104.90
	Foundation Bolts						
300.00	Providing and Fixing of MS Foundation bolts (grade HSFG 8.8 grade bolts or as mentioned in structural drawing) with nececessary nuts and washers of specified sizes, all conforming to relevant Indian Standards and as approved by Engineer-in-charge in column /RCC pedestal / beam at any level including maintaining the accuracy towards line, level & position including making and using the template etc. complete as directed by Engineer In Charge. (Contractor will take due care for its threads and rusting by applying grease and cotton waste.)	KG	60	126.02	18%	148.70	8,922.22
	Chequered Plate & Grating						
310.00	Steel work welded in built up sections/ framed work, including cutting,hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc. as required. In stringers, treads, landings etc. of stair cases, including use of chequered plate/Grating wherever required, all complete	Kg	270	105.06	18%	123.97	33,472.12
	Chain link fencing wire mesh						
	Providing and fixing G.I. chain link fabric fencing of required width in mesh size 50x50 mm including strengthening with 2 mm dia wire or nuts, bolts and washers as required complete as per the direction of the Engineer-in-Charge.						
320.00	Made of G.I. wire of dia. 4 mm, PVC coated to achieve outer dia not less than 5 mm in required colour and shade.	SQM	150	720.21	18%	849.85	1,27,477.17
	Concertina coil fence for Boundary wall						
330.00	Providing and fixing concertina coil fencing with punched tape concertina coil 600 mm dia 10 metre openable length (total length 90 m), having 50 nos rounds per 6 metre length, up to 3 m height of wall with existing angle iron 'Y' shaped placed 2.4m or 3.00 m apart and with 9 horizontal R.B.T. reinforced barbed wire, stud tied with G.I. staples and G.I. clips to retain horizontal, including necessary bolts or G.I. barbed wire tied to angle iron, all complete as per direction of Engineer-in-charge, with reinforced barbed tape(R.B.T.) / Spring core (2.5mm thick) wire of high tensile strength of 165 kg/ sq.mm with tape (0.52 mm thick) and weight 43.478 gm/ metre (cost of M.S. angle, C.C. blocks shall be paid separately)	METRE	135	252.38	18%	297.81	40,204.13
	Kota Stone for staircase and dado						

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340.00	Kota stone slabs 20 mm thick in risers of steps, skirting, dado and pillars laid on 12 mm (average) thick cement mortar 1:3 (1 cement: 3 coarse sand) and jointed with grey cement slurry mixed with pigment to match the shade of the slabs, including rubbing and polishing complete.	SQM	17	1,628.06	18%	1,921.11	32,658.88
	Toilet wall tiles						
350.00	Providing and fixing first quality ceramic glazed wall tiles conforming to IS:15622,Minimum 8 mm thick, of approved make, in all colours, shades except burgundy, bottle green, black of any size as approved by the Engineer-in-Charge, in skirting, risers of steps and dados, over 12 mm thick bed of cement mortar 1:3 (1 cement : 3 coarse sand) and jointing with grey cement slurry @ 3.3 Kg/sq.m., including pointing in white cement mixed with pigment of matching shade complete.	SQM	90	883.32	18%	1,042.32	93,808.58
	Toilet floor tiles						
360.00	Providing and laying Ceramic glazed floor tiles of size 300x300 mm, Minimum 8 mm thick of first quality conforming to IS:15622 of approved make in colours such as White, Ivory, Grey, Fume Red Brown, laid on 20 mm thick cement mortar 1:4 (1 Cement : 4 Coarse sand), jointing with grey cement slurry @ 3.3 Kg/sq.m. including pointing the joints with white cement and matching pigment, etc. complete.	SQM	23	779.12	18%	919.36	21,145.32
	Vitrified floor tiles						
	Providing and laying vitrified tiles in floor & skirting in different sizes,minimum 10 mm thick with water absorption less than 0.08% and conforming to IS: 15622, of approved make, in all colours and shades, laid on 20mm thick cement mortar 1:4 (1 cement : 4 coarse sand), jointing with grey cement slurry @ 3.3 kg/ sqm including grouting the joints with white cement and matching pigments etc., complete						
370.00	Size of Tile 600x600 mm	SQM	150	1,170.91	18%	1,381.67	2,07,251.07
	Vitrified wall tiles						
	Providing and laying Vitrified tiles in different sizes (thickness to be specified by manufacturer), with water absorption less than 0.08 % and conforming to IS:15622, of approved make, in all colours & shade, in skirting, riser of steps, over 12 mm thick bed of cement mortar 1:3 (1 cement: 3 coarse sand), jointing with grey cement slurry @ 3.3 Kg/sq.m. including grouting the joint with white cement & matching pigments etc. complete.						
380.00	Size of Tile 600x600 mm	SQM	35	1,170.91	18%	1,381.67	48,358.58
	Providing and fixing 10 mm thick acid and/or alkali resistant tiles of approved make and colour using acid and/or alkali resisting mortar bedding, and joints filled with acid and/or alkali resisting cement as per IS:4457, complete as per the direction of Engineer-in-Charge.						
	In flooring on a bed of 10 mm thick mortar 1:4 (1 acid proof cement : 4 coarse sand)						
390.00	Acid and alkali resistant tile	SQM	40	1,449.27	18%	1,710.14	68,405.54
	52 mm thick cement concrete flooring						
400.00	52 mm thick cement concrete flooring with concrete hardener topping under layer 40 mm thick cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) and top layer 12 mm thick cement hardener consisting of mix 1:2 (1 cement hardener mix : 2 graded stone aggregate 6 mm nominal size) by volume, hardening compound is mixed @2 litre per 50kg of cement or as per manufacturers specifications. This includes cost of cement slurry, 2 mm thick PVC strip at desired spacing, cost of nosing in steps etc. complete.	SQM	40	818.32	18%	965.62	38,624.70
	Khurras for down comer						
410.00	Making Khurras 45x45 cm with average minimum thickness of 5 cm cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate of 20 mm nominal size) over P.V.C. sheet 1 m x 1 m x 400 micron, finished with 12 mm cement plaster 1:3 (1 cement : 3 coarse sand) and a coat of neat cement, rounding the edges and making and finishing the outlet complete.	EACH	12	213.40	18%	251.81	3,021.74
	Down Comer pipes						
420.00	Providing and fixing on wall face Unplasticised Rigid PVC (UPVC) rainwater pipes conforming to IS:13592 Type-A, including Coupler, Bend, Palin shoe and all fittings, jointing with seal ring conforming to IS:5382, leaving 10 mm gap for thermal expansion: (i) Single socketed pipes : 110 mm diameter	METRE	65	551.88	18%	651.22	42,329.20

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	Champering/gola						
	Supply and Construction of a chase of (champering/gola) 75x75 mm in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 stone aggregate 10 mm and down gauge), including finishing with cement mortar 1:3 (1 cement : 3 fine sand) as per standard design at the joint of parapet and RCC roof slab :						
430.00	In 75x75 mm deep chase	METRE	52	240.07	18%	283.28	14,730.70
	Road paving subgrade compaction						
440.00	Preparation and consolidation of sub-grade with power road roller of 8 to 12 tonne capacity after excavating earth to an average of 22.5 cm depth, dressing to camber and consolidating with road roller including making good the undulations etc. and re-rolling the sub grade and disposal of surplus earth outside the property boundary in the un-disputed areas as directed by Engineer-In-Charge.	SQM	350	144.41	18%	170.40	59,641.33
	Road paving grade -WMM						
450.00	Providing, laying, spreading and compacting graded stone aggregate (size range 53 mm to 0.075 mm) to wet mix macadam (WMM) specification including premixing the material with water at OMC in for all leads & lifts, laying in uniform layers with mechanical paverfinisher in sub- base / base course on well prepared surface and compacting with vibratory roller of 8 to 10 tonne capacity to achievethe desired density, complete as per specifications and directions of Engineer-in-Charge. 3Layers of 75mm thickness each.	CUM	77	2,110.04	18%	2,489.85	1,91,718.23
	Joint Ceiling						
460.00	Providing and laying in position **bitumen hot sealing compound** for expansion joints etc. Using grade 'A' sealing compound. (RATE FOR JOINT OF 10MM DEPTH, 10MM WIDTH PER M LENGTH)	METRE	11	25.76	18%	30.40	334.36
	Paver block paving						
	Providing and laying factory made chamfered edge Cement Concrete paver blocks In foot path, park & lawns driveway or light & traffic parking etc. of required strength, thickness & size/ shape, made by table vibratory method using PU mould, laid in required colour & pattern over 50mm thick compacted bed of course sand, compacting and proper embedding/laying of inter locking paver blocks into the sand bedding layer through vibratory compaction by using plate vibrator, filling the joints with sand and cutting of paver blocks as per required size and pattern, finishing and sweeping extra sand, all complete as per manufacturer's specifications & direction of the Engineer-in-Charge.						
470.00	**60mm thick Cement Concrete paver block of M-35 grade with approved colour, design & pattern.**	SQM	450	745.04	18%	879.15	3,95,616.24
	Supply & laying the same factory made chamfered edge Cement Concrete paver blocks In foot path, park & lawns driveway or light & traffic parking etc. of required strength, thickness & size/ shape, made by table vibratory method using PU mould, laid in required colour & pattern over 50mm thick compacted bed of course sand, compacting and proper embedding/laying of inter locking paver blocks into the sand bedding layer through vibratory compaction by using plate vibrator, filling the joints with sand and cutting of paver blocks as per required size and pattern, finishing and sweeping extra sand, all complete as per manufacturer's specifications & direction of the Engineer-in-Charge.						
480.00	**80mm thick Cement Concrete paver block of M-40 grade with approved colour, design & pattern.**	SQM	900	831.70	18%	981.41	8,83,265.40
	Granular sub-base (GSB)						

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	Construction of granular sub-base (GSB) by providing close graded Material conforming to specifications, mixing in a mechanical mix plant at OMC, carriage of mixed material by tippers to work site, for all leads & lifts, spreading in uniform layers of specified thickness with motor grader on prepared surface and compacting with vibratory power roller to achieve the desired density, complete as per specifications and directions of Engineer-in-Charge						
490.00	With material conforming to Grade-II (size range 53 mm to 0.075 mm) having CBR Value-25	CUM	200	2,102.68	18%	2,481.16	4,96,232.48
	Dry Lean Cement Concrete (DLC)						
500.00	Construction of dry lean cement concrete sub base over a prepared sub- grade with coarse and fine aggregate conforming to IS:383, the size of coarse aggregate not exceeding 25 mm, aggregate cement ratio not to exceed 15:1, aggregate gradation after blending to be as per specifications, cement content not to be less than 150 Kg/cum, optimum moisture content to be determined during trial length construction, concrete strength not to be less than 10 Mpa at 7 days, mixed in a batching plant, transported to site, for all leads & lifts, laid with a mechanical paver, compacting with 8-10 tonne vibratory roller, finishing and curing etc. complete as per direction of Engineer-in-charge.	CUM	3	3,526.35	18%	4,161.10	12,483.29
	CONCRETE PAVEMENTS						
	Providing and laying design mix cement concrete of M-30 grade, in roads/ taxi tracks/ runways, using cement content as per design mix, using coarse sand and graded stone aggregate of 40 mm nominal size in appropriate proportions as per approved & specified design criteria, providing dowel bars with sleeve/ tie bars wherever required, laying at site, spreading and compacting mechanically by using needle and surface vibrators, levelling to required slope/ camber, finishing with required texture, including steel form work with sturdy M.S. channel sections, curing, making provision for contraction/ expansion, construction & longitudinal joints (10 mm wide x 50 mm deep) by groove cutting machine, providing and filling joints with approved joint filler and sealants, complete all as per direction of Engineer-in-charge (Item of joint fillers, sealants, dowel bars with sleeve/ tie bars to be paid separately).						
510.00	Cement concrete prepared with batch mixing machine	CUM	10	8,949.95	18%	10,560.94	1,05,609.38
	RUNWAY MARKING						
	Painting runway/taxi track/apron marking with adequate nos of coats to give uniform finish with road marking paint of superior make as approved by the Engineer-in-charge, including cleaning the surface of ail dirt, scales, oil, grease and other foreign material etc. and lining out complete.						
520.00	New work (Two or more coats)	SQM	30	159.97	18%	188.76	5,662.94
	Kerb Stone						
530.00	Providing and laying at or near ground level factory made kerb stone of M-25 grade cement concrete in position to the required line, leve and curvature, jointed with cement mortar 1:3 (1 cement: 3 coarse sand), including making joints with or without grooves (thickness of joints except at sharp curve shall not to more than 5mm), including making drainage opening wherever required complete etc. as per direction of Engineer-in-charge (length of finished kerb edging shall be measured for payment). (Precast C.C. kerb stone shall be approved by Engineer-in-charge).	Cum	12	6,878.30	18%	8,116.39	97,396.73
	Plumbing & Sanitory Pipes						
	32 mm OD pipe						
540.00	Providing and fixing Polyethelene-Aluminium-Polyethelene (PE-AL-PE) Composite Pressure Pipes conforming to IS-15450, U.V. stabilized with carbon black having thermal stability for hot & cold water supply, capable to withstand temperature up to 80°C, including all special fittings of composite material (engineering plastic blend and brass inserts wherever required) e.g. elbows, tees, reducers, couplers & connectors etc., with clamps at 1.00 metre spacing. This includes testing of joints complete as per direction of the Engineer-in-Charge.	METRE	30	437.84	18%	516.65	15,499.54
	25 mm OD pipe						
550.00	Providing and fixing Polyethelene-Aluminium-Polyethelene (PE-AL-PE) Composite Pressure Pipes conforming to IS-15450, U.V. stabilized with carbon black having thermal stability for hot & cold water supply, capable to withstand temperature up to 80°C, including all special fittings of composite material (engineering plastic blend and brass inserts wherever required) e.g. elbows, tees, reducers, couplers & connectors etc., with clamps at 1.00 metre spacing. This includes testing of joints complete as per direction of the Engineer-in-Charge.	METRE	20	356.58	18%	420.76	8,415.29

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	15 mm nominal outer dia pipes Concealed work, including cutting chases and making good the walls etc.						
560.00	Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply, including all CPVC plain & brass threaded fittings, i/c fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step CPVC solvent cement and the cost of cutting chases and making good the same including testing of joints complete as per direction of the Engineer-In-Charge.	METRE	50	412.99	18%	487.33	24,366.41
	External Work : Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply including all CPVC plain & brass threaded fittings This includes jointing of pipes & fittings with one step CPVC solvent cement, trenching, refilling & testing of joints complete as per direction of the Engineer-In-Charge. a) 150 mm nominal outer dia pipes						
570.00	**150 mm nominal outer dia pipes**	METRE	50	5,613.50	18%	6,623.93	3,31,196.50
	Circular Tank						
580.00	Providing and placing on terrace (at all floor levels) polyethylene water storage tank (Ref. Make: SINTEX or approved equivalent), IS:12701 marked, with cover and suitable locking arrangement and making necessary holes for inlet, outlet and overflow pipes but without fittings and the base support for tank.	PER LITRE	1000	8.61	18%	10.16	10,159.80
	Gate Valve						
590.00	Providing and fixing gun metal gate valve with C.I. wheel of approved quality (screwed end) : 32 mm nominal bore	EACH	5	490.42	18%	578.70	2,893.48
	Gate Valve						
600.00	Providing and fixing gun metal gate valve with C.I. wheel of approved quality (screwed end) : 25 mm nominal bore	EACH	5	442.62	18%	522.29	2,611.46
	Bib Cock						
610.00	Providing and fixing C.P. brass long nose bib cock of approved quality conforming to IS standards and weighing not less than 810 gms. : 15 mm nominal bore	EACH	10	252.38	18%	297.81	2,978.08
	W.C. pan with ISI marked white solid plastic seat and lid.						
620.00	Providing and fixing white vitreous china Wall mounted water closet of size 780 x 370x690 mm (European type W.C. pan) with seat and lid, 10 litre low level white P.V.C. flushing cistern, including flush pipe, with manually controlled device (handle lever), conforming to IS:7231, with all fittings and fixtures complete, including cutting and making good the walls and floors wherever required : W.C. pan with ISI marked white solid plastic seat and lid.	EACH	2	8,236.70	18%	9,719.31	19,438.61
	Urinal basin						
630.00	Providing and fixing white vitreous china flat back or wall corner type lipped front urinal basin of 430x260x350 mm and 340x410x265 mm sizes respectively with manual flushing cistern with standard flush pipe and C.P. brass spreaders with brass unions and G.I clamps complete, including painting of fittings and brackets, cutting and making good the walls and floors wherever required :One urinal basin.	EACH	1	4,461.55	18%	5,264.63	5,264.63
640.00	15 mm C.P. brass tap	EACH	2	105.16	18%	124.09	248.18
650.00	Providing and fixing PVC NAHANI TRAP of approved quality & make and as per the direction of Engineer-in-charge.	EACH	2	258.11	18%	304.57	609.14
	White Vitreous China Flat back wash basin size 550x400 mm with single 15 mm C.P. brass pillar tap						

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660.00	Providing and fixing wash basin with C.I. brackets, 15 mm C.P. brass pillar taps, 32 mm C.P. brass waste of standard pattern, including painting of fittings and brackets, cutting and making good the walls wherever require : White Vitreous China Flat back wash basin size 550x400 mm with single 15 mm C.P. brass pillar tap	EACH	2	633.82	18%	747.91	1,495.82
	Waste Pipe						
	Providing and fixing P.V.C. waste pipe for sink or wash basin including P.V.C. waste fittings complete :						
670.00	Flexible Pipe : 32 mm diameter	EACH	5	86.04	18%	101.53	507.64
	Mirror						
680.00	Providing and fixing 600x450 mm beveled edge mirror of superior glass (of approved quality) complete with 6 mm thick hard board ground fixed to wooden cleats with C.P. brass screws and washers complete.	EACH	4	1,209.31	18%	1,426.99	5,707.94
	Providing and fixing toilet paper holder :						
690.00	C.P. Brass (Ref. Make: JAQUAR, Model: Cat. No.-1151 or approved equivalent).	EACH	2	651.02	18%	768.20	1,536.41
	Bib Cock (approved MAKE) 15 MM DIA						
700.00	Providing and fixing C.P. brass bib cock of approved quality conforming to IS:8931 : including cutting & making good the walls wherever required, etc. complete in all respects inclusive of cost of all materials, labour, tools, tackles etc. as per specifications and directions of the Engineer-in-Charge. : Bib Cock (approved MAKE) 15 MM DIA	EACH	2	360.40	18%	425.27	850.54
	Angle Valve (approved make) 15 MM DIA						
710.00	Providing and fixing C.P. brass angle valve for of approved quality conforming to IS:8931 including cutting & making good the walls wherever required, etc. complete in all respects inclusive of cost of all materials, labour, tools, tackles etc. as per specifications and directions of the Engineer-in-Charge. : Angle Valve (approved make) 15 MM DIA	EACH	2	488.16	18%	576.02	1,152.05
	Soap Dish Holder						
720.00	Providing and fixing the following washroom fittings, complete in all respects; inclusive of cost of all materials, labour, tools, tackles etc. as per specifications and directions of the Engineer-in-Charge. : Providing and fixing PTMT soap Dish Holder having length of 138mm, breadth 102mm, height of 75mm with concealed fitting arrangements, weighing not less than 106 gms.	EACH	2	94.73	18%	111.78	223.57
	Stoneware Pipes						
730.00	Providing, laying and jointing glazed stoneware pipes Class SP-1 with stiff mixture of cement mortar in the proportion of 1:1 (1 cement : 1 fine sand) including testing of joints etc. complete : a) 150 mm diameter	METRE	22	491.38	18%	579.83	12,756.22
	Gully Trap						
740.00	Providing and fixing square-mouth S.W. gully trap class SP-1 complete with C.I. grating brick masonry chamber with water tight C.I. cover with frame of 300x300 mm size (inside) the weight of cover to be not less than 4.50 kg and frame to be not less than 2.70 kg as per standard design : a) 100x100 mm size P-type : With common burnt clay F.P.S. (Non-modular) bricks of class designation 7.5	EACH	2	2,055.35	18%	2,425.31	4,850.63
	150 mm dia. R.C.C. pipe						

