



**NORTH EAST GAS DISTRIBUTION COMPANY LIMITED
(NEGDC)**

**TENDER OF
COMPOSITE WORK OF MOTHER STATION AT
MANGALDOI FOR CITY GAS DISTRIBUTION PROJECT
OF NEGDC**

E-Tender No.: - _ _ _ _ _
DATED:- _ _ _ _ _

(VOLUME II OF II TECHNICAL)



**PREPARED AND ISSUED BY
VCS QUALITY SERVICES PVT. LTD.
Noida, India**



MASTER INDEX

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VOLUME A
(PIPELINE & PIPING)

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**Scope Of Work
(PIPING & MECHANICAL)**

 VCS Project Consultants Pvt Ltd		PROJECT NUMBER: C241131		 North East Gas Distribution Company Limited Fueling dreams for a sustainable tomorrow	
SCOPE OF WORK-PIPING & MECHANICAL (MOTHER STATION)			Total Sheets		20
Document No		C241131	000	PP	SOW
NORTH EAST GAS DISTRIBUTION COMPANY LIMITED (NEGDCL) COMPOSITE WORK OF MOTHER STATION AT MANGALDOI FOR CITY GAS DISTRIBUTION PROJECT OF NEGDCL					
C1	18.06.2026	ISSUED FOR CLIENT REVIEW		PK	DK
REV	DATE	DESCRIPTION		PREP	CHKD

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1. INTRODUCTION

North East Gas Distribution Company Limited (NEGDCCL) is a consortium of Assam Gas Company Limited (AGCL) and Oil India Limited (OIL) having its registered office in 6th Floor, Central Mall, G.S. Road, Guwahati. NEGDCCL won authorization for 3 geographical areas (GAs) in the northeast region of India viz. GA of Darrang(Mangaldoi), Udalguri, Sonitpur, Bishwanath, Lakhimpur and Dhemaji districts in Assam (GA ID: 11.03) and GA of Sepahijala and South Tripura districts (GA ID: 11.56) and GA of North Tripura, Khowai, Dhalai and Unakoti districts in Tripura (GA ID: 11.57).

NEGDCCL intends to develop the City Gas Distribution (CGD) Network in all districts of the GA so as to leverage the synergies anticipated during infrastructure creation, operations & maintenance and administration of each of the individual GA.

VCS Quality Services has been appointed as Engineering Project Management Consultant by M/s HPCL to provide engineering consultancy services for setting up "City Gas Distribution (CGD) Network in the district of Darrang (Mangaldoi) in Assam"

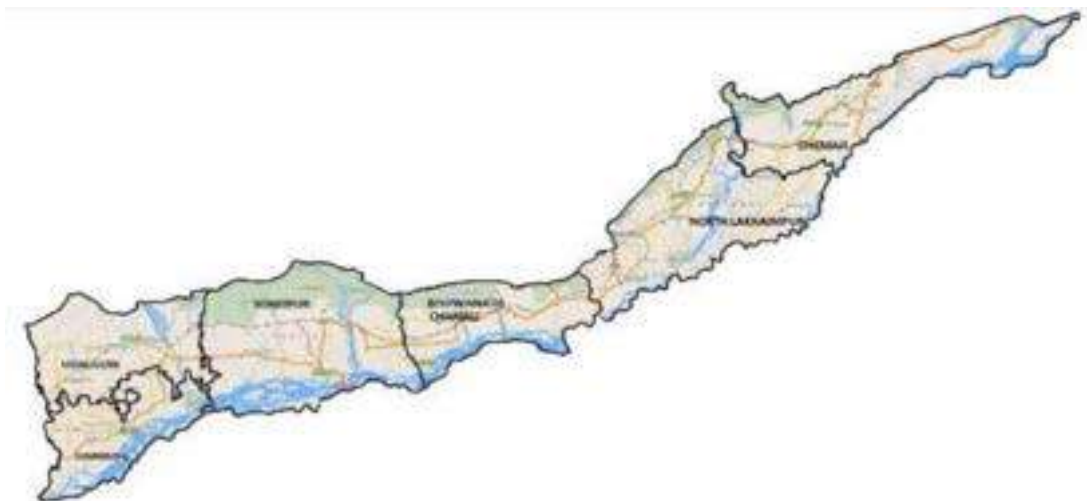
2. PROJECT BRIEF

Petroleum and Natural Gas Regulatory Board (PNGRB) came up with eleventh round of City Gas Distribution (CGD) bidding for awarding licenses for 65 geographical areas (GAs) covering 209 districts. A consortium of Assam Gas Company Limited (AGCL) and Oil India Limited (OIL) won authorization for 3 geographical areas (GAs) in the northeast region of India viz. GA of Darrang (Mangaldoi), Udalguri, Sonitpur, Bishwanath, Lakhimpur and Dhemaji districts in Assam (GA ID: 11.03) and GA of Sepahijala and South Tripura districts (GA ID: 11.56) and GA of North Tripura, Khowai, Dhalai and Unakoti districts in Tripura (GA ID: 11.57).

The current report is with respect to the GA of Darrang(Mangaldoi), Udalguri, Sonitpur, Bishwanath, Lakhimpur and Dhemaji districts in Assam. The GA comprises of 6 districts. The districts are Darrang, Udalguri, Sonitpur, Bishwanath, Lakhimpur and Dhemaji. AGCL and OIL intends to develop the City Gas Distribution (CGD) Network in all districts of the GA as a JV so as to leverage the synergies anticipated during infrastructure creation, operations & maintenance and administration of each of the individual GA. Hence, a Detailed Feasibility Report (DFR) is being prepared for the GA to be submitted to the regulator (PNGRB). AGCL and OIL has engaged KPMG to prepare Detailed Feasibility Report for the GA. The below figure shows the map of the GA with 6 districts of Assam district wise:

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**MAP OF THE DARRANG(MANGALDOI), UDALGURI, SONITPUR,
BISHWANATH, LAKHIMPUR AND DHEMAJI DISTRICTS GA**



In the GA, there are some districts with high commercial activity like Sonitpur and Lakhimpur and in addition, i Sonitpur, Bishwanath and Darrang (Mangaldoi) districts have high convertible industrial demand. These districts also have high consumption in tea-based industries. Patanjali, Dabur, Northeast nutrients are some of the major industries in the GA.

POPULATION, HOUSE HOLDS, POPULATION DENSITY, CHARGE AREA

One of the 3 GAs is the GA of the Darrang(Mangaldoi), Udalguri, Sonitpur, Bishwanath, Lakhimpur and Dhemaji districts of Assam state. It is located in the central and north-eastern part of Assam. The GA is divided into 7 charge areas and none of the charge areas have already been authorized before.

GA PROFILE

Official Name	Darrang(Mangaldoi).Lakhimpur, Dhemaji, Udalguri, Sonitpur and Biswanath districts	
Demography	Population (2011 Census)	49,78,220
	Households (2011)	10,83,595

Area	Total	12,443 km ²
	Population Density	400/km ²
Districts	6	
Charge Areas	7	

3. BRIEF SCOPE

The scope of work includes Mechanical Works for CNG stations at Mangaldoi in Assam.

This document covers the details of supply and installation of mechanical equipment at CNG at at Mangaldoi Darrang dist in Assam.

It includes installation of Cascades, Compressor, Dispensor etc. and supply and installation of Fire extinguisher and trailer panel etc. All works and clauses of this document shall be applicable unless specifically mentioned otherwise.

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

All materials and consumables (e.g., Valves, Fittings, Flanges, Assorted Pipes etc.) of below 2 inches required for satisfactory completion of the job shall be in the scope of the Contractor except free issue material provided by Owner. It shall include Supply, Erection, Testing and safely commissioning of all items required for completion of all the jobs mentioned in scope of work including inspection of all supply items but not limited to above. Wherever it is mentioned in the Specifications or Scope of Work that the Contractor shall perform certain work or provide certain facilities, contractor shall execute the work without any extra charges.