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750.00	Providing and laying non-pressure NP-2 class (light duty) R.C.C. pipes with collars jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement : 2 fine sand) including testing of joints etc. complete :	METRE	20	472.98	18%	558.12	11,162.39
	300 mm dia. R.C.C. pipe						
760.00	Providing and laying non-pressure NP-2 class (light duty) R.C.C. pipes with collars jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement : 2 fine sand) including testing of joints etc. complete :	METRE	30	830.58	18%	980.08	29,402.53
	C.I. inspection chamber						
	Constructing brick masonry chamber for underground C.I. inspection chamber and bends with bricks in cement mortar 1:4 (1 cement : 4 coarse sand) C.I. cover with frame (light duty) 455x610 mm internal dimensions, total weight of cover with frame to be not less than 38 kg (weight of cover 23 Kg and weight of frame 15 Kg), R.C.C. top slab with 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size), foundation concrete 1:5:10 (1 cement : 5 coarse sand (Zone-III) : 10 graded stone aggregate 40 mm nominal size), inside plastering 12 mm thick with cement mortar 1:3 (1 cement : 3 coarse sand), finished smooth with a floating coat of neat cement on walls and bed concrete etc. complete as per standard design :						
770.00	With non modular fly ash bricks conforming to IS:12894, class designation 10	EACH	2	5,452.60	18%	6,434.07	12,868.14
780.00	Providing and fixing trap of self cleansing design with screwed down or hinged grating with or without vent arm complete, including cost of cutting and making good the walls and floors as per drawings, specifications and directions of the Engineer-in-Charge. 100 mm inlet and 100 mm outlet-Sand Cast Iron S&S as per IS: 1729	EACH	2	1,495.64	18%	1,764.86	3,529.71
	DOOR, WINDOW AND VANTILATORS						
	Aluminium sections for frame and shutters						
	Providing and fixing aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS:733 and IS:1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of the Engineer-In-Charge. (Glazing, paneling and dash fasteners to be paid for separately) : For fixed portion :						
790.00	Anodised aluminium (anodised transparent or dyed to required shade according to IS: 1868, Minimum anodic coating of grade AC 15)	KG	217	338.49	18%	399.42	86,673.75
	Aluminium door shutters						
	Providing and fixing aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS:733 and IS:1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of the Engineer-In-Charge. (Glazing, paneling and dash fasteners to be paid for separately) : For shutters of doors, windows & ventilators including providing and fixing hinges/ pivots and making provision for fixing of fittings wherever required including the cost of EPDM rubber/ neoprene gasket required. (Fittings shall be paid for separately) :						

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800.00	**Anodised aluminium (anodised transparent or dyed to required shade according to IS: 1868, Minimum anodic coating of grade AC 15)**	KG	266	489.34	18%	577.42	1,53,594.04
	Pre-laminated particle board with decorative lamination on both sides						
810.00	Providing and fixing 12 mm thick prelaminated particle board flat pressed three layer or graded wood particle board conforming to IS: 12823 Grade l Type ll, in panelling fixed in aluminum doors, windows shutters and partition frames with C.P. brass / stainless steel screws etc. complete as per architectural drawings and directions of engineer- in-charge.	SQM	23	759.76	18%	896.52	20,619.89
	Glazing for doors, window and ventilators						
	Providing and fixing glazing in aluminium door, window, ventilator shutters and partitions etc. with EPDM rubber/ neoprene gasket etc. complete as per the architectural drawings and the directions of Engineer-In-Charge. (Cost of aluminium snap beading shall be paid in basic item) :						
820.00	**With toughened glass panes of 5.0 mm thickness (Weight not less than 12.5 kg/sqm.)**	SQM	22	1,058.70	18%	1,249.27	27,483.85
	Providing and fixing aluminium tubular handle bar 32 mm outer dia, 3.0 mm thick & 100 mm long with SS screws etc .complete as per direction of the Engineer-In-Charge.						
830.00	Anodized (AC 15) aluminium tubular handle bar	EACH	32	409.32	18%	483.00	15,455.92
840.00	Providing and fixing 100 mm x10mm bright finished brass **tower bolts** (best make of approved quality) for aluminium doors including necessary cutting and making good etc. complete.	EACH	16	128.77	18%	151.95	2,431.18
850.00	Providing and fixing chromium plated brass 100 mm **mortice latch and lock** with 6 levers and a pair of lever handles of approved quality with necessary screws etc. complete.	EACH	6	848.60	18%	1,001.35	6,008.07
860.00	Providing and fixing bright finished brass casement window fastener with necessary screws etc. complete.	EACH	8	61.63	18%	72.72	581.79
	Hydraulic Floor Spring						
	Providing and fixing double action hydraulic floor spring of approved brand and manufacture conforming to IS:6315, having brand logo embossed on the body/ plate with double spring mechanism and door weight up to 125 Kg, for doors, including cost of cutting floors, embedding in floors as required and making good the same matching to the existing floor finishing and cover plates with brass pivot and single piece M.S. sheet outer box with slide plate etc. complete as per the direction of Engineer-In-Charge. :						
870.00	With stainless steel cover plate minimum 1.25 mm thickness	EACH	10	2,249.31	18%	2,654.19	26,541.86
	Sun Control film						
880.00	Providing and fixing, on fixed glazing/ doors/ window panes, sun control film "HP NATURAL 35 SAFETY COMBINATION FILM-4Mil" of M/s. GARWARE or approved equivalent make and shade, all complete as per manufacturer's specification and as per instructions of the Engineer-in-Charge.	SQM	50	2,818.61	18%	3,325.96	1,66,297.99

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890.00	Providing and fixing mineral fibre false ceiling tiles at all heights of size 595X595mm of approved texture, design and pattern. The tiles should have Humidity Resistance (RH)a of 99%, Light Reflectance > 85%, Thermal Conductivity k = 0.052 - 0.057 w/m K, Fire Performance as per (BS 476 pt - 6 &7)in true horizontal level suspended on interlocking T-Grid of hot dipped all round galvanized iron section of 0.33 mm thick (galvanized @120 gsm) comprising of main T runners of 15x32 mm of length 3000 mm, cross T of size 15x32mm of length 1200 mm and secondary intermediate cross T of size 15x32 mm of length 600 mm to form grid module of size 600x600 mm suspended from ceiling using galvanized mild steel item (galvanised@80gsm) 50 mm long 8mm outer diameter M-6 dash fasteners, 6 mm diameter fully threaded hanger rod up to 1000 mm length and L-shape level adjuster of size 85x25x2 mm, spaced at 1200 mm centre to centre along main 'T'. The system should rest on periphery walls /partitions with the help of GI perimeter wall angle of size24x24X3000 mm made of 0.40 mm thick sheet, to be fixed to the wall with help of plastic rawl plug at 450 mm centre to centre & 40 mm long dry wall S.S. screws. The exposed bottom portion of all T-sections used in false ceiling support system shall be pre-painted with polyester baked paint, for all heights. The work shall be carried out as per specifications, drawings and as per directions of the engineer-incharge. (Note: Measurement shall be made wall to wall without any deduction for openings, for payment purpose). With 16 mm thick beveled tegular mineral fibre false ceiling tile (NRC 0.55 to 0.6)	SQM	150	2,028.79	18%	2,393.97	3,59,095.83
	Providing and fixing tiled false ceiling of specified materials of size 595x595 mm in true horizontal level, suspended on inter locking metal grid of hot dipped galvanized steel sections (galvanized @ 120 grams/sq.m., both side inclusive) consisting of main 'T' runner with suitably spaced joints to get required length and of size 24x38 mm made from 0.30 mm thick (minimum) sheet, spaced at 1200 mm center to center and cross 'T' of size 24x25 mm made of 0.30 mm thick (minimum) sheet, 1200 mm long spaced between main 'T' at 600 mm center to center to form a grid of 1200x600 mm and secondary cross 'T' of length 600 mm and size 24x25 mm made of 0.30 mm thick (minimum) sheet to be interlocked at middle of the 1200x600 mm panel to form grids of 600x600 mm and wall angle of size 24x24x0.3 mm and laying false ceiling tiles of approved texture in the grid including, required cutting/ making, opening for services like diffusers, grills, light fittings, fixtures, smoke detectors etc. Main 'T' runners to be suspended from ceiling using G.I. slotted cleats of size 27x37x25x1.6 mm fixed to ceiling with 12.5 mm dia. and 50 mm long dash fasteners, 4 mm G.I. adjustable rods with galvanised butterfly level clips of size 85x30x0.8 mm spaced at 1200 mm center to center along main 'T', bottom exposed width of 24 mm of all 'T'-sections shall be pre-painted with polyester paint, all complete for all heights as per specifications, drawings and as directed by the Engineer-in-Charge :						
900.00	G.I. Metal Ceiling Lay in plain Tegular edge Global white color tiles of size 595x595 mm, and 0.5 mm thick with 8 mm drop; made of G.I. sheet having galvanizing of 100 gms/sq.m. (both sides inclusive) and electro-statically polyester powder coated of thickness 60 microns (minimum), including factory painted after bending.	SQM	10	1,520.96	18%	1,794.73	17,947.33
	ROOF WATERPROOFING						
	Providing and laying APP (Atactic Polypropylene Polymer) modified prefabricated five layer, 3 mm thick water proofing membrane, black finished reinforced with non-woven polyester matt consisting of a coat of bitumen primer for bitumen membrane @ 0.40 litre/sqm by the same membrane manufacture of density at 25°C, 0.87-0.89 kg/ litre and viscocity 70-160 cps. Over the primer coat the layer of membrane shall be laid using Butane Torch and sealing all joints etc, and preparing the surface complete. The vital physical and chemical parameters of the membrane shall be as under : (a) Joint strength in longitudinal and transverse direction at 23°C as 650/450N/5cm. (b) Tear strength in longitudinal and transverse direction as 300/250N. (c) Softening point of membrane not less than 150°C. (d) Cold flexibility shall be up to -2°C when tested in accordance with ASTM, D-5147. The laying of membrane shall be got done through the authorised applicator of the manufacturer of membrane :						
910.00	3 mm thick	SQM	150	426.79	18%	503.61	75,541.83
	Clay tiles for terrace						
920.00	Providing and laying pressed clay tiles (as per approved pattern 20mm nominal thickness of approved size) on roofs jointed with cement mortar 1:4 (1 cement : 4 coarse sand) mixed with 2% integral water proofing compound, laid over a bed of 20 mm thick cement mortar 1:4 (1 cement : 4 coarse sand) and finished neat complete.	SQM	150	495.78	18%	585.02	87,753.06
	Stone Boulders (Filter media)						
930.00	Supplying, filling, spreading & leveling stone boulders of size range 5 cm to 20 cm, Gravels of 5mm to 10mm and coarse sand of size range 1.5mm to 2mm (each in equal quantity) in recharge pits and required size gravel in the borewell, in the required thickness, for all leads & lifts, all complete as per detail drawing and direction of the Engineer-In-Charge.	CUM	11	1,122.16	18%	1,324.15	14,565.64
	Grouting						

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940.00	Providing and injecting approved grout in proportion recommended by the manufacturer into cracks/honey-comb area of concrete/ masonry by suitable gun/pump at required pressure including cutting of nipples after curing etc. complete as per directions of Engineer-in-Charge. (The payment shall be made on the basis of actual weight of approved grout injected.) 26.35.1 Stirrer mixed Acrylic Polymer of approved make @ 2% of weight of cement used) modified Cement slurry made with non shrink compound in concrete/RCC work (Note: This item shall be operated under specific instruction of the Engineer-in-Charge.)	KG	11	101.41	18%	119.66	1,316.24
	Weep holes						
950.00	Providing and fixing of U-PVC pipes (working pressure 4 kg / cm²) Single socketed pipe 75 mm dia in weep holes.	METRE	11	460.32	18%	543.18	5,974.95
	RCC Manhole						
960.00	Supply and fixing in position precast RCC manhole cover and rectangular shape 600x450mm (internal clear dimensions) all completed along with associated works as per approved drawing, Technical specification and direction of Engineer-In-Charge.	EACH	2	1,222.00	18%	1,441.96	2,883.93
970.00	Providing M.S. foot rests including fixing in manholes with 20x20x10 cm cement concrete blocks 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size) as per standard design/ all completed along with associated works as per approved drawing, Technical specification and direction of Engineer-In-Charge.: With 20 mm diameter round bar	EACH	20	386.32	18%	455.86	9,117.15
	Precast Concrete Cover						
980.00	Providing and placing in position 100 mm thick factory made machine batched & machine mixed Precast RCC Rectangular Covers on drains, SS trench of various sizes, of M-25 grade cement concrete for RCC work, including cost of centering, shuttering, reinforcement of 8 mm dia TMT bars of Fe 500 grade @ maximum 100mm c/c on both ways , neat cement punning on finished surface, properly encased on all edges with 1.6 mm thick , 100 mm wide MS sheet duly painted over priming coat , reinforcement to be welded at edges with MS sheet and providing 2 Nos. 12 mm dia bar for hooks etc i/c cost of cartage, all leads & lift, handling at site etc. all complete as per direction of Engineer-in-Charge.	SQM	50	1,969.30	18%	2,323.77	1,16,188.70
	Bore well						
990.00	Supplying, providing, installation, boring/drilling, testing & commissioning of bore well of required dia by suitable method prescribed in IS:2800 (Part-I) including casing/ strainer pipe, collecting samples from different strata, preparing and submitting strata chart/ bore log, including hire & running charges of all equipment, tools, plants & machineries required for the job, all complete as per direction of the Engineer-In-Charge, drilling 300mm dia bore up to 50 metre depth below ground level, providing and installation of unplasticized PVC medium well casing (CM) pipe of 150mm dia and unplasticized PVC medium well screen (RMS) pipes of 150mm dia with ribs conforming to IS: 12818 , PVC inlet and Outlet pipes of 25mm diameter.	metre	500	466.34	18%	550.28	2,75,140.60
1000.00	Supply, installation, testing and fixing of Single phase, 5.0 HP sub-mersible pump-cum motor of approved make capable of delivering 300 Litre Per Minute (LPM) to required head with starter, wiring (3 core X2.5 Cu flat cable-60m) from starter to motor and incoming feeder to starter i.e. spot welded plate for borewell top, M.S clamps at top of casing/housing pipe, Bail plug/bottom plug, complete in all respects inclusive of cost of all labour, materials, tools, tackles, etc. as per drawings, specifications and directions of the Engineer-in-Charge.	EACH	1	1,50,000.00	18%	1,77,000.00	1,77,000.00
	LANDSCAPING						
1010.00	**Supplying and mixing of good earth** and sludge in (80:20 ratio) at site and spreading in required thickness as per direction on Engineer-in-charge or as per drawings including royalty and carriage up to 5 km lead complete.	CUM	15	529.56	18%	624.88	9,373.21
1020.00	Providing & laying Selection no. 1 grass turf with earth 50mm to 60mm thickness of existing ground prepared with proper level and ramming with required tools wooden and than rolling the surface with light roller make the surface smoothen and light watering the same maintenance for 30 days or more till the grass establish properly,as per direction of officer in charge	SQM	50	75.23	18%	88.77	4,438.57
	Bore well For Percolation Pit						

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	Boring/ drilling bore well of required dia for casing/ strainer pipe, by suitable method prescribed in IS:2800 (Part-I), including collecting samples from different strata, preparing and submitting strata chart/ bore log, including hire & running charges of all equipment, tools, plants & machineries required for the job, all complete as per direction of the Engineer-In-Charge, up to 90 metre depth below ground level.						
1030.00	300 mm nominal size diameter	METRE	50	466.34	18%	550.28	27,514.06
	Supplying, assembling, lowering and fixing in vertical position in bore well, Un-plasticized PVC medium well casing (CM) pipe of required dia, conforming to IS:12818, including required hire and labour charges, fittings & accessories etc. all complete, for all depths, as per direction of the Engineer-In-Charge. Pipe Shall be Slotted as per detail engineering drawing requirement.						
1040.00	150 mm nominal size diameter	METRE	5	567.47	18%	669.61	3,348.07
	Dry Stone Pitching						
1050.00	Providing and laying of 225mm thick dry rubble stone soling under foundations PCC or wherever required as per direction of Engineer-In-Charge and drawings including hand packing, filling the interstices with chips, spalls and binding with grit and selected murrum/coarse sand, watering, compaction by hand ramming etc. complete in all respect all completed along with associated works as per approved drawing, Technical specification and direction of Engineer-In-Charge. (Boulders of size 100mm to 150mm size shall be provided)	SQM	1223	597.28	18%	704.79	8,61,958.66
	Boring, providing and installation bored cast-in-situ reinforced cement **concrete piles** of grade M-25 of specified diameter and length below the pile cap, to carry a safe working load not less than specified, excluding the cost of steel reinforcement but including the cost of boring with bentonite solution and temporary casing of appropriate length for setting out and removal of same and the length of the pile to be embedded in the pile cap etc. by percussion drilling using Direct mud circulation (DMC) or Bailer and chisel technique by tripod and mechanical Winch Machine all complete, including removal of excavated earth with all its lifts and leads [**Notes:** (1) Length of pile for payment shall be measured up to bottom of pile cap. (2) Truck Mounted rotary/ TMR/ Tubewell boring machine shall not be used] :						
1060.00	450 mm diameter piles	METRE	0.1	1,882.75	18%	2,221.65	222.16
	Vertical load testing of piles in accordance with IS:2911 (Part-IV) including installation of loading platform by Kentledge/ Anchor piles method and preparation of pile head or construction of test cap and dismantling of test cap after test etc. complete as per specification & the direction of the Engineer-In-Charge. [**Notes :** (1) Initial and Routine Load Test shall not be carried out by Dynamic method of testing. (2) Testing agency shall submitt the design of loading platform for the approval of the Engineer-In-Charge.] :						
1070.00	Initial Test (Test Load 2.5 times the Safe Capacity)	PER TEST	1	45,393.23	18%	53,564.01	53,564.01
	Vertical load testing of piles in accordance with IS:2911 (Part-IV) including installation of loading platform by Kentledge/ Anchor piles method and preparation of pile head or construction of test cap and dismantling of test cap after test etc. complete as per specification & the direction of the Engineer-In-Charge. [**Notes :** (1) Initial and Routine Load Test shall not be carried out by Dynamic method of testing. (2) Testing agency shall submitt the design of loading platform for the approval of the Engineer-In-Charge.] :						
1080.00	Routine Test (Test Load 1.5 times the Safe Capacity)	PER TEST	1	17,022.95	18%	20,087.08	20,087.08
	GI ROOFING SHEETS						
1090.00	Providing and fixing precoated galvanised iron profile sheets (size, shape and pitch of corrugation as approved by Engineer-in-charge) 0.50 mm (+ 0.05 %) total coated thickness with zinc coating 120 grams per sqm as per IS: 277, in 240 mpa steel grade, 5-7 microns epoxy primer on both side of the sheet and polyester top coat 15-18 microns. Sheet should have protective guard film of 25 microns minimum to avoid scratches during transportation and should be supplied in single length upto 12 metre or as desired by Engineerin- charge. The sheet shall be fixed using self drilling /self tapping screws of size (5.5x 55 mm) with EPDM seal, complete upto any pitch in horizontal/ vertical or curved surfaces, excluding the cost of purlins, rafters and trusses and including cutting to size and shape wherever required.	METRE	150	656.57	18%	774.75	1,16,212.89
	Partition panels						
1100.00	Providing and laying Gypsum panel partitions 100 mm thick with water proof Gypsum panels of size 666x500x100 mm, made of calcite phosphor Gypsum fixed with tongue and groove edges and jointed with bonding plaster as per manufacturer's specifications in superstructure above plinth level up to floor V level. Gypsum blocks will have a minimum compressive strength of 9.3 kg/cm 2	SQM	66	870.06	18%	1,026.67	67,760.27
B	**MISC. WORKS**						

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	FLEX FOR SIGNAGES						
1110.00	SUPPLYING FLEX, FABRICATING, TRANSPORTING, ERECTING, ETC. ON SITE/SHOP AS PER SPECIFICATIONS AND DRAWING**- FLEX FOR SIGNAGES WHEREVER REQUIRED FOR BRANDING.**	SQFT	230	445.00	18%	525.10	1,20,773.00
1120.00							
1130.00	SUPPLY AND INSTALLATION OF MANDATORY SIGNS MADE OF 3 MM ACM SHEET AND PRINTED ON ECO VINYL SHEET 450X300 MM. DETAIL SPECIFICATION AS GIVEN IN THE TENDER DOCUMENT.	Each	29	2,325.00	18%	2,743.50	79,561.50
1140.00	Supply and installation of Aluminum composite panel board all support structural/fixtures at all heights painted with two coats of first quality synthetic enamel paint over two coats of Zinc phosphate primer of approved make, concrete grouting in 1:2:4, wherever required complete in all aspects as per following specifications, size, shape and as directed by In-Charge. Board Material : Aluminum composite panel (Alucobond, Alpolic, Renybond 3mm/ 0.3 mm thick PVDF coated French Blue No. 166 (IS -5) Lettering : 3M vinyl 3630 series Border : L pipe, Aluminum ; Powder coated Laminate : 3M 8519 series laminate film Note: The matter/drawing to be printed shall be provided in soft form as Doc/ PDF/Dwg file. Conversion required if any for making the files printable shall be in vendor's scope.	SM	12	3,720.00	18%	4,389.60	52,675.20
	Internal Signage Boards						
1150.00	SUPPLY AND INSTALLATION OF MANDATORY SIGNS MADE OF 3 MM ACM SHEET AND PRINTED ON ECO VINYL SHEET 300x100 MM. DETAIL SPECIFICATION AS GIVEN IN THE TENDER	EA	10	1,860.00	18%	2,194.80	21,948.00
	INTERIOR WORKS						
1160.00	**High Back chair with head rest (for GA in charge, confereance room)** Supply of High Back chair with adjustable head rest. The seat size shall be 485mm (W) x 460mm (D), The back heightshall be mm 710mm and overall height- 1160mm . The seat shall be made of hot pressed 15mm thick moulded ply and upholstered with Urethane foam Foam density 40kg/m3 & net fabric tapestry. The Back is made of polyproplene outer side and upholstered with nett or breathable mesh with cushioned support. The armrests are made of polyproplene and mechanism shall be knee tilt with four point locking. The pneumatic height adjustment shall have an adjustment of 63mm in BIFMA Standard class 3..Pedestal is made of injection moulded black nylon fitted with 5 nos. twin wheels castors which are made of injection moulded black nylon 30% glass filled and nylon base is load tested capacity -1150 kg in BIFMA standard. All material shall be supplied inline with the sample approved by Engineer in charge.	EA	1	15,300.00	18%	18,054.00	18,054.00
1170.00	**High Back chair without head rest (for manager, confereance room)** Supply of High Back chair. The seat size shall be 485mm (W) x 460mm (D), The back heightshall be mm 710mm and overall height- 1160mm . The seat shall be made of hot pressed 15mm thick moulded ply and upholstered with Urethane foam Foam density 40kg/m3 & net fabric tapestry. The Back is made of polyproplene outer side and upholstered with nett or breathable mesh with cushioned support. Thearmrests are made of polyproplene and mechanism shall be knee tilt with four point locking. The pneumatic height adjustment shall have an adjustment of 63mm in BIFMA Standard class 3..Pedestal is made of injection moulded black nylon fitted with 5 nos. twin wheels castors which are made of injection moulded black nylon 30% glass filled and nylon base is load tested capacity -1150 kg in BIFMA standard. All material shall be supplied inline with the sample approved by Engineer in charge.	EA	5	13,500.00	18%	15,930.00	79,650.00
1180.00	**Medium Back chair (for office room, reception, security room, outsider meeting room, sales room)** Medium Back chair. The seat size shall be 485mm (W) x 460mm (D), The back height shall be mm 560mm and overall height- 1000mm . The seat shall be made of hot pressed 15mm thick moulded ply and upholstered with Urethane foam Foam density 40kg/m3 & net fabric tapestry. The Back is made of polyproplene outer side and upholstered with nett or breathable mesh with cushioned support. The armrests are made of polyproplene and mechanism shall be knee tilt with four point locking. The pneumatic height adjustment shall have an adjustment of 63mm in BIFMA Standard class 3.Pedestal is made of injection moulded black nylon fitted with 5 nos. twin wheels castors which are made of injection moulded black nylon 30% glass filled and nylon base is load tested capacity -1150 kg in BIFMA standard.	EA	10	10,800.00	18%	12,744.00	1,27,440.00

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1190.00	**Table (for Meeting Room)** Providing and fixing in position Meeting Room Table shape, sizes as per the approved design and profile given in the detailed drawing consisting of :The Table top to be made in layers of 19,12,6mm thick BWP grade marine plywood covered with 4mm thick approved veneer and partly burl on top and 1mm thick approved laminate at the bottom. The edge of the table top is to be finished with moulding of matching wood. All the exposed surfaces of the veneer and matching wood moulding to be finished with polyester resin polish (PU). The under structure of the table is to be made of 19 mm thick BWP grade marine plywood with 4mm thick approval veneer with melamine polish and in side 1mm thick laminate, of approved boxing, and vertical designs patta and skirting level provide molding, with necessary leveling arrangements. Provision for power track is to be provided as per detailed drawing. RR/approved make cable tray/pop up box of approved shade/design shall be fixed as per drawing. The entire item is to be completed in totality as per the architectural drawing shall be prepared by contractor based on actual site condition and shall be submitted for Engineer- In-charge approval. Rate including cost of complete table set, in-built raceway for laying cables, wooden moulding as per details provided by architect and in between table work surface to have a seamless (hair line) joint between the two joint surface to give a continuous look, cutout for services, wooden beadings, moulding etc. complete as per direction of Engineer - in - charge / architect. Rate to be included for all the items as shown in drawing. (qualirt to be maintained where Basic rate of veneer shall be Rs. 2000/- per smt.and Basic rate of veneer shall be Rs. 2000/- per smt.and Basic Rate of Laminate: Rs 600/SM). Only surface plan area of working table/desktop shall be considered for payment.	Sqm.	4	21,600.00	18%	25,488.00	1,01,952.00
1200.00	**Table (for GA in charge room, Reception, Security room)** Supply, installation & commissioning of the Furniture as per dimension, shape, curvature and design given in the drawing and with the following specifications. i. TABLE TOP(As per drawing): To be fabricated out of 19 mm thk ply finished with 3/3.5 mm thk Veneer with melamine polish, Approved shade with Pattern, grooves etc .complete. Table apron to be made out as per drgs. Design, shape and curve of table top shall be as per the drawing and instructions of HPCL EIC/Architect. ii. DRAWER BOXES(As per drawing): below table top deep fabricated out of ply in front & on other sides and with Drawers. All drawers shall have teak wood handles as shown in Drg. Drawers to be provided with single lock arrangement complete in all respects. All exposed surfaces of table/drawer unit shall be finished with veneer with melamine polish. Drawer boxes to be finished with laminate from inside. iii. BACK CREDENZA UNIT(As per drawing): To be fabricated out of 19 mm thk ply finished with 3/3.5 mm thk Veneer with melamine polish, Approved shade with Pattern, grooves etc .complete. The unit to be provided with shelves The sliding/openable shutters finished as per drawings. Aluminium profile handles/ball catch as per Arch./HPCL Approval along with approved quality lock. Sliding channels to be provided in Aluminium. All the hardwares and fitting to be of approved makes and as per selection by Architect/ HPCL. Scope includes Providing necessary items like Grommet holes, cable hangs and trays as per site requirements. In the side unit Tray unit with Aluminium channels shall be provided with front finished in melamine polish as per detailing provided in drawing. The table to be finished with foot rest as per drgs and approval. (quality to be maintained where Basic rate of veneer shall be Rs. 2000/- per smt.) (Basic Rate of Laminate: Rs 600/SM) Keyboard Pull out tray and retrofit mouse tray to be provided in Metal Tray in MS CRCA sheet Note: Table top for main table, side unit and back unit shall be finished with veneer as per approved	Sqm.	2	36,000.00	18%	42,480.00	84,960.00
1210.00	**GRAPHICS/SIGNAGES** Providing and fixing of graphics/ signages (including printing of direction, entry, exit, department name, etc.) with self glowing/	EA	6	1,800.00	18%	2,124.00	12,744.00
1220.00	**TOWER BOLTS** Providing and fixing approved stainless steel finished tower bolts (barrel type) 10 mm diameter & 200 mm long with screws etc. complete as per drawings, specification and directions of the Engineer-in-Charge.	EA	1	810.00	18%	955.80	955.80
1230.00	Design supply & installation of suspended Spider Glazing system designed to withstand the wind pressure as per IS 875 (Part-III). The Suspended System held with Spider Fittings of SS-316 Grade Steel of approved manufacturer with glass panel having 12 mm thick clear toughened glass held together with SS-316 Grade Stainless steel Spider & bolt assembly with laminated glass fins 21 mm thick. The Glass fins and glass panel assembly shall be connected to Slab/ beams by means of SS- 316 Grade stainless steel brackets & Anchor bolts and at the bottom using SS channel of 50x25x2mm using fastener & anchor bolts, non staining weather sealants of approved make, Teflon/ nylon bushes and separators to prevent bi-metallic contacts, all complete to perform as per specification and approved drawings. The complete system to be designed to accommodate thermal expansion & seismic movements etc. The joints between glass panels (6 to 8 mm) and gaps at the perimeter & in U channel of the assembly to be filled with non staining weather sealant, so as to make the entire system fully water proof & dust proof. The rate shall include all design, Engineering and shop drawing including approval from structural designer, labour, T&P, scaffolding, other incidental charges including wastage, enabling temporary services all fitting fixers nut bolts, washer, Buffer plates, fastener, anchors, SS channel laminated glass etc. all complete. For the purpose of payment, actual elevation area of Glazing including thickness of joints and the portion of Glass panel inside the SS channel shall be measured.	SQM	60	11,700.00	18%	13,806.00	8,28,360.00

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1240.00	DESIGN WITH FILM : Providing and fixing Etching type design on glass with film of approved makes as per design and instruction of manufacturer specification.	SQM	35	2,430.00	18%	2,867.40	1,00,359.00
1250.00	**Visitor chair:** The seat & back are made of 12+6 mm thick twin wooden ply upholstered with foam density 40kg/m3 in seat and foam density 32kg/m3 in back with leatherite tapestry. The seat's main frame made of chrome plated CRCA pipe dia 20.38mm x 2mm thick. There are use of PPCP shoes in the bottom of frame for avoid streches on the floor. Whole seat quality meet at the BIFMA standard class iii. Seat size shall be-20" (W) x 19" (D) and back height shall be 20.5" from seat & overall height: 37.5"From floor. Item to be completed in all respects as per approval on contractor drawings & instructions from Project- in-charge/Architect.	EACH	5	5,400.00	18%	6,372.00	31,860.00
1260.00	**Hand Dryer** Providing & fixing Hand Drier of approved make as per approved by Architect/Engineer-in-charge complete. Item to include all fixing accessories, men material and lift up to all heights & installed complete. Item to be completed in all respects as per approval on contractor drawings & instructions from Project- in-charge/Architect.	EACH	2	22,500.00	18%	26,550.00	53,100.00
1270.00	**Normal RO at Cafeteria:** Supply & Installation of RO + UV +UF, TDS control) 20L storage, Filtration Capacity min 20 lit/hr at cafeteria. Item to include all fixing accessories, men material and lift up to all heights & installed complete. Item to be completed in all respects as per approval on contractor drawings & instructions from Project- in-charge/Architect.	Each.	1	27,000.00	18%	31,860.00	31,860.00
1280.00	**Refrigerator, 300L:** Supply & Installation of Refrigerator, 300L, Digital Inverter Technology. Double Door, 5star rating.Item to include all fixing accessories, men material and lift up to all heights & installed complete. Item to be completed in all respects as per approval on contractor drawings & instructions from Project- in-charge/Architect.	Each.	2	58,500.00	18%	69,030.00	1,38,060.00
1290.00	**Kitchen Chimney:** Supply & Installation of Kitchen Chimney Stainless Steel Baffle Filters , 1000 m3/h Wall Mounted. Item to include all duct and fixing accessories, men material and lift up to all heights & installed complete. Item to be completed in all respects as per approval on contractor drawings & instructions from Project- in-charge/Architect.	Each.	1	36,000.00	18%	42,480.00	42,480.00
1300.00	**Stretcher Trolley:** Suply of Stainless Steel Stretcher Trolley. Item to be completed in all respects as per approval on contractor drawings & instructions from Project- in-charge/Architect.	Each.	1	22,500.00	18%	26,550.00	26,550.00
1310.00	**Officer name plates:** Supply and installation of Officer name plates Name Plate for Office Table Desk Triangle Pen Box Stand Holder With Logo & Name Premium (Company or Individual) . Item to be completed in all respects as per approval on contractor drawings & instructions from Project- in-charge/Architect.	Each.	3	1,080.00	18%	1,274.40	3,823.20
1320.00	**Door name plates:** Supply and installation of Door name plates office Room 12x3 inch Stainless Steel Signage Board For office. Item to be completed in all respects as as per approval on contractor drawings & instructions from Project- in-charge/Architect.	Each.	5	1,170.00	18%	1,380.60	6,903.00
1330.00	**Office Filing Fire proof Cabinet:** Supply and installation of Office Filing Fire proof Cabinet with 4 Shutters (ht 1800 mm) Item to be completed in all respects as per approval on contractor drawings & instructions from Project- in-charge/Architect.	Each.	1	24,300.00	18%	28,674.00	28,674.00
1340.00	**Lockers (Security & Workers):** Supply and installation of Lockers (Security & Workers) 6 Door Metal Locker Cupboard Storage Cabinet with Staple Locking Office Employee Locker Box (75 X 36 X 19 Inch Powder Coated) Item to be completed in all respects as per approval on contractor drawings & instructions from Project- in-charge/Architect.	Each.	2	27,000.00	18%	31,860.00	63,720.00

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1350.00	**Three Seater visitor Bench:** Supply and installation of bench 3 seater for waiting area Cross beam shall be made up of black powder coated rectangular M.S.ERW tube having 8 ± 0.03 cm x 4 ± 0.03 cm x 0.2 ± 0.014 cm size. Leg and armrest shall be chrome plated made of cold rolled steel with 0.12 ± 0.013 cm thinkness. Seat back shell shall be 1.6 mm thk powder-coated perforated shell made from cold rolled M.S. sheet 0.14 ± 0.013 em thickness. The Side Bar shall be made of Chrome plated solid steel 3 ± 0.03 cm x 1.2 ± 0.3 cm (DIN174)with fluting and plastic inserts.The Shell shall be assembled on the Cross Beam with help of M8 Bolts (Per Seat- 8 nos. Seat to Bracket and 4nos. Bracket to Cross Beam). The seat & back cushion shall be made up of PU foam upholstered with leather cloth or fabric with plywood. Overall Dimensions shall be Seat Height - 40.0cm, Height - 67.5cm, Width & Depth of Chair as measured from pedestal - Width-163.0cm and Depth-57.0 cm. Item to be completed in all respects as per approval on contractor drawings & instructions from Project- in-charge/Architect	Each.	3	16,200.00	18%	19,116.00	57,348.00
1360.00	**Dining set (Cafeteria & Worker room):** Supply and installation of Cafeteria counter height wooden dining set (1 no table for 4 person and 4nos low back high chair) Table size 1200x900 and Table Top made of 25mm thick MDF with finished in pvc memberane using unique wrap around for better aesthetics & long lasting use. Understructure - It has 2 vertical pipes with tie bar connected horizontally on bottom of the table top. Two vertical pipes are connected with help of horizontal pipes at the top & bottom. Connector pipe is 25mm dia and is 1235 long. It is made of 1.6mm thick ss 202. Additional 2 horizontal pipe are provided below the table top for strength & stability. Entire seat & back is a single moulded bend ply with laminate coating. Entire seat & back is a single moulded bend ply with laminate coating.	Set	2	36,000.00	18%	42,480.00	84,960.00
1370.00	**Cabinets in Kitchen:** Supply and installation of Cabinets in Kitchen. Made of Marine-grade plywood with select laminate skin(basic cost is not less than Rs. 600/SM-) on both faces- pedestal box frame of 19 thick ply board with 12 thick backer ply, horizontal shelving of 19 thick ply board & drawer sideboard of 12 thick ply board, all as per Design drawing. Item to be inclusive of sample unit approval from Architect/Engineer-in-charge, all edge lipping of water based PU polished & stained good grade TW, all GI & Al. joining cleats, fixing accessories, phenol formaldehyde based Adhesives, SS 304 Grade 'Butler' finished hardware of handles, hinges, mortise locks, clip-locks, GI drawer slides, key-hole roses etc. as approved by Architect/Engineer-in-charge; and inclusive of all installation and lift up to 20 mts, all accessories, fitments, tools and tackle, finished, laid complete. Item to be inclusive of all accessories, fixing implements, tools and tackle, men material and lift up all heights & finished installed cleaned complete. Item to be completed in all respects as per drawings & instructions from Project-incharge/ Architect. Only surface area for elevation shall be	SQM	1	18,000.00	18%	21,240.00	21,240.00
1380.00	**Mornitoring Screen:** Providing and fixing/installation of **55"display size 4K Ultra HD Smart LED o**f approved brand for meeting room including electrical wiring, frame, supporting arrangement, accessories all complete.	Each.	1	90,000.00	18%	1,06,200.00	1,06,200.00
1390.00	**Megnetic White Board:** Providing and fixing/installation of self supported 1200mmx1200mm magnetic white board in the meeting room of approved brand including frame, supporting arrangement, accessories all complete.	Each.	1	9,000.00	18%	10,620.00	10,620.00
1400.00	**Portable Fire Extinguishers : Manual Fire Fighting System** Supply & installation of Indoor located 10 Kg DCP Fire Extinguisher alongwith mounting bracket and fixing accessories suitable for wall mounting.	Each.	5	6,300.00	18%	7,434.00	37,170.00