4. WORK TENDERED

The detail scope of work is given below: -

4.1. MOTHER STATION

- Supply & Installation of Above Ground Piping
- Supply and installation of all fittings, Flanges.
- Welding, Radiography, Painting etc.
- Supply and installation of 75 kg capacity DCP type (trolley mounted)
- Supply and installation of 9 kg capacity DCP fire extinguisher
- Supply and installation of 4.5 kg capacity DCP fire extinguisher

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- Supply & installation of 4 sand buckets with stand (4 at each stand).
- Installation of Compressor, DRS unit.
- Installation of Dispenser unit.
- Installation of Cascade unit.
- Installation of LCV Filling facility (Trailer Panel) with mass flow meter, flow range (0 to 100 kg/min) along with associated fittings & consumables - 1 Nos at each station.
- Supply, erection, laying, testing, and safely commissioning of SS tubing, fittings and valves and necessary adaptors, clamps, brackets etc., as required from compressor priority panel to mobile cascade, stationary cascade, and dispenser of Online stations as per the tentative quantities mentioned in the SOR, Standard technical specifications of the SS tube and Fittings.

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

4.2 Terminal Work-Piping and equipment installation

Contractor shall carry out all works strictly in accordance with the Issued for Construction (IFC) drawings and reference specifications/ standards, documents, data sheets etc. enclosed with this tender document and instructions of Company/ Engineer-in-Charge and other provisions of Contract document.

- i. Providing all manpower, machinery, consumables for completion of works, inspection, testing; all types of safety tools, tackles, devices and apparatus, equipment etc. including ladders and scaffolding etc. complete as required including providing all types of consumables, tools, tackles and facilities for inspection and interpretation of testing results by Company/Company's Representative personnel. Strict work permit system shall be followed & safety rules are must for manpower deployed.
- ii. 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.
- iii. Installation of equipment shall be done by bidder as per directions, supervision, and guidance of equipment manufacturer Engineer. Bidder shall inform at least 15 days before to owner for mobilizing of Vendor Engineer to site. Commissioning shall be done in presence & guidance of equipment manufacturer Engineer.

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- iv. "Receiving and taking over" of all Company supplied free issue materials (if any) from the Company's designated place(s) of issue, transportation including loading, unloading, handling from Company's designated place(s) of issue to Contractor's own stock yard(s)/ work site(s)/work shop(s) including arranging all necessary intermediate storage area(s) thereof as required till the permanent installation of materials.
- v. Procurement and supply of all materials and consumables that are included in the scope of supply of Contractor (Clause 6.2 of this document), transportation of all materials 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) thereof, as required.
- vi. Supply, fabrication and erection of pipe/ equipment support (for all sizes/ thickness) including shoes, pipes, cradles, turn buckles, T-posts for all types of guides, anchors, all necessary equipment, consumables, labor etc. for completing all works including supply of bolts, nuts, washers, U-clamps, wooden blocks etc. as required for supporting.
- vii. Contractor shall prepare isometrics and fabrication shall be carried out accordingly. All isometrics shall be checked by contractor quality team for accuracy before work. No approval of isometric drawings will be given by owner.
- viii. Installation of Valves, flow tee, IJ, valves and all other required flanges, fittings and associated equipment as approved by engineer in charge. Precaution shall be taken to avoid any damage to the installation equipment.
- ix. Hook-up of piping with metering skid, equipment's & vessels, with the existing facilities, with the pipeline and at the battery limit with the facilities installed by others by welding or by flanged connection including cutting, fit-up, welding, NDT, radiography, interface/co-ordination as required with other Contractor(s)/Agencies.
- x. All works related to cleaning, flushing, hydro testing and dewatering of piping facilities and all other pre-commissioning checks as applicable to the scope of work.
- xi. The Hookup to where welding to be made, if already commissioned shall be flushed with nitrogen to clean any hydrocarbon pockets. Before welding, all rust and foreign matter shall be removed from the beveled ends by power operated tools. The bevels shall be thoroughly inspected. Manual cutting and weld repairs of bevels is not allowed.

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- xii. The alignment to be checked properly and welding to be properly spaced, allowing for temperature changes during welding.
- xiii. Carrying out welding including cutting, edge preparation (inclusive of grinding the edges of pipe, fittings, flanges, etc. to match with the matching edges of different thickness wherever required), fit-up, bending, pre-heating wherever required, NDT including radiography and other non-destructive tests as specified.
- xiv. Supply and purging of N₂ gas to purge the line before isolating, venting and commissioning.
- xv. Carrying out pre-commissioning of CGS piping and associated facilities and providing Commissioning assistance to the Company during overall commissioning of the piping.
- xvi. The hydro test of the piping section shall be performed at pressure 1.5 times the design pressure.
- xvii. Installation of all types of valves (manual/ actuated), all types of inline/online instruments, safety valves, tapping for thermowells, sample connections, pressure gauges, etc. for all sizes and ratings including installation and fixing of gaskets, bolts, studs & nuts of all sizes, ratings and materials.
- xviii. All associated civil, structural, mechanical and electrical works including supply of all material required covered in the tender, including construction of pipe supports, fabrication and erection of supporting structural elements for piping such as shoes, clamps, platforms, anchors, guides, insert plates, brackets, structural column etc.
- xix. Painting of pipe supports, piping and all miscellaneous items as required with paints suitable for Normal Corrosive environment / Highly Corrosive environment as defined in "**Standard Specification for Painting**" (Spec. No. VCS-SS-PP-2502). Wherever touch up/repair of primer is required, high build epoxy zinc phosphate primer shall be used.
- xx. Coating of all underground piping if any shall be with 1000-micron thick Solid epoxy.
- xxi. Obtaining all statutory clearances, permissions for the works within existing facilities, as required. Co-coordinating all activities with Company for movement of men and material from and to existing and operating terminals shall be the responsibility of the Contractor.
- xxii. Final clean up and restoration of site, facilities etc. as per the requirement of Company/Engineer-in-Charge.

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- xxiii. Return of all surplus Company supplied free issue material to Company's designated store after completion of works or as directed by Engineer-in-Charge including transportation and stacking at Company's storage yard.
- xxiv. Preparation of as-built drawings, documents and project records, additional support in existing piping, if any as indicated in the drawings or as per instructions of Engineer-in-Charge.
- xxv. Contractor may have to make changes in the pipe routing at site as per site conditions to clear obstructions/ fouling with existing and new facilities.
- xxvi. Providing brackets from existing structure/ other structures for pipe support; modifications/ extension of platforms/extension of walkways, providing additional platforms/ ladders/ walkways for improving/ providing accessibility
- xxvii. Co-ordination as required with other Agencies/Contractor(s) till the time the commissioning operations are complete.
- xxviii. Preparation of detailed procedures for fabrication, installation, testing and pre-commissioning. Such procedures shall be submitted to Company/Engineer-in-Charge for review and approval before execution of work.
- xxix. Any other works not specifically listed herein but required for completion of the works in all respects., Mobilizing and providing all equipment's, manpower (skilled and unskilled), consumable and other resources etc. as required for the execution of the complete job defined herein.

5. OTHER CONDITIONS OF WORK

5.1 Site Visits

Bidders are advised to make site visits to CGS area and make their own assessment with regard to nature of work involved. Appraisal and taking cognizance of site-conditions, Central Government, with respect to State Government rules and regulations/ bye-laws, applicable Indian Standards and Codes, authorities having jurisdiction over the work site(s), environmental and pollution concerns including conditions/ stipulations laid down by the concerned authorities etc. The Contractor is deemed to have recognized any restrictive features and constraints of the site(s) or specific requirements of the work and made due allowance for it in the work to be performed by him.

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Interpretation and verification of data/information furnished by Company. Any additional information/data/surveys etc. required by Contractor for execution of the works shall be obtained by him. Company may assist him in obtaining such information/ data by arranging visit to site.

5.2 Hydrostatic Testing

Piping assembly shall be hydrostatically tested at site. The test shall be in accordance with **"Standard Specification for Inspection, Flushing and Testing of Piping System"** (Spec. No.-VCS-SS-PP-2501) enclosed with the tender document. Holding time shall be twelve hours & test pressure shall be 1.5 times of design pressure.

5.3 Working in Areas of Existing Facilities

Whenever works are to be carried out in existing terminals with facilities under operation. Contractor shall obtain all necessary permissions for working in/around the facility and shall be fully responsible for the safety of the existing facilities/areas during all phases of work and shall fully abide by and comply with the restrictions and conditions imposed on Contractor from time to time. The Contractor shall provide all safety appliances, gas detectors, fire screens required during execution of the work.

Use all health & safety appliance for manpower during working.

Approved dress/ Dungaree / safety dress/ safety boots/ helmet shall be worn during working inside terminal.