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1410.00	**GRG BOARD PARTITIONS** Providing and fixing partition upto ceiling height consisting of G.I. frame and required board, including providing and fixing of frame work made of special section power pressed/ roll form G.I. sheet with zinc coating of 120 gms/sqm(both side inclusive), consisting of floor and ceiling channel 50mm wide having equal flanges of 32 mm and 0.50 mm thick, fixed to the floor and ceiling at the spacing of 610 mm centre to centre with dash fastener of 12.5 mm dia meter 50 mm length or suitable anchor fastener or metal screws with nylon plugs and the studs 48 mm wide having one flange of 34 mm and other flange 36 mm and 0.50 mm thick fixed vertically within flanges of floor and ceiling channel and placed ata spacing of 610 mm centre to centre by 6 mm dia bolts and nuts, including fixing of studs along both ends of partition fixed flush to wall with suitable anchor fastener or metal screws with nylon plugs at spacing of 450 mm centre to centre, and fixing of boards to both side of frame work by 25 mm long dry wall screws on studs, floor and ceiling channels at the spacing of 300 mm centre to centre. The boards are to be fixed to the frame work with joints staggered to avoid through cracks, M.S. fixing channel of 99 mm width (0.9 mm thick having two flanges of 9.5 mm each) to be provided at the horizontal joints of two boards, fixed to the studs using metal to metal flat head screws, including jointing and finishing to a flush finish with recommended jointing compound, jointing tape, angle beads at corners (25 mm x 25 mm x 0.5 mm), joint finisher and two coats of primer suitable for board as per manufacture's specification and direction of engineer in charge all complete. 75 mm overall thickness partition with 12.5 mm thick double skin fire rated Glass Reinforced Gypsum (GRG) plaster board conforming to IS: 2095: part 3 (Board with BIS certification marks)	SQM	30	1,552.40	18%	1,831.83	54,954.96
1420.00	**ALUMINIUM FRAME FOR GLASS PARTIONS/DOORS** Providing and fixing aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge. (Glazing, paneling and dash fasteners to be paid for separately) : Anodised aluminium (anodised transparent or dyed to required shade according to IS: 1868, Minimum	Kg.	10	409.04	18%	482.67	4,826.67
1430.00	**GLAZING** Providing and fixing glazing in aluminium door, window, ventilator shutters and partitions etc. with EPDM rubber / neoprene gasket etc. complete as per the architectural drawings and the directions of engineer-in-charge . (Cost of aluminium snap beading shall be paid in basic item): With float glass panes of 8 mm thickness (weight not less than 20 kg/sqm)	SQM	10	1,379.91	18%	1,628.29	16,282.94
1440.00	**SUN CONTROL FILM/SHADING FILM** Providing and fixing, on fixed glazing/ doors/ window panes, sun control film "HP NATURAL 35 SAFETY COMBINATION FILM-4Mil" of M/s. GARWARE or approved equivalent make and shade, all complete as per manufacturer's specification and as per instructions of the Engineer-in-Charge.	SQM	50	1,182.78	18%	1,395.68	69,784.02
1450.00	**FLOOR SPRING** Providing and fixing double action hydraulic floor spring of approved brand and manufacture conforming to IS : 6315, having brand logo embossed on the body / plate with double spring mechanism and door weight upto 125 kg, for doors, including cost of cutting floors, embedding in floors as required and making good the same matching to the existing floor finishing and cover plates with brass pivot and single piece M.S. sheet outer box with slide plate etc. complete as per the direction of Engineer-in-charge. With stainless steel cover plate minimum 1.25 mm thickness	Each.	5	12,320.64	18%	14,538.35	72,691.75
1460.00	**SILICON SEALANT FOR GLAZING** Filling the gap in between aluminium frame & adjacent RCC/ Brick/ Stone work by providing weather silicon sealant over backer rod of approved quality as per architectural drawings and direction of Engineer-in-charge complete. Upto 5mm depth and 5 mm width	M	50	83.78	18%	98.86	4,943.04
1470.00	**DOOR ACCESSORIES (HANDLES, LOCK etc)** Providing and fixing stainless steel fancy handle of approved make fixed with SS screws etc. complete as per direction of Engineer-in-charge. 200mm	Each.	10	2,661.26	18%	3,140.28	31,402.84

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1480.00	**CYLINDRICAL LOCKS** Providing and fixing approved cylindrical lock of "ACME KASA" or equivalent with required colour or shade with nuts and screws etc. complete as per drawings, specifications and directions of the Engineer-in-Charge.	EA	10	3,400.50	18%	4,012.58	40,125.85
1490.00	**Wallpaper** Providing and applying select approved Wall paper of approved make and shade on all surfaces & at all heights including scaffolding, preparing the surface by brushing and brooming down etc. complete. The dry/wet cleaning of floors etc. after wallpaper is to be carried out. Item to include getting mock-up for approved by Architect/Engineer in charge, all approved gluing as per detailed specifications and approval, all accessories, men material and upto all heights protecting finished surface with min. 20 microns thk polythene sheet till facility handover, finished cleaned complete. Also rate shall be inclusive of doing any oil paint preparation over partition/wall or any other location before pasting of wallpaper as per instructions of EIC/architect. Item to be completed in all respects as per drawings & instructions from Project- incharge.	Sqm.	10	1,379.91	18%	1,628.30	16,282.95
1500.00	**Sofa 3 seater** Supplying and Placing in location Sofa 3-seater type as per selection made up of TW/SS Frame of size 38x75mm /approved equivalent frame approved size for Seating & Back, seating should have the horizontal TW/SS support of size 38x75mm/approved equivalant frame at regular intervals, the frame should have 12mm thk MDF on all sides with necessary hardware fasteners. The Chair should have Foam of approved quality & make all around with artificial Rexin/synthetic rubber drape of approved texture & colour. The base should have nylon floor strutpads/ legs. The cost includes all necessary fittings & fixtures, with necessary hardware etc. complete. (Min. Density of foam = 50Kg/m3). Size as per selection. The upholstery material to be got approved by Architect/Engineer-in-charge. Item to be inclusive of all accessories, fixing implements, tools and tackle, men material. Item to be completed in all respects as per drawings & instructions from Project- in-charge/Architect. Note: Vendors can offer sofa from their product portfolio within the basic rate mentioned with meeting minimum specifications mentioned above subject to approval from architect/HPCL EIC.	EACH.	1	51,253.85	18%	60,479.54	60,479.54
1510.00	**Console unit (Height 750 mm:450mm deep)** Providing and fixing storage units as per of required shape and size as per approved design drawings and as per the site requirements. Unit having sides, vertical dividers, top and bottom made of 19 mm thick BWP marine grade plywood.Top of the unit to be finished with 18 mm thick BWP plywood with partly burl and normal veneer with lamination. The back side of unit shall be 9 mm thick BWP plywood. The external face of the storage unit to be finished with 4 mm thick approved veneer. Shutters are to be made of 19 mm thick marine plywood and middle drawer as per approved drawings. All internal surfaces are to be finished with 1 mm thick laminate of approved make and shade. The item also includes pull out drawers, hinges, locks, handles, ball catcher, necessary cut-out etc. for services complete as per the directions of EIC/ Architect. The quoted rate shall include all hardware & accessories(Soft Closing Clip On Hinges CP,TOWER BOLT, Handle : Hand Made (T.W),Lock : Wardrobe Lock -3 point, Drawer lock Soft, Closing ball Bearing Drawer Slides, etc.). Only front surface area for elevation shall be considered for payment. (quality to be maintainèd where Basic rate of veneer shall not less than Rs. 2000/- per smt.and Basic Rate of Laminate shall not less than Rs 600/SM)	Sqm.	20	18,727.37	18%	22,098.29	4,41,965.85
1520.00	**Modular Storage Units** Modular LOW/FULL Height (450 mm D) Storage Unit : Providing & fixing storages of avg. 450 mm wide, made of BWP grade ply board with select laminate skin(basic cost is not less than Rs. 600/SM-) on both faces- pedestal box frame of 19 thick ply board with 12 thick backer ply, horizontal shelving of 19 thick ply board & drawer sideboard of 12 thick ply board, all as per Design drawing. Item to be inclusive of sample unit approval from Architect/Engineer-in-charge, all edge lipping of water based PU polished & stained good grade TW, all GI & Al. joining cleats, fixing accessories, phenol formaldehyde based Adhesives, SS 304 Grade 'Butler' finished hardware of handles, hinges, mortise locks, clip-locks, GI drawer slides, key-hole roses etc. as approved by Architect/Engineer-in-charge; and inclusive of all installation and lift up to 20 mts, all accessories, fitments, tools and tackle, finished, laid complete. Item to be inclusive of all accessories, fixing implements, tools and tackle, men material and lift up all heights & finished installed cleaned complete. Item to be completed in all respects as per drawings & instructions from Project-incharge/ Architect. Only front surface area for elevation shall be considered for payment	Sqm.	20	15,277.59	18%	18,027.55	3,60,551.09

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1530.00	**Work Stations (office, Manager room, Sales room)** Providing & fixing work station of avg. 600 mm wide working platform, 1m high verticle partition fixed on floor with GI sections, top U-shape beeding and made of BWP grade ply board with select laminate skin(basic cost is not less than Rs. 600/SM-) on both faces- frame of 19 thick ply board with 12 thick backer ply, horizontal shelving of 19 thick ply board & drawer sideboard of 12 thick ply board, all as per approved Design drawing. Item to be inclusive of sample unit approval from Architect/Engineer-in-charge, all edge lipping of water based PU polished & stained good grade TW, all GI & Al. joining cleats, fixing accessories, phenol formaldehyde based Adhesives, SS 304 Grade 'Butler' finished hardware of handles, hinges, mortise locks, clip-locks, GI drawer slides, key-hole roses,hole for electrical fixtures/fittings, The front & side wall of working destop shall have soft pin board and marker boards for individual sitting areas, side drawers shall be provided for each working station, etc. as approved by Architect/Engineer-in-charge; and inclusive of all installation and lift, all accessories, fitments, tools and tackle, finished, laid complete. Item to be inclusive of all accessories, fixing implements, tools and tackle, men material and lift up all heights & finished installed cleaned complete. Item to be completed in all respects as per drawings & instructions from Project-incharge/ Architect. Only surface plan area of working table/desktop shall be considered for payment	Sqm.	10	16,263.24	18%	19,190.62	1,91,906.22
1540.00	**Roller Blinds** Providing and fixing window blinds of chiks / bamboo / fabric /roman / roller of approved shade & makes with scoth gaurd fabric protector.The blinds should be approved by Architect / EIC.The blinds to be fixed and commissioned as per manufactures specification.The work to be completed as per satisfaction & approval of the Architect / EIC.Rate shall be including wastage as per drawing, design & direction no extra paidment shall be paid for wastage.	Sqm.	20	1,971.30	18%	2,326.14	46,522.72
1550.00	**Blackout Blinds** Providing & fixing black out roller blinds manufactured from dust & stain repellant polyster fabric in specified width of approved design & shade of make complete with control unit, idler, head rail, brackets, operating chain, roller tube & load bar etc. complete as per manufacturer's specifications. (Payment shall be made for the finished area. Height of the curtain shall be taken in open position from the top of the headrail to the bottom of the curtain.) The blinds to be fixed and commissioned as per manufactures specification. The work to be completed as per satisfaction & approval of the Architect / EIC.Rate shall be including wastage as per drawing, design & direction no extra payment shall be paid for wastage.	Sqm.	10	1,774.17	18%	2,093.52	20,935.22
1560.00	**Natural (air purifying) plants** Providing and arranging / fixing natural air purifier plants like spider plant,Dracaena, weeping, peace lily,sword fern,Viper's bowstring hemp,Areca palm etc. In Plastic or glass or any other decorative pots with marble / stone pebbles, moss etc. as per approval and selection. Rate to include all the accessories etc and No extra will be paid for additional Pebbel bags, T sheets and Wrappings if required to complete the job as per Architects Drawings and instructions from Architect / EIC.	Each.	5	2,759.82	18%	3,256.59	16,282.95
1570.00	**SS Dustbins** Providing and arranging / fixing Dustbin of 200 / 225 mm dia SS perforated dust bins with covers of approved quality as per directions of EIC/Architect.Worktable Dustbins- Providing and placing SS dustbins, avg. 1.8 mm thick & avg. 200 mm dia. Mouth tapering bucket type of avg. height 325 mm; as per approved shade and pattern, with all turned, well-formed and moulded edges at the bucket rim. Item to include sample approval from Architect/Engineer-in-Charge, item provisioned, laid complete. Item to be inclusive of all accessories, fixing implements, tools and tackle, men material , finished installed cleaned complete .Item to be completed in all respects as per drawings & instructions from Project- in-charge/Architect.	Each.	5	1,478.48	18%	1,744.60	8,723.01
1580.00	RO 80LPH: Supply & Installation of Mineralizer Water Purifier-Cooled water (Pre filter, RO + UV +UF, TDS control) Filtration Capacity min 80 lit/hr for office use.Item to include all fixing accessories, men material and lift up to all heights & installed complete. Item to be completed in all respects as per approval on contractor drawings & instructions from Project- in-charge/Architect.	Each.	1	81,000.00	18%	95,580.00	95,580.00
1590.00	White UPVC Sliding Window 3 Track (Min Size Of 1 Window 30 Feet), Glass Thickness: 5mm Clear Regular, UPVC Sliding Window 3 TRACK (2 Glass Shutter + 1 Fiber Mesh Shutter)	SQM	20	6,100.00	18%	7,198.00	1,43,960.00
1600.00	ALL WORK RELATED TO STATUTORY APPROVALS FOR THE CONSTRUCTION FROM THE COMPETENT AUTHORITY, to obtain all necessary permissions/approvals by the concerned authorities. All necessary work related to the same shall be in contractor's scope i.e. including preparation, submission of all drawing & documents , liaisoning required for making the station completely operational. All permissions mentioned below shall be acquired by contractor/bidder in complete manner and no separate payment shall be made to contractor other than below. Note:Payment shall be made for obtaining each permission (all other work related to get the permission shall be in the scope of contractor/bidder).						
1610.00	DM NOC	EACH	1	6,00,000.00	18%	7,08,000.00	7,08,000.00
1620.00	Bore well connection	EACH	1	16,999.23	18%	20,059.10	20,059.10

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1630.00	Factory license	EACH	1	46,747.89	18%	55,162.51	55,162.51
1640.00	Pollution control	EACH	1	68,187.03	18%	80,460.69	80,460.69
1650.00	PESO - CTE (basic PESO, including all other activities required to get the approval)	EACH	1	78,947.31	18%	93,157.83	93,157.83
1660.00	PESO - CTO (PESO Grant, PESO Endorsement, including all other activities required to get the approval)	EACH	1	1,26,315.70	18%	1,49,052.53	1,49,052.53
	Sub Total including GST (A)						**2,35,36,869.51**
	Percentage to be quoted by the bidder (B)						
	Amount in Rs. (C)						**0.00**
	Total including GST (A+C) after applying % offered by the bidder						**2,35,36,869.51**

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PART-B

KATEDAN

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SCHEDULE OF RATE (SOR) FOR KATEDAN (PART-B)

TENDER NAME: CIVIL AND ARCHITECTURAL WORKS FOR MOTHER STATION IN BGL AUTHROISED GA

TENDER NO.- BGL/780/2026-27

Name of the Bidder:

ITEM NO.	Description	UNIT	QTY	UNIT RATE - INCLUSIVE OF ALL TAXES AND DUTIES, LEVIES, FREIGHT, INSURANCE INCLUDING TRANSIT INSURANCE OF FREE ISSUE MATERIALS AS DEFINED IN BID DOCUMENT (EXCLUDING GST)	GST	UNIT RATE INCLUDING GST	TOTAL RATE - INCLUSIVE OF ALL TAXES AND DUTIES, LEVIES, FREIGHT, INSURANCE INCLUDING TRANSIT INSURANCE OF FREE ISSUE MATERIALS AS DEFINED IN BID DOCUMENT (INCLUDING GST)
PART B - KATEDAN							
A	**CIVIL**						
	CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS						
	Area Cleaning and Striping						
	Earth work in surface excavation (striping) not exceeding 15 cm in depth but exceeding 1.5 m in width as well as 10 sqm on plan including clearing jungle, uprooting of rank vegetation, grass, brush wood, trees and saplings, getting out and disposal of excavated earth, rubbish outside the property line, as directed by the Engineer-in-Charge :						
10.00	All kinds of soil	SQM	1200	44.15	18%	52.10	62,516.40
	Excavation						
	Earth work in excavation by mechanical means (Hydraulic excavator)/ manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth outside the property line, as directed by the Engineer-in-Charge.						
20.00	All kinds of soil- Excavation up to 1.5m Depth	CUM	1000	164.65	18%	194.29	1,94,287.00
30.00	All kinds of soil-Excavation beyond 1.5m and up to and inclusive of 3.0m	CUM	150	202.36	18%	238.78	35,817.72
	Earth work in excavation by mechanical means (Hydraulic excavator)/ manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1 .5 m, as directed by Engineer-in-charge.						
40.00	Hard rock	CUM	250	1,400.00	18%	1,652.00	4,13,000.00
	Backfilling and area filling with excavated soil						
50.00	Backfilling/Area filling with available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, including compacted up to 95% to its MDD carrying field density test to a certain compaction of soil complete in all respect as per scope of work, detailed construction drawing, as per technical specification as directed by the Engineer in charge.	CUM	650	203.28	18%	239.87	1,55,915.76
	Area filling with Borrowed soil						
60.00	Supplying and filling of local earth (including royalty) by mechanical transport, also including ramming and watering of the earth in layers not exceeding 20 cm in trenches, plinth, sides of foundation etc. complete including compacted up to 95% to its MDD carrying field density test to a certain compaction of soil complete in all respect as per scope of work, detailed construction drawing, as per technical specification as directed by the Engineer in charge.	CUM	400	297.10	18%	350.58	1,40,231.20
	Anti-termite treatment						
70.00	Supplying chemical emulsion (Chlorpyriphos/ Lindane emulsifiable concentrate of 20%) in sealed containers and applying as follow: Post construction treatment along the external wall below concrete or masonry apron using chemical emulsion @ 2.25 litres per linear metre with 1% concentration including drilling and plugging holes etc. as per Techinal specifications and direction of engineering in charge.	SQM	200	125.00	18%	147.50	29,500.00
80.00	Making plinth protection 50 mm thick of cement concrete 1:3:6 (1 cement : 3 coarse sand (zone-ill) derived from natural sources :6 graded stone aggregate 20 mm nominal size derived from natural sources) over 75 mm thick bed of dry brick ballast 40 mm nominal size, well rammed and consolidated and grouted with fine sand, including necessary excavation, levelling & dressing & finishing the top smooth.	SQM	72	627.31	18%	740.23	53,296.26
	Plain Cement Concrete						
	Providing and laying in position cement concrete of specified grade including the cost of cantering and shuttering all work for **coping, base slab of storm drains, concrete posts of fencing and other locations** as per detail engineering drawings.						
90.00	**1:2:4** (1 cement : 2 coarse sand (Zone-III) : 4 graded stone aggregate 20 mm nominal size)	CUM	12	5,881.23	18%	6,939.85	83,278.22