5.4 Work Permits

Contractor shall obtain the necessary approvals, cold work permits & statutory permits for all works, from the Company and other authorities (wherever applicable) before the actual works are taken up. All stipulations/ conditions/ recommendations of the said authorities shall be strictly complied with at no extra cost to Company. Company may, however assist the Contractors for obtaining such permission to the extent of issuing recommendation letters only.

As work to be carried out in existing station, contractor shall take all precaution including barricades etc. as instructed by engineer in charge.

5.5 Safety

Contractor shall take all safety precaution as directed by engineer in charge shall be taken for safety of the pipeline while working.

Provision of fire extinguishers, blankets etc. and strict compliance of safety & PPE. Exception to safety adherence shall not be allowed at any point of

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time and work shall be suspended till required safety arrangements are made and penalized accordingly.

Contractor shall take care of all types of safety tools, tackles, devices and apparatus, equipment etc. including ladders and scaffolding etc. complete as required. Strict work permit system shall be followed & safety rules are must for manpower deployed.

All works are to be carried out in existing terminals with facilities under operation. Contractor shall obtain all necessary permissions for working in/ around the facility and shall be fully responsible for the safety of the existing facilities/ areas during all phases of work and shall fully abide by and comply with the restrictions and conditions imposed on Contractor from time to time. The Contractor shall provide all safety appliances, gas detectors, fire screens required during execution of the work.

Contractor shall use all health & safety appliance for manpower during working.

Contractor shall ensure approved dress/ Dungaree / safety dress/ safety boots/ helmet shall be worn during working inside terminal.

Contractor shall ensure provision of fire extinguishers, blankets etc. and strict compliance of safety & PPE.

5.6 Hook-Up with Existing Piping

Cold cutting/dismantling of existing piping at the hook-up locations for hook-up with existing piping system and AFC drawings.

Contractor shall prepare a method statement with drawing for carrying out the hook-up works and submit the same to Company for review and approval. The hook-up work shall be carried out based on the approved methodology, drawings and/or as per site conditions and as per instruction of Engineer-in-Charge. Contractor shall check and ensure the safe working at the existing hook-up locations by using fire screens or any other suitable method duly approved by Company.

5.7 Hook-Up with Pipeline (If required)

Cold cutting/ jointing of newly laid pipeline within or outside CGS plot boundary.

Contractor shall prepare a method statement with drawing for carrying out the hook-up works and submit the same to Company for review and approval. The hook-up work shall be carried out based on the approved methodology, drawings and/or as per site conditions and as per instruction of Engineer-in-Charge. Contractor shall check and ensure the safe working at the existing

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hook-up locations by using fire screens or any other suitable method duly approved by Company. Inertization with nitrogen shall be carried out in case pipeline is already commissioned.

5.8 Non-Destructive Testing (NDT)

NDT requirements for process and other piping shall be in accordance with Piping Material Specification attached with the tender. Repeat Radiography due to defective radiograph on repaired joints due to Contractor's fault and/or additional radiography necessitated due to poor performance of Contractor's welders shall be done at Contractor's cost.

Contractor shall depute independent third-party inspector for carrying out radiographic inspection/ UT and interpretation of radiograph/ UT of welds. Third party inspector shall be approved by Company.

5.9 Pre-Commissioning of Terminal Piping and Commissioning Assistance

Contractor shall make arrangement of functional testing of equipment assembly during pre-commissioning without any extra cost to the Company.

Contractor shall be responsible for pre-commissioning activities and providing commissioning assistance to the Company including supply of manpower, materials, equipment along with necessary piping and instrumentation connections for monitoring flow rate, pressure, temperature etc., temporary venting/blow down along with necessary piping, joints, valves and instrumentation as well as consumables.

5.10 Commissioning

Overall commissioning of the Piping Terminal / Skid and pipeline section which was isolated earlier shall be carried out by Company. However, all assistance including supply of manpower, temporary equipment, tools and tackles etc. for the commissioning of the terminal shall be provided by Contractor. Contractor shall retain manpower required to rectify the workmanship defects, if any, noted during commissioning. Nitrogen for Purging for the terminal shall be supplied by the contractor incase instructed by the Company.

5.11 Responsibility

Review and approval of Contractor's entire work(s) by Company shall in no way relieve the Contractor of his sole responsibility for safe and efficient design / residue engineering, installation and subsequent operation of system.

5.12 Other Works

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Any other work not specifically listed but required for successful completion of entire system.

6. SCOPE OF SUPPLY:

6.1 Company Scope of Supply

Company shall supply the following materials that are required for permanent installation of the piping system, to the Contractor at an appropriate time during the execution stage as free issue materials:

- Above ground mainline pipe from Filtration/Pressure Reduction Metering Skid to Insulating Joint (IJ).
- Motor Operated/ Manual Ball valve – (2" & Above)
- Globe and Plug valves – (2" & Above)
- DRS Unit
- Cascade.
- Compressors
- LCV filling facility

6.2 CONTRACTOR'S SCOPE OF SUPPLY

The procurement and supply of all consumables required for completion of the Work as defined in this tender document except the materials specifically listed above under Company supplied free-issue material (Clause 6.1, shall be entirely the Contractor's responsibility. The item rates quoted for execution of work shall be inclusive of all these materials. All materials supplied by the Contractor shall be strictly in accordance with the requirements of relevant applicable Company Material Specifications in tender document. All equipment, materials, components etc. shall be new and specifically purchased for this job from Company approved vendors, duly inspected by Company approved third party inspection agency (Only manufacturer's certificates shall not be adequate). Contractor shall submit all details to company for review and approval before placement of order. As a minimum, such materials to be supplied by the Contractor shall include, but not limited to the following:

- i) All piping materials including, Station pipes, fittings, flanges, o-lets, spectacle blinds, fire extinguishers of with material conforming to PMS (Doc No. – C241131-0-PP-PMS-2002) and data Sheet enclosed with the bid document.

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- ii) Supply of Insulating Joint with conforming to Data Sheet as per enclosed with the bid document.
- iii) All Valves below 2".
- iv) All materials supplied by the Contractor shall be strictly in accordance with the requirements of relevant Company material specifications enclosed with the tender document.
- v) All type of valves of size below 2" for all ratings at terminals, All, O'lets (sockolets, threadolets etc.), spectacle blinds, spacer & blinds and below 2" required for permanent installation in the system. Each item shall be inclusive of commissioning spares.
- vi) All consumables for welding such as welding electrodes, oxygen, acetylene, inert gases, all types of electrodes, filler wires, brazing rods, flux etc. for welding/cutting and soldering purposes.
- vii) Cold cutting equipment.
- viii) All equipment and materials including consumables required for hook-up wherever required.
- ix) All associated mechanical, civil, structural, architectural, electrical, instrumentation work at all station facilities.
- x) All materials and consumables required for making connection to nitrogen purging for piping section(s), including supply of nitrogen for purging.
- xi) All temporary materials required for filling, pressurizing and dewatering in connection with hydrostatic testing of valve, joint and pup piece assembly, flanges, blind flanges, fittings, temporary gaskets, nuts, bolts, clamps etc. required for fabrication of test headers and all consumables.
- xii) All equipment and consumables required for hydrostatic testing like pumps, pressure and temperature gauges, test water and corrosion inhibitors for test water for hydrostatic testing.
- xiii) All equipment and consumables required for all types of test and NDT (such as radiography, magnetic particle examination, Liquid penetration testing, etc.) including radiographic film, X-ray/gamma ray machines, developing equipment and consumables etc.

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- xiv) All materials required for associated civil and structural works including cement, sand, reinforcement, structural steel etc. for piping supports.
- xv) All types of coating and painting material including primers, paints, solvents, sand blasting material and cleaning agents, compressed air etc.
- xvi) All material required for concreting and grouting works etc.
- xvii) All type of safety tools, tackles, devices and apparatus, equipment etc. including ladders and scaffolding etc. as required.
- xviii) All materials, equipment's and manpower required for providing commissioning assistance.
- xix) All materials including consumables required for hook-up with adjoining pipeline section or wherever required.
- xx) Any other material not specifically listed above but required for successful completion of all works related to the terminal piping whether temporary or permanent in nature.

The item rates quoted for the execution of work shall be inclusive of supply of all materials mentioned above unless specifically covered otherwise under Schedule of Rates.

Payment shall be made for actual materials installed by the Contractor as a part of permanent installation.

6.3 CONDITIONS FOR COMPANY SUPPLIED MATERIAL

- i) The Contractor shall be responsible for taking over of the material and subsequent handling, hauling, transportation to the actual work site(s)/fabrication yard(s) and storage & safe keeping of the materials.
- ii) The Contractor shall inspect all Company supplied free issue materials at the time of taking over from the Company and defects noticed, if any, shall be brought to the notice of Company/Company representative and jointly recorded. Once the material has been taken over by the Contractor, all the responsibility for safe keeping of the materials shall rest with the Contractor. The Contractor shall also be responsible for repair of such defects noticed at the time of taking over and shall be compensated in accordance with the provisions of the contract.
- iii) On completion of the works Contractor shall submit a "Material Appropriation Statement" for all materials supplied by the Company as free issue materials.

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- iv) The scrap allowances shall be permissible as per the provision of contract document. The percentage allowance shall be accounted on the basis of erected pipe length of approved fabrication drawings.
- v) All unused and scrap material shall be the property of the Company and shall be returned by Contractor to Company at Company's designated storage point(s) including transportation of the same from Contractor's stock yard(s)/worksite(s)/work shop(s) to the Company's designated storage point(s). Contractor shall be responsible for the proper measurements of the unused/scrap materials to be returned to the Company.

7. STORAGE OF MATERIALS:

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

8. AS-BUILT DOCUMENTS

Three sets of hard copies of following documents shall be submitted by Contractor:

- (i) Updated as-built drawings (made earlier) of Piping GAD's.
- (ii) Project Records
- (iii) Isometrics

In addition, the above documents shall also be submitted in electronic media i.e. CD ROM diskettes. Software used for the presentation of these documents shall be as follows:

Type of document	Software

a) Reports	MS Word/ Excel

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- b) Drawings AutoCAD

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

9. DOCUMENTS TO BE SUBMITTED AT THE TIME OF BIDDING

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

10. GENERAL

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

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

- a. Scope of work.
- b. Schedule of Rates.
- c. P&ID's
- d. Data Sheets
- e. Piping Material Specification
- f. Job Specifications
- g. Job Standards
- h. Specifications
- i. Standards
- j. Sketch
- k. Other documents not covered

11. CONTRACTOR'S RESPONSIBILITIES

Contractor's responsibilities, besides the scope of work to be performed by him defined earlier, shall also include the following:

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- i. Appraisal and taking cognizance of site-conditions, Central Government, Punjab and Maharashtra State Government rules and regulations/ bye-laws, applicable Indian Standards and Codes, authorities having jurisdiction over the work site(s), environmental and pollution concerns including conditions/ stipulations laid down by the concerned authorities etc. The Contractor is deemed to have recognized any restrictive features and constraints of the site(s) or specific requirements of the work and made due allowance for it in the work to be performed by him.
- ii. Company has provided the available information and survey data along with bid (If required). Company gives no guarantee or warranty as to the accuracy or completeness of the information provided. It is the Contractor's sole responsibility to obtain sufficient information / data.
- iii. Interpretation and verification of data/information furnished by Company. Any additional information/data/surveys etc. required by Contractor for detailed engineering and execution of the works shall be obtained by him. Company may assist him in obtaining such information/ data by issuing recommendatory letters.
- iv. Entire, engineering for procurement & fabrication, engineering for installation including drawings, QA/QC procedures, etc. performed by the Contractor for the CGSs system shall be reviewed and approved by Company. Contractor shall submit six sets of design/detailed engineering documents, drawings, procedures Company's review and approval. All works shall be executed based on approved documents only.
- v. Review and approval of Contractor's entire work(s) by Company shall in no way relieve the Contractor of his sole responsibility for safe and efficient design, engineering, installation and subsequent operation of system.
- vi. Furnishing and mobilizing at site(s) of all construction equipment, manpower, tools and tackles, construction spreads, fully equipped and fully manned with other required support facilities etc. commensurate for spreads needed for successful execution of the works.
- vii. Contractor shall depute independent third-party inspector for carrying out radiographic inspection/ UT and interpretation of radiograph/ UT of welds. Third party inspector shall be approved by Company.
- viii. Pre-commissioning/ commissioning of entire piping system.

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- ix. Preparing and furnishing calculation books, pipe books, material/purchase requisitions, final purchase orders including specifications, Vendor's data books (including Guarantees), fabrication and construction drawings, all survey reports, inspection and testing reports, as-built records for all phases of work.
- x. The Contractor is cautioned to exercise extreme care and take necessary precautions to prevent damage to the existing facilities, electrical and other cables during execution of the entire works. Restoration/reconstruction of all structures/ facilities affected during construction shall be carried out by Contractor.
- xi. Contractor shall carry out all testing and inspection of materials, equipment etc. in independent testing institutions, laboratories, if so desired by Company.
- xii. Disposal and treatment of treated hydro-testing water, excavated materials, surplus materials etc. as per local authority's requirements.

Any other work not specifically listed but required for successful completion of entire system.

12. AS BUILT DOCUMENT

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

- All inspection & testing documents.
- All purchase specification & procurement documents.
- All piping GA drawings and supports at terminals.
- Installation and testing reports.
- All purchase specification and procurement documents.
- All Inspection, Testing and NDT records. Radiographs/ UT of all weld joints.
- All inspection & testing documents.
- All purchase specification & procurement documents.

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DATA SHEET

		DATA SHEET : BALL VALVE (LESS THAN 2.0 INCH) SOCKET WELDED					
PMC		VCS QUALITY SERVICES PVT. LTD.					
DATA SHEET : BALL VALVE (LESS THAN 2.0 INCH) SOCKET WELDED							
GENERAL SPECIFICATION							
Process Fluid	NG	ANSI Pressure Rating	800#				
Design Temperature	(-)29°C to 65°C	Design Pressure	49 barg				
Size, Inch (DN)	Less than 2" (50)						
Valve Type	Full Bore, Floating Ball						
End Connection Type	Socket Welded	Design Standard	BS EN ISO 17292				
Face Finish	Not Applicable	Locking Arrangement					
VALVE DESIGN CONDITIONS							
Corrosion Allowance	1.5 mm	Design Factor	0.4				
Installation	Above Ground	Stem Ext Length (mm)	Not Applicable				
VALVE OPERATION							
Actuation Type	Not Applicable	Type of Actuator	Not Applicable				
PUP PIECE DETAILS							
100mm extension pups in ASTM A106 Gr.B, Sch 160 (for 3/4") and Sch XS (for 1 1/2")							
VALVE MATERIAL SPECIFICATION							
PART DESCRIPTION	MATERIAL SPECIFIED			MATERIAL OFFERED (Equivalent or Higher)			
Body	ASTM A105						
Ball	13% Cr Steel						
Body Seat	RPTFE/ DELRIN						
Gland	13% Cr Steel						
Stem (No Casting)	13% Cr Steel						
Body Seal	Grafoil						
Stem Seal	Grafoil						
Body Studs/ Nuts	ASTM A193 Gr. B7/ A194 Gr. 2H						
TESTING REQUIREMENT							
Hydrostatic Test Pressure & Time	Body: 210 kg/cm ² & 30 Minutes			Seat: 155 kg/cm ² & 30 Minutes			
Pneumatic Test Pressure & Time	7 kg/cm ² & 15 Minutes						
Hardness Test	248 HV10 max.						
Charpy Impact Test @ Temperature	Yes (at -29°C)						
Anti-Static Testing Requirement	As per BS EN ISO 17292						
Fire Safe Test	API 607 / API 6FA						
DOCUMENT NO.							
VCS-00-PP-DS-2001A							
		D1	11.06.2026	AS	PA	DK	ISSUED FOR BID
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DATA SHEET : BALL VALVE (LESS THAN 2.0 INCH) SOCKET WELDED

PMC

VCS QUALITY SERVICES PVT. LTD.

DATA SHEET : BALL VALVE (LESS THAN 2.0 INCH) SOCKET WELDED

Valve Painting Specification :

1	Surface Preparation by Short Blasting as per grade SA 2 1/2, Swedish Standard SIS-055 909.
2	For above ground installation - Three coats of corrosion resistant paint shall be applied with minimum thickness of 300 micron (Permissible thickness in each coat shall be within 80 to 120 micron). Colour of paint shade shall be RAL-7038, however any change in colour shall be finalized during drawing approval stage.
3	Lock open/ lock close requirement : As indicated in P&ID / Schedule of Rates (SOR).