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	Providing and laying in position cement concrete of specified grade including the cost of cantering and shuttering all work **under the grade slabs, plinth protections of buildings, brick masonry steps and other locations** as per detail engineering drawings.						
100.00	**1:3:6** (1 cement : 3 coarse sand (Zone-III) : 6 graded stone aggregate 40 mm nominal size)	CUM	4	5,299.00	18%	6,252.82	25,011.28
	Providing and laying in position cement concrete of specified grade including the cost of centering and shuttering all work below all the foundations or as specified in detail drawings.including curing						
110.00	**1:4:8** (1 cement : 4 coarse sand (Zone-III) : 8 graded stone aggregate 40 mm nominal size)	CUM	115	5,051.57	18%	5,960.85	6,85,498.05
	Reinforcement Steel						
120.00	Suppy of Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete - Thermo-Mechanically Treated EQR & HCR bars of grade Fe-500D or more	KG	38000	71.75	18%	84.67	32,17,270.00
	Design Mix Concrete- Substructure						
	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying, **centering, shuttering**, finishing, admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-Charge. This cost is excluding the cost of reinforcement steel. (**Note :** Minimum cement content shall be @ 330 kg/cum.Less cement used as per design mix (if any) will be recoverable separately. No extra payment against extra cement if used shall be payable..).						
130.00	**All works up to plinth level**	CUM	343	7,496.40	18%	8,845.75	30,34,092.94
	Design Mix Concrete- Superstructure						
	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying, **centering, shuttering**, finishing, admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-Charge. This cost is excluding the cost of reinforcement steel. (**Note** : Minimum cement content shall be @ 330 kg/cum.Less cement used as per design mix (if any) will be recoverable separately. No extra payment against extra cement if used shall be payable.).						
140.00	**All works above plinth level**	CUM	85	10,278.81	18%	12,129.00	10,30,964.64
	Brick Masonry						
150.00	Brick work with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 for **drains/below plinth** in: Cement mortar 1:4 (1 cement : 4 coarse sand).	CUM	45	5,495.83	18%	6,485.08	2,91,828.57
10.00	Brick work with non modular **fly ash bricks** conforming to IS:12894, class designation 10 average compressive strength in super structure above plinth level up to floor V level in : Cement mortar 1:4 (1 cement : 4 coarse sand)	CUM	90	6,286.87	18%	7,418.51	6,67,665.59
160.00	Supply and Laying of **Brick bats** of size 80 mm to 40 mm in soak Pit	CUM	40	446.25	18%	526.58	21,063.00
20.00	Providing and laying autoclaved aerated cement blocks masonry with 150mm/230mm/300 mm thick AAC blocks in super structure (Control Room/Electric Room) above plinth level up to floor V level with RCC band at sill level and lintel level with approved block laying polymer modified adhesive mortar all complete as per direction of Engineer-in-Charge. (The payment of RCC band and reinforcement shall be made for seperately). Cement Mortar 1:6 (1 Cement : 6 coarse sand)	CUM	80	5,585.06	18%	6,590.37	5,27,229.66
170.00	Providing and applying white cement based putty of average thickness 1 mm, of approved brand and manufacturer, over the plastered wall surface to prepare the surface even and smooth complete.	SQM	1400	114.06	18%	134.59	1,88,427.12
	Internal Plaster						
180.00	Providing 12 mm cement plaster of mix 1:4 (1 cement: 4 fine sand) complete as per drawing, specifications and direction of EIC.	SQM	850	246.51	18%	290.88	2,47,249.53
	Ceiling Plaster						
190.00	Providing 6 mm cement plaster of mix : 1:3 (1 cement : 3 fine sand) complete as per drawing, specifications and direction of EIC.	SQM	200	202.36	18%	238.78	47,756.96
	External Plaster						
200.00	Providing 18 mm cement plaster in two coats under layer 12 mm thick cement plaster 1:5 (1 cement : 5 coarse sand) and a top layer 6 mm thick cement plaster 1:3 (1 cement : 3 coarse sand) finished complete as per drawing, specifications and direction of EIC.	SQM	700	245.59	18%	289.80	2,02,857.34
	Chicken wire mesh						
210.00	Providing and fixing 150 mm wide chicken wire mesh between junctions of column/beam and walls, fixed with u nails 150 mm center to center before plastering the junction. Chicken wire mesh shall be of diameter 0.6 to 2 mm and mesh size 13 to 50 mm.	SQM	120	241.29	18%	284.72	34,166.66
	Neat punning for drains						

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220.00	Providing neat cement punning on inner side of drains and other areas complete as per drawing, specifications and direction of EIC.	SQM	85	54.27	18%	64.04	5,443.28
	Interior Finishing						
230.00	Applying one coat of water thinnable cement **primer** of approved brand and manufacture on wall surface: Water thinnable cement primer	SQM	850	51.51	18%	60.78	51,664.53
	Wall **painting** with premium acrylic emulsion paint of interior grade, having VOC (Volatile Organic Compound) content less than 50 grams/ litre of approved brand and manufacture, including applying additional coats wherever required to achieve even shade and colour.						
240.00	Two coats	SQM	600	92.90	18%	109.62	65,773.20
	Exterior Finishing						
250.00	Surface preparation, Supply and painting water proofing cement paint of required shade on walls :Two or more coats applied @ 3.84 kg/10 sqm of approved brand.	SQM	1100	78.19	18%	92.26	1,01,490.62
260.00	Painting foundation concrete in contact with soil and ground water with black anti-corrosive bitumastic paint of approved brand and manufacture to give an even shade : Two or more coats.	SQM	0.01	106.70	18%	125.91	1.26
	Granite for counter top						
	Providing and fixing 18 mm thick gang saw cut, mirror polished, premoulded and prepolished, machine cut for kitchen platforms, vanity counters, window sills, facias and similar locations of required size, approved shade, colour and texture laid over 20 mm thick base cement mortar 1:4 (1 cement : 4 coarse sand), joints treated with white cement, mixed with matching pigment, epoxy touch ups, including rubbing, curing, moulding and polishing to edges to give high gloss finish etc. complete at all levels. :						
270.00	Granite of any colour and shade :	SQM	8	3,533.89	18%	4,169.99	33,359.92
	Structural Steel						
280.00	Supplying, fabricating, erecting, placing and fixing in position Structural steel work riveted, bolted or welded in built up sections, trusses and framed work, tubes including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer all complete as per drawings, specifications and directions of the Engineer-in-Charge. (Excluding the cost of concrete work).	Ton (MT)	3	92,719.01	18%	1,09,408.43	3,28,225.30
	Structural Steel Paint						
290.00	Finishing with Deluxe Multi surface paint system for interiors and exteriors using Primer as per manufacturers specifications: Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @ 0.80 ltr/10 sqm of approved brand and manufacture	SQM	250	112.22	18%	132.42	33,104.90
	Foundation Bolts						
300.00	Providing and Fixing of MS Foundation bolts (grade HSFG 8.8 grade bolts or as mentioned in structural drawing) with nececessary nuts and washers of specified sizes, all conforming to relevant Indian Standards and as approved by Engineer-in-charge in column /RCC pedestal / beam at any level including maintaining the accuracy towards line, level & position including making and using the template etc. complete as directed by Engineer In Charge. (Contractor will take due care for its threads and rusting by applying grease and cotton waste.)	KG	60	126.02	18%	148.70	8,922.22
	Chequered Plate & Grating						
310.00	Steel work welded in built up sections/ framed work, including cutting,hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc. as required. In stringers, treads, landings etc. of stair cases, including use of chequered plate/Grating wherever required, all complete	Kg	270	105.06	18%	123.97	33,472.12
	Chain link fencing wire mesh						
	Providing and fixing G.I. chain link fabric fencing of required width in mesh size 50x50 mm including strengthening with 2 mm dia wire or nuts, bolts and washers as required complete as per the direction of the Engineer-in-Charge.						
320.00	Made of G.I. wire of dia. 4 mm, PVC coated to achieve outer dia not less than 5 mm in required colour and shade.	SQM	150	720.21	18%	849.85	1,27,477.17
	Concertina coil fence for Boundary wall						
330.00	Providing and fixing concertina coil fencing with punched tape concertina coil 600 mm dia 10 metre openable length (total length 90 m), having 50 nos rounds per 6 metre length, up to 3 m height of wall with existing angle iron 'Y' shaped placed 2.4m or 3.00 m apart and with 9 horizontal R.B.T. reinforced barbed wire, stud tied with G.I. staples and G.I. clips to retain horizontal, including necessary bolts or G.I. barbed wire tied to angle iron, all complete as per direction of Engineer-in-charge, with reinforced barbed tape(R.B.T.) / Spring core (2.5mm thick) wire of high tensile strength of 165 kg/ sq.mm with tape (0.52 mm thick) and weight 43.478 gm/ metre (cost of M.S. angle, C.C. blocks shall be paid separately)	METRE	135	252.38	18%	297.81	40,204.13
	Kota Stone for staircase and dado						

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340.00	Kota stone slabs 20 mm thick in risers of steps, skirting, dado and pillars laid on 12 mm (average) thick cement mortar 1:3 (1 cement: 3 coarse sand) and jointed with grey cement slurry mixed with pigment to match the shade of the slabs, including rubbing and polishing complete.	SQM	17	1,628.06	18%	1,921.11	32,658.88
	Toilet wall tiles						
350.00	Providing and fixing first quality ceramic glazed wall tiles conforming to IS:15622,Minimum 8 mm thick, of approved make, in all colours, shades except burgundy, bottle green, black of any size as approved by the Engineer-in-Charge, in skirting, risers of steps and dados, over 12 mm thick bed of cement mortar 1:3 (1 cement : 3 coarse sand) and jointing with grey cement slurry @ 3.3 Kg/sq.m., including pointing in white cement mixed with pigment of matching shade complete.	SQM	90	883.32	18%	1,042.32	93,808.58
	Toilet floor tiles						
360.00	Providing and laying Ceramic glazed floor tiles of size 300x300 mm, Minimum 8 mm thick of first quality conforming to IS:15622 of approved make in colours such as White, Ivory, Grey, Fume Red Brown, laid on 20 mm thick cement mortar 1:4 (1 Cement : 4 Coarse sand), jointing with grey cement slurry @ 3.3 Kg/sq.m. including pointing the joints with white cement and matching pigment, etc. complete.	SQM	23	779.12	18%	919.36	21,145.32
	Vitrified floor tiles						
	Providing and laying vitrified tiles in floor & skirting in different sizes,minimum 10 mm thick with water absorption less than 0.08% and conforming to IS: 15622, of approved make, in all colours and shades, laid on 20mm thick cement mortar 1:4 (1 cement : 4 coarse sand), jointing with grey cement slurry @ 3.3 kg/ sqm including grouting the joints with white cement and matching pigments etc., complete						
370.00	Size of Tile 600x600 mm	SQM	150	1,170.91	18%	1,381.67	2,07,251.07
	Vitrified wall tiles						
	Providing and laying Vitrified tiles in different sizes (thickness to be specified by manufacturer), with water absorption less than 0.08 % and conforming to IS:15622, of approved make, in all colours & shade, in skirting, riser of steps, over 12 mm thick bed of cement mortar 1:3 (1 cement: 3 coarse sand), jointing with grey cement slurry @ 3.3 Kg/sq.m. including grouting the joint with white cement & matching pigments etc. complete.						
380.00	Size of Tile 600x600 mm	SQM	35	1,170.91	18%	1,381.67	48,358.58
	Providing and fixing 10 mm thick acid and/or alkali resistant tiles of approved make and colour using acid and/or alkali resisting mortar bedding, and joints filled with acid and/or alkali resisting cement as per IS:4457, complete as per the direction of Engineer-in-Charge.						
	In flooring on a bed of 10 mm thick mortar 1:4 (1 acid proof cement : 4 coarse sand)						
390.00	Acid and alkali resistant tile	SQM	40	1,449.27	18%	1,710.14	68,405.54
	52 mm thick cement concrete flooring						
400.00	52 mm thick cement concrete flooring with concrete hardener topping under layer 40 mm thick cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) and top layer 12 mm thick cement hardener consisting of mix 1:2 (1 cement hardener mix : 2 graded stone aggregate 6 mm nominal size) by volume, hardening compound is mixed @2 litre per 50kg of cement or as per manufacturers specifications. This includes cost of cement slurry, 2 mm thick PVC strip at desired spacing, cost of nosing in steps etc. complete.	SQM	40	818.32	18%	965.62	38,624.70
	Khurras for down comer						
410.00	Making Khurras 45x45 cm with average minimum thickness of 5 cm cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate of 20 mm nominal size) over P.V.C. sheet 1 m x 1 m x 400 micron, finished with 12 mm cement plaster 1:3 (1 cement : 3 coarse sand) and a coat of neat cement, rounding the edges and making and finishing the outlet complete.	EACH	12	213.40	18%	251.81	3,021.74
	Down Comer pipes						
420.00	Providing and fixing on wall face Unplasticised Rigid PVC (UPVC) rainwater pipes conforming to IS:13592 Type-A, including Coupler, Bend, Palin shoe and all fittings, jointing with seal ring conforming to IS:5382, leaving 10 mm gap for thermal expansion: (i) Single socketed pipes : 110 mm diameter	METRE	65	551.88	18%	651.22	42,329.20

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	Champering/gola						
	Supply and Construction of a chase of (champering/gola) 75x75 mm in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 stone aggregate 10 mm and down gauge), including finishing with cement mortar 1:3 (1 cement : 3 fine sand) as per standard design at the joint of parapet and RCC roof slab :						
430.00	In 75x75 mm deep chase	METRE	52	240.07	18%	283.28	14,730.70
	Road paving subgrade compaction						
440.00	Preparation and consolidation of sub-grade with power road roller of 8 to 12 tonne capacity after excavating earth to an average of 22.5 cm depth, dressing to camber and consolidating with road roller including making good the undulations etc. and re-rolling the sub grade and disposal of surplus earth outside the property boundary in the un-disputed areas as directed by Engineer-In-Charge.	SQM	350	144.41	18%	170.40	59,641.33
	Road paving grade -WMM						
450.00	Providing, laying, spreading and compacting graded stone aggregate (size range 53 mm to 0.075 mm) to wet mix macadam (WMM) specification including premixing the material with water at OMC in for all leads & lifts, laying in uniform layers with mechanical paverfinisher in sub- base / base course on well prepared surface and compacting with vibratory roller of 8 to 10 tonne capacity to achievethe desired density, complete as per specifications and directions of Engineer-in-Charge. 3Layers of 75mm thickness each.	CUM	77	2,110.04	18%	2,489.85	1,91,718.23
	Joint Ceiling						
460.00	Providing and laying in position **bitumen hot sealing compound** for expansion joints etc. Using grade 'A' sealing compound. (RATE FOR JOINT OF 10MM DEPTH, 10MM WIDTH PER M LENGTH)	METRE	11	25.76	18%	30.40	334.36
	Paver block paving						
	Providing and laying factory made chamfered edge Cement Concrete paver blocks In foot path, park & lawns driveway or light & traffic parking etc. of required strength, thickness & size/ shape, made by table vibratory method using PU mould, laid in required colour & pattern over 50mm thick compacted bed of course sand, compacting and proper embedding/laying of inter locking paver blocks into the sand bedding layer through vibratory compaction by using plate vibrator, filling the joints with sand and cutting of paver blocks as per required size and pattern, finishing and sweeping extra sand, all complete as per manufacturer's specifications & direction of the Engineer-in-Charge.						
470.00	**60mm thick Cement Concrete paver block of M-35 grade with approved colour, design & pattern.**	SQM	450	745.04	18%	879.15	3,95,616.24
	Supply & laying the same factory made chamfered edge Cement Concrete paver blocks In foot path, park & lawns driveway or light & traffic parking etc. of required strength, thickness & size/ shape, made by table vibratory method using PU mould, laid in required colour & pattern over 50mm thick compacted bed of course sand, compacting and proper embedding/laying of inter locking paver blocks into the sand bedding layer through vibratory compaction by using plate vibrator, filling the joints with sand and cutting of paver blocks as per required size and pattern, finishing and sweeping extra sand, all complete as per manufacturer's specifications & direction of the Engineer-in-Charge.						
480.00	**80mm thick Cement Concrete paver block of M-40 grade with approved colour, design & pattern.**	SQM	900	831.70	18%	981.41	8,83,265.40
	Granular sub-base (GSB)						

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	Construction of granular sub-base (GSB) by providing close graded Material conforming to specifications, mixing in a mechanical mix plant at OMC, carriage of mixed material by tippers to work site, for all leads & lifts, spreading in uniform layers of specified thickness with motor grader on prepared surface and compacting with vibratory power roller to achieve the desired density, complete as per specifications and directions of Engineer-in-Charge						
490.00	With material conforming to Grade-II (size range 53 mm to 0.075 mm) having CBR Value-25	CUM	200	2,102.68	18%	2,481.16	4,96,232.48
	Dry Lean Cement Concrete (DLC)						
500.00	Construction of dry lean cement concrete sub base over a prepared sub- grade with coarse and fine aggregate conforming to IS:383, the size of coarse aggregate not exceeding 25 mm, aggregate cement ratio not to exceed 15:1, aggregate gradation after blending to be as per specifications, cement content not to be less than 150 Kg/cum, optimum moisture content to be determined during trial length construction, concrete strength not to be less than 10 Mpa at 7 days, mixed in a batching plant, transported to site, for all leads & lifts, laid with a mechanical paver, compacting with 8-10 tonne vibratory roller, finishing and curing etc. complete as per direction of Engineer-in-charge.	CUM	3	3,526.35	18%	4,161.10	12,483.29
	CONCRETE PAVEMENTS						
	Providing and laying design mix cement concrete of M-30 grade, in roads/ taxi tracks/ runways, using cement content as per design mix, using coarse sand and graded stone aggregate of 40 mm nominal size in appropriate proportions as per approved & specified design criteria, providing dowel bars with sleeve/ tie bars wherever required, laying at site, spreading and compacting mechanically by using needle and surface vibrators, levelling to required slope/ camber, finishing with required texture, including steel form work with sturdy M.S. channel sections, curing, making provision for contraction/ expansion, construction & longitudinal joints (10 mm wide x 50 mm deep) by groove cutting machine, providing and filling joints with approved joint filler and sealants, complete all as per direction of Engineer-in-charge (Item of joint fillers, sealants, dowel bars with sleeve/ tie bars to be paid separately).						
510.00	Cement concrete prepared with batch mixing machine	CUM	10	8,949.95	18%	10,560.94	1,05,609.38
	RUNWAY MARKING						
	Painting runway/taxi track/apron marking with adequate nos of coats to give uniform finish with road marking paint of superior make as approved by the Engineer-in-charge, including cleaning the surface of ail dirt, scales, oil, grease and other foreign material etc. and lining out complete.						
520.00	New work (Two or more coats)	SQM	30	159.97	18%	188.76	5,662.94
	Kerb Stone						
530.00	Providing and laying at or near ground level factory made kerb stone of M-25 grade cement concrete in position to the required line, leve and curvature, jointed with cement mortar 1:3 (1 cement: 3 coarse sand), including making joints with or without grooves (thickness of joints except at sharp curve shall not to more than 5mm), including making drainage opening wherever required complete etc. as per direction of Engineer-in-charge (length of finished kerb edging shall be measured for payment). (Precast C.C. kerb stone shall be approved by Engineer-in-charge).	Cum	12	6,878.30	18%	8,116.39	97,396.73
	Plumbing & Sanitory Pipes						
	32 mm OD pipe						
540.00	Providing and fixing Polyethelene-Aluminium-Polyethelene (PE-AL-PE) Composite Pressure Pipes conforming to IS-15450, U.V. stabilized with carbon black having thermal stability for hot & cold water supply, capable to withstand temperature up to 80°C, including all special fittings of composite material (engineering plastic blend and brass inserts wherever required) e.g. elbows, tees, reducers, couplers & connectors etc., with clamps at 1.00 metre spacing. This includes testing of joints complete as per direction of the Engineer-in-Charge.	METRE	30	437.84	18%	516.65	15,499.54
	25 mm OD pipe						
550.00	Providing and fixing Polyethelene-Aluminium-Polyethelene (PE-AL-PE) Composite Pressure Pipes conforming to IS-15450, U.V. stabilized with carbon black having thermal stability for hot & cold water supply, capable to withstand temperature up to 80°C, including all special fittings of composite material (engineering plastic blend and brass inserts wherever required) e.g. elbows, tees, reducers, couplers & connectors etc., with clamps at 1.00 metre spacing. This includes testing of joints complete as per direction of the Engineer-in-Charge.	METRE	20	356.58	18%	420.76	8,415.29