NOTES :

1	This Data Sheet shall be read in conjunction with Tender Documents & Specifications.
2	Material test certificates and hydrostatic test reports shall be furnished prior to dispatch.
3	Gland Packing Assembly shall permit repair of gland packing under full line pressure.
4	Detailed dimensional drawings showing cross-section with part numbers and materials shall be submitted for purchaser's approval prior to manufacture of the valves.
5	All valves shall be provided with valve position indicator.
6	Separate wrench shall be provided with each wrench operated valve.
7	Stops shall be provided to ensure positive alignment of ball with ports and ensure proper installation of handle.
8	The Charpy Impact Test temperature specified in datasheet shall supersede the specification requirements.
9	Painting procedure of valves shall be as per Manufacturer's standard.
10	All tests shall be as per BS EN 12266.
11	Inspection and Testing shall be as per attached QAP, this datasheet, BS EN 12266, other relevant standards.
12	Minimum all pressure containing and controlling parts of the valve shall be provided with EN 10204-3.2 certificate.

DOCUMENT NO.							
VCS-00-PP-DS-2001A							
		D1	11.06.2026	AS	PA	DK	ISSUED FOR BID
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		DATA SHEET : GLOBE VALVE (LESS THAN 2.0 INCH) SOCKET WELDED					
PMC		VCS QUALITY SERVICES PVT. LTD.					
DATA SHEET : GLOBE VALVE (LESS THAN 2.0 INCH) SOCKET WELDED							
GENERAL SPECIFICATION							
Process Fluid	NG	ANSI Pressure Rating		800#			
Design Temperature	(-)29°C to 65°C	Design Pressure		49 barg			
Size, Inch (DN)	Less than 2" (50)						
Valve Type	Rising Stem						
End Connection Type	Socket Welded	Design Standard		BS EN ISO 15761			
Face Finish	Not Applicable	Locking Arrangement					
VALVE DESIGN CONDITIONS							
Corrosion Allowance	1.5 mm	Design Factor		0.4			
Installation	Above Ground	Stem Ext Length (mm)		Not Applicable			
VALVE OPERATION							
Actuation Type	Not Applicable	Type of Actuator		Not Applicable			
PUP PIECE DETAILS							
100mm extension pups in ASTM A106 Gr.B, Sch 160 (for 3/4") and Sch XS (for 1 1/2")							
VALVE MATERIAL SPECIFICATION							
PART DESCRIPTION	MATERIAL SPECIFIED			MATERIAL OFFERED (Equivalent or Higher)			
Body	ASTM A105						
Bonnet (Bolted)	ASTM A105						
Disc (Loose Plug/ Ball Type)	SS316 + Stellite						
Stem (Rising)	13% Cr Steel (No Casting)						
Body Seat Ring	SS316 + Stellite						
Stem Packing (Renewable with valve open on stream)	Corrosion inhibited die formed flexible graphite with braided anti extrusion rings						
Hand Wheel (Rising)	Malleable Iron/ Cast Steel/ Fab. Steel						
Bonnet Gasket	Spiral Wound SS316 + Grafoil						
Body Studs/ Nuts	ASTM A193 Gr. B7/ A194 Gr. 2H						
TESTING REQUIREMENT							
Hydrostatic Test Pressure & Time	Body: 210 kg/cm ² & as per BS 5352			Seat: 155 kg/cm ² & as per BS 5352			
Pneumatic Test Pressure & Time	7 kg/cm ² & as per BS 5352						
Hardness Test	248 HV10 max.						
Charpy Impact Test @ Temperature	Yes (at -29°C)						
Fire Safe Test	API 607 / ISO10497						
DOCUMENT NO.							
VCS-00-PP-DS-2001B							
		D1	11.06.2026	AS	PA	DK	ISSUED FOR BID
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		PROJECT NUMBER: C241131					
DATA SHEET FOR INSULATING JOINT				TOTAL SHEET		05	
DOCUMENT NO		C241131	CGD	PL	DS	2002	
 NORTH EAST GAS DISTRIBUTION COMPANY LIMITED (NEGDCL) COMPOSITE WORK OF MOTHER STATION AT MANGALDOI FOR CITY GAS DISTRIBUTION PROJECT OF NEGDCL							
C1	19.06.2026	ISSUED FOR CLIENT REVIEW			PT	PA	DK
REV	DATE	DESCRIPTION			PREP	CHK	APPR

IJ Material Requisition (MR).	
IJ Specification No.	VCS-SS-PP-2029
<u>DESIGN DATA FOR INSULATING JOINT FOR CS LINE</u>	
Service, Design Life (Minimum)	Natural Gas, 25 yrs.
Size (OD), mm	114.3 (4")
Design Pressure	49 kg/cm ²
ANSI Rating / Design Factor	300# / 0.4
Design Temperature (°C)	-29 to 65
Corrosion Allowance (mm)	1.5
Design Code (Pipeline / Insulating Joint)	ASME B31.8 / ASME Sec VIII Div -I
End Connection/End Finish	Butt weld ends. Bevelled as per Line pipe Specification /API 5L
Insulating Joint type	Monolithic
Installation	Above ground
Piggability	Non Piggable
Bevel end protection	Required, metallic or high impact plastic bevel protectors;
<u>TESTING</u>	
Charpy Impact Test	Required, at (-)29° C
Hardness Test	Required, maximum hardness of base metal, weld metal & HAZ of all the pressure containing parts shall not exceed 248 HV10
Di-Electric test	5 KV AC, 50 Hz For One Minute Minimum
Insulation Resistance Test	Min. 25 Mega Ohms, when checked with 500-1000 v dc
Hydrostatic Test	At 75 Kg/Cm ² for Minimum Time 15 Minute
Pneumatic Test	7 Kg/cm ² for minimum Time 10 Minutes.
Internal Vacuum Sustainability	Five (5) Millibar for 5 minutes.
Torsional Test	Required, as per Manufacturer Std
Chemical Test	Required, as per Specification

 Energising Quality	DATA SHEET FOR INSULATING JOINT	Document No.	Rev
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Allowable Force and Moments	Vendor to Specify	
Dimensional Check	Required, as per Specification & Approved Drawings/ITP	
Visual Inspection	Required, As per Specification & Approved ITP	
Other Testing	Required, As per Specification	
NDE	- Wet MPI on 100% Forged Surfaces (MSS SP 53) 100% RT of Butt Weld (API 1104) 100% UT / MPI of fillet welds (As per ASME SEC. VIII) , Refer spec for Fillets Thickness 100 % UT of Finished Bevel Ends - DP of Butt Weld - 100%	
<u>SURFACE PREPARATION, PAINTING & MARKING</u>		
Surface Preparation	Shot Blasting to SP10 in accordance with "Steel Structures Painting Council- Visual Standard SSPC-VIS-I	
Painting (Internal Coating)	Two-pack (solvent free) non-conducting epoxy compound (cold or hot curing). Total DFT –200 micron. Shade Brown	
Painting- External (Non-conducting epoxy :3 Layer Paint System)	Primer: Two Pack Non-Conducting Epoxy, (Total DFT – 200 -micron) Finish Coat: Polyurethane Epoxy – DFT 100-micron, Shade Orange, The coating shall end approximately 75mm from the ends of the joint.	
Final Colour Shade	Canary Yellow	
Marking	On stainless-steel name plate as per Specification	
INSULATING JOINT MATERIAL (EQUIVALENT OR SUPERIOR)		
Part	Material of Construction	
	Specified	Offered
Body	ASTM A694 F52	
Pups	API 5L Gr X-52, PSL-2 THK. Match with connecting Pipe	
Epoxy resin Filler Material	CIBA Araldite CY-220 & Araldite HT-951 hardener.	

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Spacing Ring (Insulating Ring)	Epoxy glass fiber reinforced laminate (comply with ASTM D 709 Type TV, Group G-11 properties) Average dielectric strength shall be minimum 15 KV. (Compressive Strength $\geq$ 450 MPa)		
Sealing Ring /Gasket	Hardness test, Viton ASTM D2000 or as per Vendor Recommendation		
Sealant Material	Cold Curing Thermosetting Resin + Hardner. (Compressive Strength $\geq$ 150 Mpa)		
Test Lugs	IS2062		
External Coat	Aliphatic Polyurethane-300 Micron DFT		
Internal Coat	High Solids Epoxy-300 Micron DFT		
Double Seal Requirement	Yes		
CONNECTING PIPE DETAILS			
S. No.	Outside Diameter, OD mm (inch)	Wall Thickness, (mm)/ Schedule	Material
1	114.3 (4")	6.4	API 5L Gr. X-52 PSL-2

Notes:

- The internal diameter of Insulating Joint shall be uniform through out the entire length and shall not be less than specified internal diameter of connecting Pipeline.
- Insulating joint shall comply the requirement of Project Specification VCS-SS-PP-2029.
- The Charpy Impact temperature shall be (-)29° C as specified in data sheet and shall supersede the temperature requirement specified in Specification
- For the welding end, the out of roundness and tolerance on internal diameter at pipe ends shall be same as diameter tolerance for the pipe ends indicated in line Pipe Specification & API 5L.

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5. Insulating Joint shall be suitable for all type of pigging operation.
6. Insulating Joint shall be monolithic boltless.
7. Vendor to ensure that all material specified herein/ offered is suitable for specified fluid type & design & operating Condition.
8. All applicable test (Impact, hardness, Chemical, mechanical etc) shall also be carried out on pup piece.
9. Overall isolating joint's length shall be such that the heat generated by field welding is not detrimental to the insulating, filler materials, and internal/external coating.
10. Vendor shall furnish the allowable forces & moments for the axial, lateral & transverse (i.e., X, Y & Z) directions
11. Manufacturing shall not commence until materials, dimension (including the calculation sheet), drawings, manufacturing process and welding procedure qualification selected by the Manufacturer are approved by COMPANY.
12. Manufacturer shall ensure that the wall thickness (W.T.) of all parts of insulating joint shall be adequate to sustain design pressure and selected W.T. shall be suitable for welding with W.T. of connected pipeline.

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PMS



PROJECT NUMBER: C241131



PIPING MATERIAL SPECIFICATION

Total Sheets

39

Document No

C241131

00

PP

PMS

2002



NORTH EAST GAS DISTRIBUTION COMPANY LIMITED (NEGDCL)

**COMPOSITE WORK OF MOTHER STATION AT
MANGALDOI FOR CITY GAS DISTRIBUTION PROJECT OF
NEGDCL**

C1	29.09.2025	ISSUED FOR CLIENT REVIEW	AS	PA	DK
REV	DATE	DESCRIPTION	PREP	CHKD	APPR

ABBREVIATION

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AARH	Arithmetic Average Roughness Height
BS	British Standards
CS	Carbon Steel
MS	Mild Steel
IS	Indian Standard Code
NFPA	National Fire Protection Association
OISD	Oil Industry Safety Directorate
PNRGB	Petroleum & Natural Gas Board
ERW	Electric Resistance Welding
BE	Bevel End
BW	Butt Welded
FF	Flat Face
PBE	Plain Both End
PE	Plain End
RF	Raised Face
SCRF	Screwed End - Female
SCRM	Screwed End - Male
CA	Corrosion Allowance
M	To Match Pipe

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1.0 INTRODUCTION

This specification covers minimum requirements for the material specification for pipe, fittings, flanges, line blinds, bolts, gaskets, and valves that shall be used for natural gas pipeline and associated facilities in accordance with ASME B31.8, OISD-226 and PNGRB guideline.

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

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

2.0 CODES AND STANDARDS

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

ASME 31.3	:	Process Piping
ASME 31.8	:	Gas Transmission and Distribution Piping Systems
OISD STD-226	:	Natural Gas Transmission Pipeline and City Gas Distribution Networks
PNGRB	:	Petroleum and Natural Gas Regulatory Board

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

For sake of brevity the initials of the society to which the codes are referred may be omitted in the specifications, for example, B16.5 is a code referring to ASME A106 is a code referring to ASTM.

In addition to this PMS, various piping and pipeline materials shall also be applicable.

3.0 MATERIAL SPECIFICATIONS

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

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4.0 CLASS DESIGNATION CODE

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

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

15 - 150 Class

30 - 300 Class

The first alphabet indicates differences in the Fluid Services within the same class rating and material, e. g. H stands for Hydrocarbon, W stands for Water, G stands for Galvanize etc.

The last one or two letter (as applicable) indicates type of material, e.g.

C - Carbon steel

LT - Low Temperature (Carbon Steel)

5.0 TECHNICAL REQUIREMENTS

5.1 General Notes

1. All piping materials selected under this specification shall be in compliance with the project specification.
2. Material selections shall comply with the maximum pressure and temperature limitation as specified in the service summary.
3. Substitution of equivalent materials is subject to approval of the Client /PMC. All requests for substitution shall be accompanied with sufficient data, drawings and descriptive details to permit evaluation by the Client /PMC.
4. Cast iron, ductile or malleable iron, aluminum, plastic or copper-bearing alloys shall not be used in hydrocarbon service.
5. Piping design pressure is based on flange maximum-allowable working pressure, unless otherwise noted in Job Specification.
6. When required, impact testing shall comply with applicable standards and material specifications.
7. All gaskets shall be asbestos free.
8. Aluminum jumper shall be provided across the flanged joint and length of the bolt shall be taken such that at least two threads remain exposed after the nut for fixing the continuity jumper.

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5.2 Units

1. All units are expressed in SI system with the exception of nominal pipe sizes (NPS) and bolting diameters, which are in inches.
2. Pressures are gauge pressures (in Kg/cm²g) and temperatures are in deg. Celsius (°C).
3. Pressures and Temperatures ratings are based ASME 16.5.

6.0 PIPELINE

- Line pipe material grade and wall thickness details are indicated in PMS.

7.0 PIPES

- Carbon steel pipe shall be made by open hearth, electric furnace or basic oxygen process only. The steel used shall be fully killed and made with fine grain structure. The grade and wall thickness of various sizes of pipes shall be as per piping material specification for the applicable class.
- Pipe dimensions shall be in accordance with ASME B 36.10 for carbon steel ASTM standard pipes & API 5L for carbon steel API 5L grade pipes.
- All pipe threads shall conform to American Standard taper as per ASME B 1.20.1 NPT, unless otherwise specified.
- For butt weld end, bevel shall be in accordance with API specification 5L or ASME B16.25 as applicable.
- Where difference in thickness of matching pipe ends exist, bevels for such matching pairs shall be prepared in accordance with ASME B 31.8.
- Pipes shall be supplied with beveled end. Beveling shall be in accordance with ASME B16.25. Where plain end pipes are specified, as for small bore pipes for socket welded piping, the pipes shall be supplied with square cut ends.
- All pipe threads shall conform to American Standard taper as per ASME B 1.20.1 NPT, unless otherwise specified.
- Dimensions of socket weld ends shall confirm to ASME B 16.11. Bore shall match pipe OD and pipe ID.
- Pipe to pipe joints shall be made as follows:

For sizes upto & including DN40

Socket weld/ As per Piping Class

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For size DN50 and above

Butt Welded

8.0 FITTINGS

- Fully killed carbon steel shall be used in the manufacture of fittings. The fitting shall have carbon equivalent not exceeding 0.45, based on check analysis.
- Threaded joints, if used, shall conform to American Standard taper as per ASME B1.20.1 NPT.
- Dimensions of socket welded/screwed fittings shall conform to ASME B 16.11. Swage shall be as per BS 3799.
- Dimensions of steel butt welded fittings shall be as per ASME B 16.9.
- Bore of socket welded fittings shall suit outside diameter (OD) of pipe and its thickness.
- Butt welding ends shall conform to API specification 5L or ASME B 16.25 as applicable. In case of difference in thickness of matching ends, requirements of ASME B 31.4 shall apply.
- Integrally reinforced forged branch fittings such as Sockolet, Weldolet etc. shall be as per MSS-SP-97. Fittings not covered in ASME B16.9 and MSS-SP-97 shall conform to manufacturer's standard.
- Fittings thickness tolerances shall match pipe thickness tolerance.

9.0 BENDS

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

$D =$ Specified Outside Diameter

- Miters shall not be used.

10.0 FLANGES

- Pressure Temperature rating of flanges shall conform to B16.5/ MSS-SP44/ B16.47 Series A, as applicable.
- Dimensions of flanges shall be in accordance with B16.5/ MSS-SP44/ B16.47 Series A, as applicable.
- Neck of weld neck (WN) flanges shall suit pipe bore and thickness.
- Bore of socket welded (SW) flanges shall suit pipe O.D. and its thickness.