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	15 mm nominal outer dia pipes Concealed work, including cutting chases and making good the walls etc.						
560.00	Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply, including all CPVC plain & brass threaded fittings, i/c fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step CPVC solvent cement and the cost of cutting chases and making good the same including testing of joints complete as per direction of the Engineer-In-Charge.	METRE	50	412.99	18%	487.33	24,366.41
	External Work : Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply including all CPVC plain & brass threaded fittings This includes jointing of pipes & fittings with one step CPVC solvent cement, trenching, refilling & testing of joints complete as per direction of the Engineer-In-Charge. a) 150 mm nominal outer dia pipes						
570.00	**150 mm nominal outer dia pipes**	METRE	50	5,613.50	18%	6,623.93	3,31,196.50
	Circular Tank						
580.00	Providing and placing on terrace (at all floor levels) polyethylene water storage tank (Ref. Make: SINTEX or approved equivalent), IS:12701 marked, with cover and suitable locking arrangement and making necessary holes for inlet, outlet and overflow pipes but without fittings and the base support for tank.	PER LITRE	1000	8.61	18%	10.16	10,159.80
	Gate Valve						
590.00	Providing and fixing gun metal gate valve with C.I. wheel of approved quality (screwed end) : 32 mm nominal bore	EACH	5	490.42	18%	578.70	2,893.48
	Gate Valve						
600.00	Providing and fixing gun metal gate valve with C.I. wheel of approved quality (screwed end) : 25 mm nominal bore	EACH	5	442.62	18%	522.29	2,611.46
	Bib Cock						
610.00	Providing and fixing C.P. brass long nose bib cock of approved quality conforming to IS standards and weighing not less than 810 gms. : 15 mm nominal bore	EACH	10	252.38	18%	297.81	2,978.08
	W.C. pan with ISI marked white solid plastic seat and lid.						
620.00	Providing and fixing white vitreous china Wall mounted water closet of size 780 x 370x690 mm (European type W.C. pan) with seat and lid, 10 litre low level white P.V.C. flushing cistern, including flush pipe, with manually controlled device (handle lever), conforming to IS:7231, with all fittings and fixtures complete, including cutting and making good the walls and floors wherever required : W.C. pan with ISI marked white solid plastic seat and lid.	EACH	2	8,236.70	18%	9,719.31	19,438.61
	Urinal basin						
630.00	Providing and fixing white vitreous china flat back or wall corner type lipped front urinal basin of 430x260x350 mm and 340x410x265 mm sizes respectively with manual flushing cistern with standard flush pipe and C.P. brass spreaders with brass unions and G.I clamps complete, including painting of fittings and brackets, cutting and making good the walls and floors wherever required :One urinal basin.	EACH	1	4,461.55	18%	5,264.63	5,264.63
640.00	15 mm C.P. brass tap	EACH	2	105.16	18%	124.09	248.18
650.00	Providing and fixing PVC NAHANI TRAP of approved quality & make and as per the direction of Engineer-in-charge.	EACH	2	258.11	18%	304.57	609.14
	White Vitreous China Flat back wash basin size 550x400 mm with single 15 mm C.P. brass pillar tap						

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660.00	Providing and fixing wash basin with C.I. brackets, 15 mm C.P. brass pillar taps, 32 mm C.P. brass waste of standard pattern, including painting of fittings and brackets, cutting and making good the walls wherever require : White Vitreous China Flat back wash basin size 550x400 mm with single 15 mm C.P. brass pillar tap	EACH	2	633.82	18%	747.91	1,495.82
	Waste Pipe						
	Providing and fixing P.V.C. waste pipe for sink or wash basin including P.V.C. waste fittings complete :						
670.00	Flexible Pipe : 32 mm diameter	EACH	5	86.04	18%	101.53	507.64
	Mirror						
680.00	Providing and fixing 600x450 mm beveled edge mirror of superior glass (of approved quality) complete with 6 mm thick hard board ground fixed to wooden cleats with C.P. brass screws and washers complete.	EACH	4	1,209.31	18%	1,426.99	5,707.94
	Providing and fixing toilet paper holder :						
690.00	C.P. Brass (Ref. Make: JAQUAR, Model: Cat. No.-1151 or approved equivalent).	EACH	2	651.02	18%	768.20	1,536.41
	Bib Cock (approved MAKE) 15 MM DIA						
700.00	Providing and fixing C.P. brass bib cock of approved quality conforming to IS:8931 : including cutting & making good the walls wherever required, etc. complete in all respects inclusive of cost of all materials, labour, tools, tackles etc. as per specifications and directions of the Engineer-in-Charge. : Bib Cock (approved MAKE) 15 MM DIA	EACH	2	360.40	18%	425.27	850.54
	Angle Valve (approved make) 15 MM DIA						
710.00	Providing and fixing C.P. brass angle valve for of approved quality conforming to IS:8931 including cutting & making good the walls wherever required, etc. complete in all respects inclusive of cost of all materials, labour, tools, tackles etc. as per specifications and directions of the Engineer-in-Charge. : Angle Valve (approved make) 15 MM DIA	EACH	2	488.16	18%	576.02	1,152.05
	Soap Dish Holder						
720.00	Providing and fixing the following washroom fittings, complete in all respects; inclusive of cost of all materials, labour, tools, tackles etc. as per specifications and directions of the Engineer-in-Charge. : Providing and fixing PTMT soap Dish Holder having length of 138mm, breadth 102mm, height of 75mm with concealed fitting arrangements, weighing not less than 106 gms.	EACH	2	94.73	18%	111.78	223.57
	Stoneware Pipes						
730.00	Providing, laying and jointing glazed stoneware pipes Class SP-1 with stiff mixture of cement mortar in the proportion of 1:1 (1 cement : 1 fine sand) including testing of joints etc. complete : a) 150 mm diameter	METRE	22	491.38	18%	579.83	12,756.22
	Gully Trap						
740.00	Providing and fixing square-mouth S.W. gully trap class SP-1 complete with C.I. grating brick masonry chamber with water tight C.I. cover with frame of 300x300 mm size (inside) the weight of cover to be not less than 4.50 kg and frame to be not less than 2.70 kg as per standard design : a) 100x100 mm size P-type : With common burnt clay F.P.S. (Non-modular) bricks of class designation 7.5	EACH	2	2,055.35	18%	2,425.31	4,850.63
	150 mm dia. R.C.C. pipe						

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750.00	Providing and laying non-pressure NP-2 class (light duty) R.C.C. pipes with collars jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement : 2 fine sand) including testing of joints etc. complete :	METRE	20	472.98	18%	558.12	11,162.39
	300 mm dia. R.C.C. pipe						
760.00	Providing and laying non-pressure NP-2 class (light duty) R.C.C. pipes with collars jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement : 2 fine sand) including testing of joints etc. complete :	METRE	30	830.58	18%	980.08	29,402.53
	C.I. inspection chamber						
	Constructing brick masonry chamber for underground C.I. inspection chamber and bends with bricks in cement mortar 1:4 (1 cement : 4 coarse sand) C.I. cover with frame (light duty) 455x610 mm internal dimensions, total weight of cover with frame to be not less than 38 kg (weight of cover 23 Kg and weight of frame 15 Kg), R.C.C. top slab with 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size), foundation concrete 1:5:10 (1 cement : 5 coarse sand (Zone-III) : 10 graded stone aggregate 40 mm nominal size), inside plastering 12 mm thick with cement mortar 1:3 (1 cement : 3 coarse sand), finished smooth with a floating coat of neat cement on walls and bed concrete etc. complete as per standard design :						
770.00	With non modular fly ash bricks conforming to IS:12894, class designation 10	EACH	2	5,452.60	18%	6,434.07	12,868.14
780.00	Providing and fixing trap of self cleansing design with screwed down or hinged grating with or without vent arm complete, including cost of cutting and making good the walls and floors as per drawings, specifications and directions of the Engineer-in-Charge. 100 mm inlet and 100 mm outlet-Sand Cast Iron S&S as per IS: 1729	EACH	2	1,495.64	18%	1,764.86	3,529.71
	DOOR, WINDOW AND VANTILATORS						
	Aluminium sections for frame and shutters						
	Providing and fixing aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS:733 and IS:1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of the Engineer-In-Charge. (Glazing, paneling and dash fasteners to be paid for separately) : For fixed portion :						
790.00	Anodised aluminium (anodised transparent or dyed to required shade according to IS: 1868, Minimum anodic coating of grade AC 15)	KG	217	338.49	18%	399.42	86,673.75
	Aluminium door shutters						
	Providing and fixing aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS:733 and IS:1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of the Engineer-In-Charge. (Glazing, paneling and dash fasteners to be paid for separately) : For shutters of doors, windows & ventilators including providing and fixing hinges/ pivots and making provision for fixing of fittings wherever required including the cost of EPDM rubber/ neoprene gasket required. (Fittings shall be paid for separately) :						

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800.00	**Anodised aluminium (anodised transparent or dyed to required shade according to IS: 1868, Minimum anodic coating of grade AC 15)**	KG	266	489.34	18%	577.42	1,53,594.04
	Pre-laminated particle board with decorative lamination on both sides						
810.00	Providing and fixing 12 mm thick prelaminated particle board flat pressed three layer or graded wood particle board conforming to IS: 12823 Grade l Type ll, in panelling fixed in aluminum doors, windows shutters and partition frames with C.P. brass / stainless steel screws etc. complete as per architectural drawings and directions of engineer- in-charge.	SQM	23	759.76	18%	896.52	20,619.89
	Glazing for doors, window and ventilators						
	Providing and fixing glazing in aluminium door, window, ventilator shutters and partitions etc. with EPDM rubber/ neoprene gasket etc. complete as per the architectural drawings and the directions of Engineer-In-Charge. (Cost of aluminium snap beading shall be paid in basic item) :						
820.00	**With toughened glass panes of 5.0 mm thickness (Weight not less than 12.5 kg/sqm.)**	SQM	22	1,058.70	18%	1,249.27	27,483.85
	Providing and fixing aluminium tubular handle bar 32 mm outer dia, 3.0 mm thick & 100 mm long with SS screws etc .complete as per direction of the Engineer-In-Charge.						
830.00	Anodized (AC 15) aluminium tubular handle bar	EACH	32	409.32	18%	483.00	15,455.92
840.00	Providing and fixing 100 mm x10mm bright finished brass **tower bolts** (best make of approved quality) for aluminium doors including necessary cutting and making good etc. complete.	EACH	16	128.77	18%	151.95	2,431.18
850.00	Providing and fixing chromium plated brass 100 mm **mortice latch and lock** with 6 levers and a pair of lever handles of approved quality with necessary screws etc. complete.	EACH	6	848.60	18%	1,001.35	6,008.07
860.00	Providing and fixing bright finished brass casement window fastener with necessary screws etc. complete.	EACH	8	61.63	18%	72.72	581.79
	Hydraulic Floor Spring						
	Providing and fixing double action hydraulic floor spring of approved brand and manufacture conforming to IS:6315, having brand logo embossed on the body/ plate with double spring mechanism and door weight up to 125 Kg, for doors, including cost of cutting floors, embedding in floors as required and making good the same matching to the existing floor finishing and cover plates with brass pivot and single piece M.S. sheet outer box with slide plate etc. complete as per the direction of Engineer-In-Charge. :						
870.00	With stainless steel cover plate minimum 1.25 mm thickness	EACH	10	2,249.31	18%	2,654.19	26,541.86
	Sun Control film						
880.00	Providing and fixing, on fixed glazing/ doors/ window panes, sun control film "HP NATURAL 35 SAFETY COMBINATION FILM-4Mil" of M/s. GARWARE or approved equivalent make and shade, all complete as per manufacturer's specification and as per instructions of the Engineer-in-Charge.	SQM	50	2,818.61	18%	3,325.96	1,66,297.99

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890.00	Providing and fixing mineral fibre false ceiling tiles at all heights of size 595X595mm of approved texture, design and pattern. The tiles should have Humidity Resistance (RH)a of 99%, Light Reflectance > 85%, Thermal Conductivity k = 0.052 - 0.057 w/m K, Fire Performance as per (BS 476 pt - 6 &7)in true horizontal level suspended on interlocking T-Grid of hot dipped all round galvanized iron section of 0.33 mm thick (galvanized @120 gsm) comprising of main T runners of 15x32 mm of length 3000 mm, cross T of size 15x32mm of length 1200 mm and secondary intermediate cross T of size 15x32 mm of length 600 mm to form grid module of size 600x600 mm suspended from ceiling using galvanized mild steel item (galvanised@80gsm) 50 mm long 8mm outer diameter M-6 dash fasteners, 6 mm diameter fully threaded hanger rod up to 1000 mm length and L-shape level adjuster of size 85x25x2 mm, spaced at 1200 mm centre to centre along main 'T'. The system should rest on periphery walls /partitions with the help of GI perimeter wall angle of size24x24X3000 mm made of 0.40 mm thick sheet, to be fixed to the wall with help of plastic rawl plug at 450 mm centre to centre & 40 mm long dry wall S.S. screws. The exposed bottom portion of all T-sections used in false ceiling support system shall be pre-painted with polyester baked paint, for all heights. The work shall be carried out as per specifications, drawings and as per directions of the engineer-incharge. (Note: Measurement shall be made wall to wall without any deduction for openings, for payment purpose). With 16 mm thick beveled tegular mineral fibre false ceiling tile (NRC 0.55 to 0.6)	SQM	150	2,028.79	18%	2,393.97	3,59,095.83
	Providing and fixing tiled false ceiling of specified materials of size 595x595 mm in true horizontal level, suspended on inter locking metal grid of hot dipped galvanized steel sections (galvanized @ 120 grams/sq.m., both side inclusive) consisting of main 'T' runner with suitably spaced joints to get required length and of size 24x38 mm made from 0.30 mm thick (minimum) sheet, spaced at 1200 mm center to center and cross 'T' of size 24x25 mm made of 0.30 mm thick (minimum) sheet, 1200 mm long spaced between main 'T' at 600 mm center to center to form a grid of 1200x600 mm and secondary cross 'T' of length 600 mm and size 24x25 mm made of 0.30 mm thick (minimum) sheet to be interlocked at middle of the 1200x600 mm panel to form grids of 600x600 mm and wall angle of size 24x24x0.3 mm and laying false ceiling tiles of approved texture in the grid including, required cutting/ making, opening for services like diffusers, grills, light fittings, fixtures, smoke detectors etc. Main 'T' runners to be suspended from ceiling using G.I. slotted cleats of size 27x37x25x1.6 mm fixed to ceiling with 12.5 mm dia. and 50 mm long dash fasteners, 4 mm G.I. adjustable rods with galvanised butterfly level clips of size 85x30x0.8 mm spaced at 1200 mm center to center along main 'T', bottom exposed width of 24 mm of all 'T'-sections shall be pre-painted with polyester paint, all complete for all heights as per specifications, drawings and as directed by the Engineer-in-Charge :						
900.00	G.I. Metal Ceiling Lay in plain Tegular edge Global white color tiles of size 595x595 mm, and 0.5 mm thick with 8 mm drop; made of G.I. sheet having galvanizing of 100 gms/sq.m. (both sides inclusive) and electro-statically polyester powder coated of thickness 60 microns (minimum), including factory painted after bending.	SQM	10	1,520.96	18%	1,794.73	17,947.33
	ROOF WATERPROOFING						
	Providing and laying APP (Atactic Polypropylene Polymer) modified prefabricated five layer, 3 mm thick water proofing membrane, black finished reinforced with non-woven polyester matt consisting of a coat of bitumen primer for bitumen membrane @ 0.40 litre/sqm by the same membrane manufacture of density at 25°C, 0.87-0.89 kg/ litre and viscocity 70-160 cps. Over the primer coat the layer of membrane shall be laid using Butane Torch and sealing all joints etc, and preparing the surface complete. The vital physical and chemical parameters of the membrane shall be as under : (a) Joint strength in longitudinal and transverse direction at 23°C as 650/450N/5cm. (b) Tear strength in longitudinal and transverse direction as 300/250N. (c) Softening point of membrane not less than 150°C. (d) Cold flexibility shall be up to -2°C when tested in accordance with ASTM, D-5147. The laying of membrane shall be got done through the authorised applicator of the manufacturer of membrane :						
910.00	3 mm thick	SQM	150	426.79	18%	503.61	75,541.83
	Clay tiles for terrace						
920.00	Providing and laying pressed clay tiles (as per approved pattern 20mm nominal thickness of approved size) on roofs jointed with cement mortar 1:4 (1 cement : 4 coarse sand) mixed with 2% integral water proofing compound, laid over a bed of 20 mm thick cement mortar 1:4 (1 cement : 4 coarse sand) and finished neat complete.	SQM	150	495.78	18%	585.02	87,753.06
	Stone Boulders (Filter media)						
930.00	Supplying, filling, spreading & leveling stone boulders of size range 5 cm to 20 cm, Gravels of 5mm to 10mm and coarse sand of size range 1.5mm to 2mm (each in equal quantity) in recharge pits and required size gravel in the borewell, in the required thickness, for all leads & lifts, all complete as per detail drawing and direction of the Engineer-In-Charge.	CUM	11	1,122.16	18%	1,324.15	14,565.64
	Grouting						

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940.00	Providing and injecting approved grout in proportion recommended by the manufacturer into cracks/honey-comb area of concrete/ masonry by suitable gun/pump at required pressure including cutting of nipples after curing etc. complete as per directions of Engineer-in-Charge. (The payment shall be made on the basis of actual weight of approved grout injected.) 26.35.1 Stirrer mixed Acrylic Polymer of approved make @ 2% of weight of cement used) modified Cement slurry made with non shrink compound in concrete/RCC work (Note: This item shall be operated under specific instruction of the Engineer-in-Charge.)	KG	11	101.41	18%	119.66	1,316.24
	Weep holes						
950.00	Providing and fixing of U-PVC pipes (working pressure 4 kg / cm²) Single socketed pipe 75 mm dia in weep holes.	METRE	11	460.32	18%	543.18	5,974.95
	RCC Manhole						
960.00	Supply and fixing in position precast RCC manhole cover and rectangular shape 600x450mm (internal clear dimensions) all completed along with associated works as per approved drawing, Technical specification and direction of Engineer-In-Charge.	EACH	2	1,222.00	18%	1,441.96	2,883.93
970.00	Providing M.S. foot rests including fixing in manholes with 20x20x10 cm cement concrete blocks 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size) as per standard design/ all completed along with associated works as per approved drawing, Technical specification and direction of Engineer-In-Charge.: With 20 mm diameter round bar	EACH	20	386.32	18%	455.86	9,117.15
	Precast Concrete Cover						
980.00	Providing and placing in position 100 mm thick factory made machine batched & machine mixed Precast RCC Rectangular Covers on drains, SS trench of various sizes, of M-25 grade cement concrete for RCC work, including cost of centering, shuttering, reinforcement of 8 mm dia TMT bars of Fe 500 grade @ maximum 100mm c/c on both ways , neat cement punning on finished surface, properly encased on all edges with 1.6 mm thick , 100 mm wide MS sheet duly painted over priming coat , reinforcement to be welded at edges with MS sheet and providing 2 Nos. 12 mm dia bar for hooks etc i/c cost of cartage, all leads & lift, handling at site etc. all complete as per direction of Engineer-in-Charge.	SQM	50	1,969.30	18%	2,323.77	1,16,188.70
	Bore well						
990.00	Supplying, providing, installation, boring/drilling, testing & commissioning of bore well of required dia by suitable method prescribed in IS:2800 (Part-I) including casing/ strainer pipe, collecting samples from different strata, preparing and submitting strata chart/ bore log, including hire & running charges of all equipment, tools, plants & machineries required for the job, all complete as per direction of the Engineer-In-Charge, drilling 300mm dia bore up to 50 metre depth below ground level, providing and installation of unplasticized PVC medium well casing (CM) pipe of 150mm dia and unplasticized PVC medium well screen (RMS) pipes of 150mm dia with ribs conforming to IS: 12818 , PVC inlet and Outlet pipes of 25mm diameter.	metre	500	466.34	18%	550.28	2,75,140.60
1000.00	Supply, installation, testing and fixing of Single phase, 5.0 HP sub-mersible pump-cum motor of approved make capable of delivering 300 Litre Per Minute (LPM) to required head with starter, wiring (3 core X2.5 Cu flat cable-60m) from starter to motor and incoming feeder to starter i.e. spot welded plate for borewell top, M.S clamps at top of casing/housing pipe, Bail plug/bottom plug, complete in all respects inclusive of cost of all labour, materials, tools, tackles, etc. as per drawings, specifications and directions of the Engineer-in-Charge.	EACH	1	1,50,000.00	18%	1,77,000.00	1,77,000.00
	LANDSCAPING						
1010.00	**Supplying and mixing of good earth** and sludge in (80:20 ratio) at site and spreading in required thickness as per direction on Engineer-in-charge or as per drawings including royalty and carriage up to 5 km lead complete.	CUM	15	529.56	18%	624.88	9,373.21
1020.00	Providing & laying Selection no. 1 grass turf with earth 50mm to 60mm thickness of existing ground prepared with proper level and ramming with required tools wooden and than rolling the surface with light roller make the surface smoothen and light watering the same maintenance for 30 days or more till the grass establish properly,as per direction of officer in charge	SQM	50	75.23	18%	88.77	4,438.57
	Bore well For Percolation Pit						

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	Boring/ drilling bore well of required dia for casing/ strainer pipe, by suitable method prescribed in IS:2800 (Part-I), including collecting samples from different strata, preparing and submitting strata chart/ bore log, including hire & running charges of all equipment, tools, plants & machineries required for the job, all complete as per direction of the Engineer-In-Charge, up to 90 metre depth below ground level.						
1030.00	300 mm nominal size diameter	METRE	50	466.34	18%	550.28	27,514.06
	Supplying, assembling, lowering and fixing in vertical position in bore well, Un-plasticized PVC medium well casing (CM) pipe of required dia, conforming to IS:12818, including required hire and labour charges, fittings & accessories etc. all complete, for all depths, as per direction of the Engineer-In-Charge. Pipe Shall be Slotted as per detail engineering drawing requirement.						
1040.00	150 mm nominal size diameter	METRE	5	567.47	18%	669.61	3,348.07
	Dry Stone Pitching						
1050.00	Providing and laying of 225mm thick dry rubble stone soling under foundations PCC or wherever required as per direction of Engineer-In-Charge and drawings including hand packing, filling the interstices with chips, spalls and binding with grit and selected murrum/coarse sand, watering, compaction by hand ramming etc. complete in all respect all completed along with associated works as per approved drawing, Technical specification and direction of Engineer-In-Charge. (Boulders of size 100mm to 150mm size shall be provided)	SQM	1223	597.28	18%	704.79	8,61,958.66
	Boring, providing and installation bored cast-in-situ reinforced cement **concrete piles** of grade M-25 of specified diameter and length below the pile cap, to carry a safe working load not less than specified, excluding the cost of steel reinforcement but including the cost of boring with bentonite solution and temporary casing of appropriate length for setting out and removal of same and the length of the pile to be embedded in the pile cap etc. by percussion drilling using Direct mud circulation (DMC) or Bailer and chisel technique by tripod and mechanical Winch Machine all complete, including removal of excavated earth with all its lifts and leads [**Notes:** (1) Length of pile for payment shall be measured up to bottom of pile cap. (2) Truck Mounted rotary/ TMR/ Tubewell boring machine shall not be used] :						
1060.00	450 mm diameter piles	METRE	0.1	1,882.75	18%	2,221.65	222.16
	Vertical load testing of piles in accordance with IS:2911 (Part-IV) including installation of loading platform by Kentledge/ Anchor piles method and preparation of pile head or construction of test cap and dismantling of test cap after test etc. complete as per specification & the direction of the Engineer-In-Charge. [**Notes :** (1) Initial and Routine Load Test shall not be carried out by Dynamic method of testing. (2) Testing agency shall submitt the design of loading platform for the approval of the Engineer-In-Charge.] :						
1070.00	Initial Test (Test Load 2.5 times the Safe Capacity)	PER TEST	1	45,393.23	18%	53,564.01	53,564.01
	Vertical load testing of piles in accordance with IS:2911 (Part-IV) including installation of loading platform by Kentledge/ Anchor piles method and preparation of pile head or construction of test cap and dismantling of test cap after test etc. complete as per specification & the direction of the Engineer-In-Charge. [**Notes :** (1) Initial and Routine Load Test shall not be carried out by Dynamic method of testing. (2) Testing agency shall submitt the design of loading platform for the approval of the Engineer-In-Charge.] :						
1080.00	Routine Test (Test Load 1.5 times the Safe Capacity)	PER TEST	1	17,022.95	18%	20,087.08	20,087.08
	GI ROOFING SHEETS						
1090.00	Providing and fixing precoated galvanised iron profile sheets (size, shape and pitch of corrugation as approved by Engineer-in-charge) 0.50 mm (+ 0.05 %) total coated thickness with zinc coating 120 grams per sqm as per IS: 277, in 240 mpa steel grade, 5-7 microns epoxy primer on both side of the sheet and polyester top coat 15-18 microns. Sheet should have protective guard film of 25 microns minimum to avoid scratches during transportation and should be supplied in single length upto 12 metre or as desired by Engineerin- charge. The sheet shall be fixed using self drilling /self tapping screws of size (5.5x 55 mm) with EPDM seal, complete upto any pitch in horizontal/ vertical or curved surfaces, excluding the cost of purlins, rafters and trusses and including cutting to size and shape wherever required.	METRE	150	656.57	18%	774.75	1,16,212.89
	Partition panels						
1100.00	Providing and laying Gypsum panel partitions 100 mm thick with water proof Gypsum panels of size 666x500x100 mm, made of calcite phosphor Gypsum fixed with tongue and groove edges and jointed with bonding plaster as per manufacturer's specifications in superstructure above plinth level up to floor V level. Gypsum blocks will have a minimum compressive strength of 9.3 kg/cm 2	SQM	66	870.06	18%	1,026.67	67,760.27
B	**MISC. WORKS**						

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	FLEX FOR SIGNAGES						
1110.00	SUPPLYING FLEX, FABRICATING, TRANSPORTING, ERECTING, ETC. ON SITE/SHOP AS PER SPECIFICATIONS AND DRAWING**- FLEX FOR SIGNAGES WHEREVER REQUIRED FOR BRANDING.**	SQFT	230	445.00	18%	525.10	1,20,773.00
1120.00							
1130.00	SUPPLY AND INSTALLATION OF MANDATORY SIGNS MADE OF 3 MM ACM SHEET AND PRINTED ON ECO VINYL SHEET 450X300 MM. DETAIL SPECIFICATION AS GIVEN IN THE TENDER DOCUMENT.	Each	29	2,325.00	18%	2,743.50	79,561.50
1140.00	Supply and installation of Aluminum composite panel board all support structural/fixtures at all heights painted with two coats of first quality synthetic enamel paint over two coats of Zinc phosphate primer of approved make, concrete grouting in 1:2:4, wherever required complete in all aspects as per following specifications, size, shape and as directed by In-Charge. Board Material : Aluminum composite panel (Alucobond, Alpolic, Renybond 3mm/ 0.3 mm thick PVDF coated French Blue No. 166 (IS -5) Lettering : 3M vinyl 3630 series Border : L pipe, Aluminum ; Powder coated Laminate : 3M 8519 series laminate film Note: The matter/drawing to be printed shall be provided in soft form as Doc/ PDF/Dwg file. Conversion required if any for making the files printable shall be in vendor's scope.	SM	12	3,720.00	18%	4,389.60	52,675.20
	Internal Signage Boards						
1150.00	SUPPLY AND INSTALLATION OF MANDATORY SIGNS MADE OF 3 MM ACM SHEET AND PRINTED ON ECO VINYL SHEET 300x100 MM. DETAIL SPECIFICATION AS GIVEN IN THE TENDER	EA	10	1,860.00	18%	2,194.80	21,948.00
	INTERIOR WORKS						
1160.00	**High Back chair with head rest (for GA in charge, confereance room)** Supply of High Back chair with adjustable head rest. The seat size shall be 485mm (W) x 460mm (D), The back heightshall be mm 710mm and overall height- 1160mm . The seat shall be made of hot pressed 15mm thick moulded ply and upholstered with Urethane foam Foam density 40kg/m3 & net fabric tapestry. The Back is made of polyproplene outer side and upholstered with nett or breathable mesh with cushioned support. The armrests are made of polyproplene and mechanism shall be knee tilt with four point locking. The pneumatic height adjustment shall have an adjustment of 63mm in BIFMA Standard class 3..Pedestal is made of injection moulded black nylon fitted with 5 nos. twin wheels castors which are made of injection moulded black nylon 30% glass filled and nylon base is load tested capacity -1150 kg in BIFMA standard. All material shall be supplied inline with the sample approved by Engineer in charge.	EA	1	15,300.00	18%	18,054.00	18,054.00
1170.00	**High Back chair without head rest (for manager, confereance room)** Supply of High Back chair. The seat size shall be 485mm (W) x 460mm (D), The back heightshall be mm 710mm and overall height- 1160mm . The seat shall be made of hot pressed 15mm thick moulded ply and upholstered with Urethane foam Foam density 40kg/m3 & net fabric tapestry. The Back is made of polyproplene outer side and upholstered with nett or breathable mesh with cushioned support. Thearmrests are made of polyproplene and mechanism shall be knee tilt with four point locking. The pneumatic height adjustment shall have an adjustment of 63mm in BIFMA Standard class 3..Pedestal is made of injection moulded black nylon fitted with 5 nos. twin wheels castors which are made of injection moulded black nylon 30% glass filled and nylon base is load tested capacity -1150 kg in BIFMA standard. All material shall be supplied inline with the sample approved by Engineer in charge.	EA	5	13,500.00	18%	15,930.00	79,650.00
1180.00	**Medium Back chair (for office room, reception, security room, outsider meeting room, sales room)** Medium Back chair. The seat size shall be 485mm (W) x 460mm (D), The back height shall be mm 560mm and overall height- 1000mm . The seat shall be made of hot pressed 15mm thick moulded ply and upholstered with Urethane foam Foam density 40kg/m3 & net fabric tapestry. The Back is made of polyproplene outer side and upholstered with nett or breathable mesh with cushioned support. The armrests are made of polyproplene and mechanism shall be knee tilt with four point locking. The pneumatic height adjustment shall have an adjustment of 63mm in BIFMA Standard class 3.Pedestal is made of injection moulded black nylon fitted with 5 nos. twin wheels castors which are made of injection moulded black nylon 30% glass filled and nylon base is load tested capacity -1150 kg in BIFMA standard.	EA	10	10,800.00	18%	12,744.00	1,27,440.00

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1190.00	**Table (for Meeting Room)** Providing and fixing in position Meeting Room Table shape, sizes as per the approved design and profile given in the detailed drawing consisting of :The Table top to be made in layers of 19,12,6mm thick BWP grade marine plywood covered with 4mm thick approved veneer and partly burl on top and 1mm thick approved laminate at the bottom. The edge of the table top is to be finished with moulding of matching wood. All the exposed surfaces of the veneer and matching wood moulding to be finished with polyester resin polish (PU). The under structure of the table is to be made of 19 mm thick BWP grade marine plywood with 4mm thick approval veneer with melamine polish and in side 1mm thick laminate, of approved boxing, and vertical designs patta and skirting level provide molding, with necessary leveling arrangements. Provision for power track is to be provided as per detailed drawing. RR/approved make cable tray/pop up box of approved shade/design shall be fixed as per drawing. The entire item is to be completed in totality as per the architectural drawing shall be prepared by contractor based on actual site condition and shall be submitted for Engineer- In-charge approval. Rate including cost of complete table set, in-built raceway for laying cables, wooden moulding as per details provided by architect and in between table work surface to have a seamless (hair line) joint between the two joint surface to give a continuous look, cutout for services, wooden beadings, moulding etc. complete as per direction of Engineer - in - charge / architect. Rate to be included for all the items as shown in drawing. (qualirt to be maintained where Basic rate of veneer shall be Rs. 2000/- per smt.and Basic rate of veneer shall be Rs. 2000/- per smt.and Basic Rate of Laminate: Rs 600/SM). Only surface plan area of working table/desktop shall be considered for payment.	Sqm.	4	21,600.00	18%	25,488.00	1,01,952.00
1200.00	**Table (for GA in charge room, Reception, Security room)** Supply, installation & commissioning of the Furniture as per dimension, shape, curvature and design given in the drawing and with the following specifications. i. TABLE TOP(As per drawing): To be fabricated out of 19 mm thk ply finished with 3/3.5 mm thk Veneer with melamine polish, Approved shade with Pattern, grooves etc .complete. Table apron to be made out as per drgs. Design, shape and curve of table top shall be as per the drawing and instructions of HPCL EIC/Architect. ii. DRAWER BOXES(As per drawing): below table top deep fabricated out of ply in front & on other sides and with Drawers. All drawers shall have teak wood handles as shown in Drg. Drawers to be provided with single lock arrangement complete in all respects. All exposed surfaces of table/drawer unit shall be finished with veneer with melamine polish. Drawer boxes to be finished with laminate from inside. iii. BACK CREDENZA UNIT(As per drawing): To be fabricated out of 19 mm thk ply finished with 3/3.5 mm thk Veneer with melamine polish, Approved shade with Pattern, grooves etc .complete. The unit to be provided with shelves The sliding/openable shutters finished as per drawings. Aluminium profile handles/ball catch as per Arch./HPCL Approval along with approved quality lock. Sliding channels to be provided in Aluminium. All the hardwares and fitting to be of approved makes and as per selection by Architect/ HPCL. Scope includes Providing necessary items like Grommet holes, cable hangs and trays as per site requirements. In the side unit Tray unit with Aluminium channels shall be provided with front finished in melamine polish as per detailing provided in drawing. The table to be finished with foot rest as per drgs and approval. (quality to be maintained where Basic rate of veneer shall be Rs. 2000/- per smt.) (Basic Rate of Laminate: Rs 600/SM) Keyboard Pull out tray and retrofit mouse tray to be provided in Metal Tray in MS CRCA sheet Note: Table top for main table, side unit and back unit shall be finished with veneer as per approved	Sqm.	2	36,000.00	18%	42,480.00	84,960.00
1210.00	**GRAPHICS/SIGNAGES** Providing and fixing of graphics/ signages (including printing of direction, entry, exit, department name, etc.) with self glowing/	EA	6	1,800.00	18%	2,124.00	12,744.00
1220.00	**TOWER BOLTS** Providing and fixing approved stainless steel finished tower bolts (barrel type) 10 mm diameter & 200 mm long with screws etc. complete as per drawings, specification and directions of the Engineer-in-Charge.	EA	1	810.00	18%	955.80	955.80
1230.00	Design supply & installation of suspended Spider Glazing system designed to withstand the wind pressure as per IS 875 (Part-III). The Suspended System held with Spider Fittings of SS-316 Grade Steel of approved manufacturer with glass panel having 12 mm thick clear toughened glass held together with SS-316 Grade Stainless steel Spider & bolt assembly with laminated glass fins 21 mm thick. The Glass fins and glass panel assembly shall be connected to Slab/ beams by means of SS- 316 Grade stainless steel brackets & Anchor bolts and at the bottom using SS channel of 50x25x2mm using fastener & anchor bolts, non staining weather sealants of approved make, Teflon/ nylon bushes and separators to prevent bi-metallic contacts, all complete to perform as per specification and approved drawings. The complete system to be designed to accommodate thermal expansion & seismic movements etc. The joints between glass panels (6 to 8 mm) and gaps at the perimeter & in U channel of the assembly to be filled with non staining weather sealant, so as to make the entire system fully water proof & dust proof. The rate shall include all design, Engineering and shop drawing including approval from structural designer, labour, T&P, scaffolding, other incidental charges including wastage, enabling temporary services all fitting fixers nut bolts, washer, Buffer plates, fastener, anchors, SS channel laminated glass etc. all complete. For the purpose of payment, actual elevation area of Glazing including thickness of joints and the portion of Glass panel inside the SS channel shall be measured.	SQM	60	11,700.00	18%	13,806.00	8,28,360.00

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1240.00	DESIGN WITH FILM : Providing and fixing Etching type design on glass with film of approved makes as per design and instruction of manufacturer specification.	SQM	35	2,430.00	18%	2,867.40	1,00,359.00
1250.00	**Visitor chair:** The seat & back are made of 12+6 mm thick twin wooden ply upholstered with foam density 40kg/m3 in seat and foam density 32kg/m3 in back with leatherite tapestry. The seat's main frame made of chrome plated CRCA pipe dia 20.38mm x 2mm thick. There are use of PPCP shoes in the bottom of frame for avoid streches on the floor. Whole seat quality meet at the BIFMA standard class iii. Seat size shall be-20" (W) x 19" (D) and back height shall be 20.5" from seat & overall height: 37.5"From floor. Item to be completed in all respects as per approval on contractor drawings & instructions from Project- in-charge/Architect.	EACH	5	5,400.00	18%	6,372.00	31,860.00
1260.00	**Hand Dryer** Providing & fixing Hand Drier of approved make as per approved by Architect/Engineer-in-charge complete. Item to include all fixing accessories, men material and lift up to all heights & installed complete. Item to be completed in all respects as per approval on contractor drawings & instructions from Project- in-charge/Architect.	EACH	2	22,500.00	18%	26,550.00	53,100.00
1270.00	**Normal RO at Cafeteria:** Supply & Installation of RO + UV +UF, TDS control) 20L storage, Filtration Capacity min 20 lit/hr at cafeteria. Item to include all fixing accessories, men material and lift up to all heights & installed complete. Item to be completed in all respects as per approval on contractor drawings & instructions from Project- in-charge/Architect.	Each.	1	27,000.00	18%	31,860.00	31,860.00
1280.00	**Refrigerator, 300L:** Supply & Installation of Refrigerator, 300L, Digital Inverter Technology. Double Door, 5star rating.Item to include all fixing accessories, men material and lift up to all heights & installed complete. Item to be completed in all respects as per approval on contractor drawings & instructions from Project- in-charge/Architect.	Each.	2	58,500.00	18%	69,030.00	1,38,060.00
1290.00	**Kitchen Chimney:** Supply & Installation of Kitchen Chimney Stainless Steel Baffle Filters , 1000 m3/h Wall Mounted. Item to include all duct and fixing accessories, men material and lift up to all heights & installed complete. Item to be completed in all respects as per approval on contractor drawings & instructions from Project- in-charge/Architect.	Each.	1	36,000.00	18%	42,480.00	42,480.00
1300.00	**Stretcher Trolley:** Suply of Stainless Steel Stretcher Trolley. Item to be completed in all respects as per approval on contractor drawings & instructions from Project- in-charge/Architect.	Each.	1	22,500.00	18%	26,550.00	26,550.00
1310.00	**Officer name plates:** Supply and installation of Officer name plates Name Plate for Office Table Desk Triangle Pen Box Stand Holder With Logo & Name Premium (Company or Individual) . Item to be completed in all respects as per approval on contractor drawings & instructions from Project- in-charge/Architect.	Each.	3	1,080.00	18%	1,274.40	3,823.20
1320.00	**Door name plates:** Supply and installation of Door name plates office Room 12x3 inch Stainless Steel Signage Board For office. Item to be completed in all respects as as per approval on contractor drawings & instructions from Project- in-charge/Architect.	Each.	5	1,170.00	18%	1,380.60	6,903.00
1330.00	**Office Filing Fire proof Cabinet:** Supply and installation of Office Filing Fire proof Cabinet with 4 Shutters (ht 1800 mm) Item to be completed in all respects as per approval on contractor drawings & instructions from Project- in-charge/Architect.	Each.	1	24,300.00	18%	28,674.00	28,674.00
1340.00	**Lockers (Security & Workers):** Supply and installation of Lockers (Security & Workers) 6 Door Metal Locker Cupboard Storage Cabinet with Staple Locking Office Employee Locker Box (75 X 36 X 19 Inch Powder Coated) Item to be completed in all respects as per approval on contractor drawings & instructions from Project- in-charge/Architect.	Each.	2	27,000.00	18%	31,860.00	63,720.00