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- Threads for screwed flanges, if used, shall conform to American Standard taper as per ASME B 1.20.1 NPT.
- Sizes for blind flanges shall be indicated by nominal pipe size.
- Unless specified otherwise in Piping Material Specification the flange face finish shall be as per ASME B16.5.
- Butt welding ends of WN flanges shall conform to ASME B 16.25.
- Spectacle blind/spacer & blinds shall be in accordance with ASME B 16.48/ manufacturer's standard.
- Flange face finish for raised face flanges shall be as per ASME B16.5/ ASME B 16.47 as applicable. For RTJ flanges groove finish shall be 32-63 micro inches AARH as per MSS-SP-6. Hardness of groove surface shall be minimum 140 BHN.
- Butt welding ends of WN flanges shall conform to ASME B 16.25.
- Spectacle blind/spacer & blinds shall be in accordance with ASME B16.48 / manufacturer's standard.
- Two jackscrews, 180° apart shall be provided for all RTJ flange assemblies and Spacer blind/ Figure 8 assemblies. Holes for jackscrews shall be drilled and tapped at site. Jackscrews shall be as per ASTM A193 Gr. B7. Heads of jackscrews shall be heavy hexagonal type and jackscrew end shall be rounded. Dimensions shall be as per ASME B18.2.1.
- Flanges shall be packed and shipped in such a way as to prevent damage of machined parts.
- All machined or threaded parts shall be protected in accordance with ASTM A700. Suitable protection shield, or cover shall be provided on the gasket contact surface.
- Carbon steel forgings shall be supplied with a maximum carbon content of 0.25% and CE of 0.45 by product analysis.
- The finish of contact faces of pipe flanges & connecting end flanges of valves & fittings shall be governed by ASME B16.5 & following:
Roughness requirements (Finish: AARH standards per ASME B46.1):
a) Raised Face (RF): Serrated finish 125 to 250 µin Ra.
b) Flat Face (FF): Serrated finish 125 to 250 µin Ra.
c) Ring Type Joint (RTJ): Extra-smooth finish 63 µin Ra max.
- Flat face flanges, unless specified on the Piping Specifications, shall not be used without specific Client/PMC approval. Full-face gaskets shall be used with flat-face flanges as per ASME B16.20.

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- All flanged joints shall be installed with a single gasket between contact faces.
- Spectacle blank (figure 8 blank), blank (blind) & spacer shall conform to the requirement of ASME B16.48 up to sizes 24". For 150#, 300# and 600# spectacle blank shall be used up to 8", blank (blind) & spacer for sizes 10" & above

11.0 GASKETS

- Spiral wound metallic gasket with Graphite filled winding with SS304 inner ring and CS outer ring/ Soft iron octagonal ring type joint gasket, and shall conform to ASME B 16.20/ API 601
- Spiral wound gaskets shall be self-aligning type.

12.0 BOLTING & THREADS

- Nuts for stud bolts shall be American Standard Hexagon Heavy Series and double chamfered.
- Dimension and tolerances for stud bolts and nuts shall be as per ASME B18.2.1 and 18.2.2 with full threading to ASME B 1.1 Class 2A thread for bolts and Class 2B for nuts. Diameter and length of stud bolts shall be as per ASME B16.5/ASME B16.47 with full threading.
- Threads for nuts shall be as per ASME B 1.1 as follows:

Nuts for stud bolts Dia ¼" to 1"	:	UNC-2B
Nuts for stud bolts Dia 1⅛" to 3¼"	:	8UN-2B
- Threads for stud bolts shall be as per ASME B 1.1, as follows:

Stud bolts Dia ¼" to 1"	:	UNC-2A
Stud bolts Dia 1⅛" to 3¼"	:	8UN-2A
- Threads for threaded pipe, fitting, flanges and valve shall be in accordance with B1.20.1 taper threads, unless specified otherwise.
- Heads of jack screws shall be heavy hexagonal type. Jack screw end shall be rounded. Stud bolts shall be fully threaded with two hexagonal nuts.

13.0 THREAD SEALANT

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

14.0 VALVES

- Valve ends shall be as per valve data sheets for various piping class.
- Sectionalizing valves, Block valves and other isolation valves installed on the main pipeline shall be ball valves with butt welding ends. All inline isolation valves on the

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mainline (pipeline) shall be full bore valves to allow smooth passage of cleaning as well as intelligent pigs.

- All buried valves shall be provided with stem extension shall have Butt Welded ends as per relevant specification/ data sheet.
- All valves in the piggable section of pipeline and Main Process Flow Line shall be Full Opening valve as per API 6D. Other valves shall be Reduced Opening type unless specified otherwise in P&ID.
- Flange dimensions and face finish of flanged end valves shall conform to clause 10.0 of this specification.
- Butt welding ends of Butt Welded valves shall conform to ASME B 16.25.
- Face to face and end to end dimensions shall conform to applicable standards.
- Valves shall conform to following standards unless specified otherwise in piping material specification for various piping class.

Flanged/Socket Welded end valves (1½" and below)
Design STD. for Process lines

Gate Valves	:	API 602
Globe Valves	:	BS EN ISO 15761
Check Valves	:	BS EN ISO 15761
Ball Valve	:	BS EN ISO 17292
Plug Valve	:	BS 5353

Flanged/Butt Welded end valves (2" and above)
Design STD. for Process Lines

Gate Valves	:	API 6D
Globe Valves	:	BS 1873
Check Valves	:	API 6D
Ball Valve	:	API 6D
Plug Valve	:	API 6D

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

For ANSI class 150 and 300

- Hand wheel operated for size ≤ 12" NB.
- Gear operated for size ≥ 14" NB.

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For ANSI class 600

- Hand wheel operated for size ≤ 10 " NB.
- Gear operated for size ≥ 12 " NB.

- **Globe Valves**

For ANSI class 150, 300, 600 and 900 - Hand wheel operated for all Size.

- **Ball Valves & Plug Valves**

For all ANSI class

- Wrench operated for size ≤ 4 " NB.
- Gear operated for size ≥ 6 " NB.

- **Actuated Valves**

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

15.0 QUICK OPENING END CLOSURE

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

16.0 HYDROTESTING VENTS AND DRAINS

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

17.0 PIPING SPECIALTY ITEMS

- Primary material Pipeline specialty items viz. flow tees, insulating joints, LR bends etc. shall be as per respective data sheets and specification.
- For mainline items, corrosion allowance shall be as per respective data sheet.

18.0 INSULATING GASKET, SLEEVE AND WASHER

The insulating gasket shall consist of a PTFE (Teflon) spring-energized face seal, or an elastomeric O-ring, seated in an isolating laminate, which shall be permanently bonded

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to a high strength metal gasket core. Due to this unique pressure activated sealing mechanism, the gasket requires far less bolt stress to seal than any other gasket. The gasket inner diameter shall be exactly matched to the flange bore to eliminate turbulent flow and flange face erosion/ corrosion. The seal elements shall be replaceable in the reusable gasket retainer. The core of gasket shall be made of annealed 316 stainless steel or other metals including duplex and Inconel etc.

Insulating gasket shall include the following applications,

- Flange isolation in conjunction with Cathodic protection.
- Isolation between dissimilar metals to prevent galvanic corrosion.
- Mating mismatched ring-joint to raised -face flanges.
- Eliminate fluid trap corrosion between ring-joint (RTJ) flanges where high concentrations of Co₂, H₂S and other aggressive hydrocarbon media are present.
- Eliminate turbulence and flow induced erosion between ring-joint (RTJ) flanges.
- Protect against coating impingement on coated flange faces.
- To seal between flanges subjected to vibration/ cavitation.

18.1 Insulating Gaskets, Sleeves and Washer Materials Properties

Compressive Strength	:	65000 psi
Average Dielectric Strength	:	15 kV or more
Electrical Resistance	:	>1 MΩ (When tested with 500-1000 V DC merger)
Max. Operating Temperature	:	302°F (150°C)
Min. Operating Temperature	:	(-) 200°F (-129°C)
Water Absorption	:	5%
Flexural Strength	:	70000 psi
Tensile Strength	:	50000 psi
Bond Strength	:	2600 lb.
Shear Strength	:	22000 lb.

18.2 Seal Material

The sealing elements shall intend to provide an impervious barrier through which no contained media or other substance can penetrate. The composite retainer backing

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material behind the seal remains uncontaminated and thus permanently holds the seal in place in a static, fully encapsulated manner.

Viton as a seal material shall consist following properties,

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

Isolating Sleeve

Mylar as a seal material shall consist following properties,

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

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

Steel Washer: ZPS standard – Zinc plated steel washers.