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1350.00	**Three Seater visitor Bench:** Supply and installation of bench 3 seater for waiting area Cross beam shall be made up of black powder coated rectangular M.S.ERW tube having 8 ± 0.03 cm x 4 ± 0.03 cm x 0.2 ± 0.014 cm size. Leg and armrest shall be chrome plated made of cold rolled steel with 0.12 ± 0.013 cm thinkness. Seat back shell shall be 1.6 mm thk powder-coated perforated shell made from cold rolled M.S. sheet 0.14 ± 0.013 em thickness. The Side Bar shall be made of Chrome plated solid steel 3 ± 0.03 cm x 1.2 ± 0.3 cm (DIN174)with fluting and plastic inserts.The Shell shall be assembled on the Cross Beam with help of M8 Bolts (Per Seat- 8 nos. Seat to Bracket and 4nos. Bracket to Cross Beam). The seat & back cushion shall be made up of PU foam upholstered with leather cloth or fabric with plywood. Overall Dimensions shall be Seat Height - 40.0cm, Height - 67.5cm, Width & Depth of Chair as measured from pedestal - Width-163.0cm and Depth-57.0 cm. Item to be completed in all respects as per approval on contractor drawings & instructions from Project- in-charge/Architect	Each.	3	16,200.00	18%	19,116.00	57,348.00
1360.00	**Dining set (Cafeteria & Worker room):** Supply and installation of Cafeteria counter height wooden dining set (1 no table for 4 person and 4nos low back high chair) Table size 1200x900 and Table Top made of 25mm thick MDF with finished in pvc memberane using unique wrap around for better aesthetics & long lasting use. Understructure - It has 2 vertical pipes with tie bar connected horizontally on bottom of the table top. Two vertical pipes are connected with help of horizontal pipes at the top & bottom. Connector pipe is 25mm dia and is 1235 long. It is made of 1.6mm thick ss 202. Additional 2 horizontal pipe are provided below the table top for strength & stability. Entire seat & back is a single moulded bend ply with laminate coating. Entire seat & back is a single moulded bend ply with laminate coating.	Set	2	36,000.00	18%	42,480.00	84,960.00
1370.00	**Cabinets in Kitchen:** Supply and installation of Cabinets in Kitchen. Made of Marine-grade plywood with select laminate skin(basic cost is not less than Rs. 600/SM-) on both faces- pedestal box frame of 19 thick ply board with 12 thick backer ply, horizontal shelving of 19 thick ply board & drawer sideboard of 12 thick ply board, all as per Design drawing. Item to be inclusive of sample unit approval from Architect/Engineer-in-charge, all edge lipping of water based PU polished & stained good grade TW, all GI & Al. joining cleats, fixing accessories, phenol formaldehyde based Adhesives, SS 304 Grade 'Butler' finished hardware of handles, hinges, mortise locks, clip-locks, GI drawer slides, key-hole roses etc. as approved by Architect/Engineer-in-charge; and inclusive of all installation and lift up to 20 mts, all accessories, fitments, tools and tackle, finished, laid complete. Item to be inclusive of all accessories, fixing implements, tools and tackle, men material and lift up all heights & finished installed cleaned complete. Item to be completed in all respects as per drawings & instructions from Project-incharge/ Architect. Only surface area for elevation shall be	SQM	1	18,000.00	18%	21,240.00	21,240.00
1380.00	**Mornitoring Screen:** Providing and fixing/installation of **55"display size 4K Ultra HD Smart LED o**f approved brand for meeting room including electrical wiring, frame, supporting arrangement, accessories all complete.	Each.	1	90,000.00	18%	1,06,200.00	1,06,200.00
1390.00	**Megnetic White Board:** Providing and fixing/installation of self supported 1200mmx1200mm magnetic white board in the meeting room of approved brand including frame, supporting arrangement, accessories all complete.	Each.	1	9,000.00	18%	10,620.00	10,620.00
1400.00	**Portable Fire Extinguishers : Manual Fire Fighting System** Supply & installation of Indoor located 10 Kg DCP Fire Extinguisher alongwith mounting bracket and fixing accessories suitable for wall mounting.	Each.	5	6,300.00	18%	7,434.00	37,170.00

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1410.00	**GRG BOARD PARTITIONS** Providing and fixing partition upto ceiling height consisting of G.I. frame and required board, including providing and fixing of frame work made of special section power pressed/ roll form G.I. sheet with zinc coating of 120 gms/sqm(both side inclusive), consisting of floor and ceiling channel 50mm wide having equal flanges of 32 mm and 0.50 mm thick, fixed to the floor and ceiling at the spacing of 610 mm centre to centre with dash fastener of 12.5 mm dia meter 50 mm length or suitable anchor fastener or metal screws with nylon plugs and the studs 48 mm wide having one flange of 34 mm and other flange 36 mm and 0.50 mm thick fixed vertically within flanges of floor and ceiling channel and placed ata spacing of 610 mm centre to centre by 6 mm dia bolts and nuts, including fixing of studs along both ends of partition fixed flush to wall with suitable anchor fastener or metal screws with nylon plugs at spacing of 450 mm centre to centre, and fixing of boards to both side of frame work by 25 mm long dry wall screws on studs, floor and ceiling channels at the spacing of 300 mm centre to centre. The boards are to be fixed to the frame work with joints staggered to avoid through cracks, M.S. fixing channel of 99 mm width (0.9 mm thick having two flanges of 9.5 mm each) to be provided at the horizontal joints of two boards, fixed to the studs using metal to metal flat head screws, including jointing and finishing to a flush finish with recommended jointing compound, jointing tape, angle beads at corners (25 mm x 25 mm x 0.5 mm), joint finisher and two coats of primer suitable for board as per manufacture's specification and direction of engineer in charge all complete. 75 mm overall thickness partition with 12.5 mm thick double skin fire rated Glass Reinforced Gypsum (GRG) plaster board conforming to IS: 2095: part 3 (Board with BIS certification marks)	SQM	30	1,552.40	18%	1,831.83	54,954.96
1420.00	**ALUMINIUM FRAME FOR GLASS PARTIONS/DOORS** Providing and fixing aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge. (Glazing, paneling and dash fasteners to be paid for separately) : Anodised aluminium (anodised transparent or dyed to required shade according to IS: 1868, Minimum anodic coating of grade AC 15)	Kg.	10	409.04	18%	482.67	4,826.67
1430.00	**GLAZING** Providing and fixing glazing in aluminium door, window, ventilator shutters and partitions etc. with EPDM rubber / neoprene gasket etc. complete as per the architectural drawings and the directions of engineer-in-charge . (Cost of aluminium snap beading shall be paid in basic item): With float glass panes of 8 mm thickness (weight not less than 20 kg/sqm)	SQM	10	1,379.91	18%	1,628.29	16,282.94
1440.00	**SUN CONTROL FILM/SHADING FILM** Providing and fixing, on fixed glazing/ doors/ window panes, sun control film "HP NATURAL 35 SAFETY COMBINATION FILM-4Mil" of M/s. GARWARE or approved equivalent make and shade, all complete as per manufacturer's specification and as per instructions of the Engineer-in-Charge.	SQM	50	1,182.78	18%	1,395.68	69,784.02
1450.00	**FLOOR SPRING** Providing and fixing double action hydraulic floor spring of approved brand and manufacture conforming to IS : 6315, having brand logo embossed on the body / plate with double spring mechanism and door weight upto 125 kg, for doors, including cost of cutting floors, embedding in floors as required and making good the same matching to the existing floor finishing and cover plates with brass pivot and single piece M.S. sheet outer box with slide plate etc. complete as per the direction of Engineer-in-charge. With stainless steel cover plate minimum 1.25 mm thickness	Each.	5	12,320.64	18%	14,538.35	72,691.75
1460.00	**SILICON SEALANT FOR GLAZING** Filling the gap in between aluminium frame & adjacent RCC/ Brick/ Stone work by providing weather silicon sealant over backer rod of approved quality as per architectural drawings and direction of Engineer-in-charge complete. Upto 5mm depth and 5 mm width	M	50	83.78	18%	98.86	4,943.04

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1470.00	**DOOR ACCESSORIES (HANDLES, LOCK etc)** Providing and fixing stainless steel fancy handle of approved make fixed with SS screws etc. complete as per direction of Engineer-in-charge. 200mm	Each.	10	2,661.26	18%	3,140.28	31,402.84
1480.00	**CYLINDRICAL LOCKS** Providing and fixing approved cylindrical lock of "ACME KASA" or equivalent with required colour or shade with nuts and screws etc. complete as per drawings, specifications and directions of the Engineer-in-Charge.	EA	10	3,400.50	18%	4,012.58	40,125.85
1490.00	**Wallpaper** Providing and applying select approved Wall paper of approved make and shade on all surfaces & at all heights including scaffolding, preparing the surface by brushing and brooming down etc. complete. The dry/wet cleaning of floors etc. after wallpaper is to be carried out. Item to include getting mock-up for approved by Architect/Engineer in charge, all approved gluing as per detailed specifications and approval, all accessories, men material and upto all heights protecting finished surface with min. 20 microns thk polythene sheet till facility handover, finished cleaned complete. Also rate shall be inclusive of doing any oil paint preparation over partition/wall or any other location before pasting of wallpaper as per instructions of EIC/architect. Item to be completed in all respects as per drawings & instructions from Project- incharge.	Sqm.	10	1,379.91	18%	1,628.30	16,282.95
1500.00	**Sofa 3 seater** Supplying and Placing in location Sofa 3-seater type as per selection made up of TW/SS Frame of size 38x75mm /approved equivalent frame approved size for Seating & Back, seating should have the horizontal TW/SS support of size 38x75mm/approved equivalant frame at regular intervals, the frame should have 12mm thk MDF on all sides with necessary hardware fasteners. The Chair should have Foam of approved quality & make all around with artificial Rexin/synthetic rubber drape of approved texture & colour. The base should have nylon floor strutpads/ legs. The cost includes all necessary fittings & fixtures, with necessary hardware etc. complete. (Min. Density of foam = 50Kg/m3). Size as per selection. The upholstery material to be got approved by Architect/Engineer-in-charge. Item to be inclusive of all accessories, fixing implements, tools and tackle, men material. Item to be completed in all respects as per drawings & instructions from Project- in-charge/Architect. Note: Vendors can offer sofa from their product portfolio within the basic rate mentioned with meeting minimum specifications mentioned above subject to approval from architect/HPCL EIC.	EACH.	1	51,253.85	18%	60,479.54	60,479.54
1510.00	**Console unit (Height 750 mm:450mm deep)** Providing and fixing storage units as per of required shape and size as per approved design drawings and as per the site requirements. Unit having sides, vertical dividers, top and bottom made of 19 mm thick BWP marine grade plywood.Top of the unit to be finished with 18 mm thick BWP plywood with partly burl and normal veneer with lamination. The back side of unit shall be 9 mm thick BWP plywood. The external face of the storage unit to be finished with 4 mm thick approved veneer. Shutters are to be made of 19 mm thick marine plywood and middle drawer as per approved drawings. All internal surfaces are to be finished with 1 mm thick laminate of approved make and shade. The item also includes pull out drawers, hinges, locks, handles, ball catcher, necessary cut-out etc. for services complete as per the directions of EIC/ Architect. The quoted rate shall include all hardware & accessories(Soft Closing Clip On Hinges CP,TOWER BOLT, Handle : Hand Made (T.W),Lock : Wardrobe Lock -3 point, Drawer lock Soft, Closing ball Bearing Drawer Slides, etc.). Only front surface area for elevation shall be considered for payment. (quality to be maintainèd where Basic rate of veneer shall not less than Rs. 2000/- per smt.and Basic Rate of Laminate shall not less than Rs 600/SM)	Sqm.	20	18,727.37	18%	22,098.29	4,41,965.85
1520.00	**Modular Storage Units** Modular LOW/FULL Height (450 mm D) Storage Unit : Providing & fixing storages of avg. 450 mm wide, made of BWP grade ply board with select laminate skin(basic cost is not less than Rs. 600/SM-) on both faces- pedestal box frame of 19 thick ply board with 12 thick backer ply, horizontal shelving of 19 thick ply board & drawer sideboard of 12 thick ply board, all as per Design drawing. Item to be inclusive of sample unit approval from Architect/Engineer-in-charge, all edge lipping of water based PU polished & stained good grade TW, all GI & Al. joining cleats, fixing accessories, phenol formaldehyde based Adhesives, SS 304 Grade 'Butler' finished hardware of handles, hinges, mortise locks, clip-locks, GI drawer slides, key-hole roses etc. as approved by Architect/Engineer-in-charge; and inclusive of all installation and lift up to 20 mts, all accessories, fitments, tools and tackle, finished, laid complete. Item to be inclusive of all accessories, fixing implements, tools and tackle, men material and lift up all heights & finished installed cleaned complete. Item to be completed in all respects as per drawings & instructions from Project-incharge/ Architect. Only front surface area for elevation shall be considered for payment	Sqm.	20	15,277.59	18%	18,027.55	3,60,551.09

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1530.00	**Work Stations (office, Manager room, Sales room)** Providing & fixing work station of avg. 600 mm wide working platform, 1m high verticle partition fixed on floor with GI sections, top U-shape beeding and made of BWP grade ply board with select laminate skin(basic cost is not less than Rs. 600/SM-) on both faces- frame of 19 thick ply board with 12 thick backer ply, horizontal shelving of 19 thick ply board & drawer sideboard of 12 thick ply board, all as per approved Design drawing. Item to be inclusive of sample unit approval from Architect/Engineer-in-charge, all edge lipping of water based PU polished & stained good grade TW, all GI & Al. joining cleats, fixing accessories, phenol formaldehyde based Adhesives, SS 304 Grade 'Butler' finished hardware of handles, hinges, mortise locks, clip-locks, GI drawer slides, key-hole roses,hole for electrical fixtures/fittings, The front & side wall of working destop shall have soft pin board and marker boards for individual sitting areas, side drawers shall be provided for each working station, etc. as approved by Architect/Engineer-in-charge; and inclusive of all installation and lift, all accessories, fitments, tools and tackle, finished, laid complete. Item to be inclusive of all accessories, fixing implements, tools and tackle, men material and lift up all heights & finished installed cleaned complete. Item to be completed in all respects as per drawings & instructions from Project-incharge/ Architect. Only surface plan area of working table/desktop shall be considered for payment.	Sqm.	10	16,263.24	18%	19,190.62	1,91,906.22
1540.00	**Roller Blinds** Providing and fixing window blinds of chiks / bamboo / fabric /roman / roller of approved shade & makes with scoth gaurd fabric protector.The blinds should be approved by Architect / EIC.The blinds to be fixed and commissioned as per manufactures specification.The work to be completed as per satisfaction & approval of the Architect / EIC.Rate shall be including wastage as per drawing, design & direction no extra paidment shall be paid for wastage.	Sqm.	20	1,971.30	18%	2,326.14	46,522.72
1550.00	**Blackout Blinds** Providing & fixing black out roller blinds manufactured from dust & stain repellant polyster fabric in specified width of approved design & shade of make complete with control unit, idler, head rail, brackets, operating chain, roller tube & load bar etc. complete as per manufacturer's specifications. (Payment shall be made for the finished area. Height of the curtain shall be taken in open position from the top of the headrail to the bottom of the curtain.) The blinds to be fixed and commissioned as per manufactures specification. The work to be completed as per satisfaction & approval of the Architect / EIC.Rate shall be including wastage as per drawing, design & direction no extra payment shall be paid for wastage.	Sqm.	10	1,774.17	18%	2,093.52	20,935.22
1560.00	**Natural (air purifying) plants** Providing and arranging / fixing natural air purifier plants like spider plant,Dracaena, weeping, peace lily,sword fern,Viper's bowstring hemp,Areca palm etc. In Plastic or glass or any other decorative pots with marble / stone pebbles, moss etc. as per approval and selection. Rate to include all the accessories etc and No extra will be paid for additional Pebbel bags, T sheets and Wrappings if required to complete the job as per Architects Drawings and instructions from Architect / EIC.	Each.	5	2,759.82	18%	3,256.59	16,282.95
1570.00	**SS Dustbins** Providing and arranging / fixing Dustbin of 200 / 225 mm dia SS perforated dust bins with covers of approved quality as per directions of EIC/Architect.Worktable Dustbins- Providing and placing SS dustbins, avg. 1.8 mm thick & avg. 200 mm dia. Mouth tapering bucket type of avg. height 325 mm; as per approved shade and pattern, with all turned, well-formed and moulded edges at the bucket rim. Item to include sample approval from Architect/Engineer-in-Charge, item provisioned, laid complete. Item to be inclusive of all accessories, fixing implements, tools and tackle, men material , finished installed cleaned complete .Item to be completed in all respects as per drawings & instructions from Project- in-charge/Architect.	Each.	5	1,478.48	18%	1,744.60	8,723.01
1580.00	RO 80LPH: Supply & Installation of Mineralizer Water Purifier-Cooled water (Pre filter, RO + UV +UF, TDS control) Filtration Capacity min 80 lit/hr for office use.Item to include all fixing accessories, men material and lift up to all heights & installed complete. Item to be completed in all respects as per approval on contractor drawings & instructions from Project- in-charge/Architect.	Each.	1	81,000.00	18%	95,580.00	95,580.00
1590.00	White UPVC Sliding Window 3 Track (Min Size Of 1 Window 30 Feet), Glass Thickness: 5mm Clear Regular, UPVC Sliding Window 3 TRACK (2 Glass Shutter + 1 Fiber Mesh Shutter)	SQM	20	6,100.00	18%	7,198.00	1,43,960.00
1600.00	ALL WORK RELATED TO STATUTORY APPROVALS FOR THE CONSTRUCTION FROM THE COMPETENT AUTHORITY, to obtain all necessary permissions/approvals by the concerned authorities. All necessary work related to the same shall be in contractor's scope i.e. including preparation, submission of all drawing & documents , liaisoning required for making the station completely operational. All permissions mentioned below shall be acquired by contractor/bidder in complete manner and no separate payment shall be						
1610.00	DM NOC	EACH	1	6,00,000.00	18%	7,08,000.00	7,08,000.00
1620.00	Bore well connection	EACH	1	16,999.23	18%	20,059.10	20,059.10

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1630.00	Factory license	EACH	1	46,747.89	18%	55,162.51	55,162.51
1640.00	Pollution control	EACH	1	68,187.03	18%	80,460.69	80,460.69
1650.00	PESO - CTE (basic PESO, including all other activities required to get the approval)	EACH	1	78,947.31	18%	93,157.83	93,157.83
1660.00	PESO - CTO (PESO Grant, PESO Endorsement, including all other activities required to get the approval)	EACH	1	1,26,315.70	18%	1,49,052.53	1,49,052.53
						Sub total including GST (A)	**2,35,36,869.51**
						Percentage to be quoted by the bidder (B)	
						Amount in Rs. (C)	**0.00**
						Total including GST (A+C) after applying % offered by the bidder	**2,35,36,869.51**

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