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

The dimensions of insulating components (gaskets, sleeves and washers) shall be as indicated in Data Sheet. The insulating gasket and washers shall have adequate compressive strength to permit proper tightening of flange bolts for leak proof joint.

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

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

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

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

19.0 CHARPY V-NOTCH TEST & HARDNESS TEST

All piping material like valves, fittings, flanges bolting etc. shall be Charpy impact

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tested. Charpy V-notch impact tests are required for the base metal weld metal and heat-affected zone (HAZ)

Appendix – A

Piping Material Specification – Index

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Sr. No.	Piping Class	Rating	C. A. (MM)	Spl. Reqt.	Basic Material	Service	Remarks
1	15HC	150	1.5	NON IBR	CARBON STEEL	NON-CORROSIVE PROCESS-FLAMMABLE /NONFLAMMABLE, NON LETHAL- HYDROCARBONS	Page 17
2	15HLT	150	1.5	LOW TEMPER ATURE SERVICE	CARBON STEEL	NON-CORROSIVE PROCESS-FLAMMABLE /NON-FLAMMABLE, NON LETHAL- HYDROCARBONS	Page 22
3	30HC	300	1.5	NON IBR	CARBON STEEL	NON-CORROSIVE PROCESS-FLAMMABLE / NONFLAMMABLE, NON LETHAL- HYDROCARBONS	Page 28
4	30HLT	300	1.5	LOW TEMPER ATURE SERVICE	CARBON STEEL	NON-CORROSIVE PROCESS-FLAMMABLE / NONFLAMMABLE, NON LETHAL- HYDROCARBONS	Page 35

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Appendix – B

Piping Class

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PIPE CLASS	15HC
DESIGN CODE	ASME B31.8
RATING	150#
BASE MATERIAL	CARBON STEEL
CA	1.5 MM
SPECIAL REQUIREMENT	Non IBR
SERVICE	Natural Gas, Utilities (water, inst. air, plant air, nitrogen, carbon dioxide)

Temperature (Deg. C) and Pressure (Kg/cm²g) Ratings

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

NOTES:

1. All vents and drains shall be provided with gate valve with blind flange assembly unless otherwise indicated in P&ID.
2. NDT of welds shall be as follows:
Radiography : All butt welds 100%
MPI : Socket welds 100%
3. Piping design as per ASME B 31.8, OISD 226 & PNGRB Guidelines
4. Charpy V notch test and hardness test shall be conducted for pipes, fittings and flanges at (-) 29°C.
5. All branch connections including vent, drain, pressure and temperature connection shall be as per branch connection table.
6. For valves, refer valve data sheets.

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

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Branch Table

CODES	DESCRIPTION
T	Tees
W	Weldolet

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S Sockolet

Item	Lower Size (Inch)	Upper Size (Inch)	Sch. / Thk.	Dmn. STD	Material (Charpy)	Description
PIPE GROUP						
PIPE	00.500	00.750	S160	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS
PIPE	01.000	01.500	XS	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS
PIPE	02.000	02.000	XS	B-36.10	ASTM A 106 GR.B (Charpy)	BE, SEAMLESS
PIPE	03.000	14.000	STD	B-36.10	ASTM A 106 GR.B (Charpy)	BE, SEAMLESS
PIPE	16.000	24.000	STD	B-36.10	ASTM A 672 B65 CL-12 (Charpy)	BE, E.FS.W
NIPPLE	00.500	01.500	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS
FLANGE GROUP						
FLNG.SW	00.500	01.500	M	B-16.5	ASTM A 105	150, RF/ 125AARH
FLNG.WN	2.000	24.000	M	B-16.5	ASTM A 105 (Charpy)	150, RF/ 125AARH
FLNG.BLIND	00.500	01.500		B-16.5	ASTM A 105	150, RF/ 125AARH
FLNG.BLIND	00.500	24.000		B-16.5	ASTM A 105 (Charpy)	150, RF/ 125AARH
FLNG.FIG.8	00.500	08.000		ASME B16.48	ASTM A 105 (Charpy)	150, FF/ 125AARH
SPCR&BLND	10.000	24.000		ASME B16.48	ASTM A 105 (Charpy)	150, FF/ 125AARH
FITTING GROUP						
ELBOW.90	00.500	01.500		B-16.11	ASTM A 105	SW, 6000
ELBOW.90	02.000	12.000	M	B-16.9	ASTM A 234 GR.WPB (Charpy)	BW, 1.5D
ELBOW.45	00.500	01.500		B-16.11	ASTM A 105	SW, 6000
ELBOW.45	02.000	24.000	M	B-16.9	ASTM A 234 GR.WPB (Charpy)	BW, 1.5D
T.EQUAL	00.500	01.500		B-16.11	ASTM A 105	SW, 6000

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T.EQUAL	02.000	24.000	M	B-16.9	ASTM A 234 GR.WPB (Charpy)	BW
T.RED	00.500	01.500		B-16.11	ASTM A 105	SW, 6000

Item	Lower Size (Inch)	Upper Size (Inch)	Sch. / Thk.	Dmn. STD	Material (Charpy)	Description
T.RED	02.000	24.000	M, M	B-16.9	ASTM A 234 GR.WPB (Charpy)	BW
REDUC. CONC	02.000	24.000	M, M	B-16.9	ASTM A 234 GR.WPB (Charpy)	BW
REDUC. ECC	02.000	24.000	M, M	B-16.9	ASTM A 234 GR.WPB (Charpy)	BW
SWAGE. CONC	00.500	03.000	M, M	BS-3799	ASTM A 105 (Charpy)	PBE
SWAGE.ECC	00.500	03.000	M, M	BS-3799	ASTM A 105	PBE
CAP	00.500	00.750		B-16.11	ASTM A 105	SCRF, 6000
CAP	01.000	01.500		B-16.11	ASTM A 105	SCRF, 3000
CAP	02.000	24.000	M	B-16.9	ASTM A 234 GR.WPB (Charpy)	BW
PLUG	00.500	00.750		B-16.11	ASTM A 105	SCRM, 6000
O'let						
WELDOLET	02.000	06.000	M, S160	MSS-SP97	ASTM A 105 (Charpy)	BW
SOCKOLET	00.500	00.750		MSS-SP97	ASTM A 105	SCRF, 6000
SOCKOLET	01.000	01.500		MSS-SP97	ASTM A 105	SW, 3000
VALVES GROUP						
VLV.GLOBE	00.250	01.500		BS EN ISO 15761	BODY-ASTM A 105,TRIM- STELLITED,STEM- 13%CR STEEL	SW, 800, 3000, B- 16.11
VLV.GLOBE	02.000	24.000		BS-1873	BODY-ASTM A 216 GR.WCB,TRIM- 13% CR.STEEL	FLGD, 150, B- 16.5, RF/125AARH

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VLV.CHECK	00.250	01.500		BS EN ISO 15761	BODY-ASTM A 105,TRIM- STELLITED	SW, 800, 3000, B- 16.11
VLV.CHECK	02.000	24.000		API-6D	BODY-ASTM A 216 GR.WCB,TRIM- 13% CR.STEEL	FLGD, 150, B-16.5, RF/125AARH

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Item	Lower Size (Inch)	Upper Size (Inch)	Sch. / Thk.	Dmn. STD	Material (Charpy)	Description
VLV.BALL	00.500	01.500		BS EN 1SO 17292	BODY-ASTM A 105,TRIM-13% CR.STEEL, SEAT-RPTFE	SW, 800, B-16.11, RF/125AARH
VLV.BALL	02.000	24.000		API-6D	BODY-ASTM A216 GR.WCB,TRIM/BALL SEAT-(AISI 4140 + 0.003"ENP)/AISI 410	FLGD, 150, B-16.11, RF/125AARH
VLV.BALL	02.000	24.000		API-6D	BODY-ASTM A 216 GR.WCB, TRIM-BALL, SEAT-(AISI 4140 + 0.003"ENP) /AISI 410	BW, 150, B-16.25
VLV.PLUG	00.500	01.500		BS-5353	BODY-ASTM A 105,PLUG - A105 + 0.003" ENP	SW, 800, 3000, B-16.11,
VLV.PLUG	02.000	24.000		API-6D	BODY- A 216GR. WCB, PLUG: A216 GR.WCB + 0.003" ENP	FLGD, 150, B-16.5, RF/125AARH
VLV.PLUG	02.000	24.000	M	API-6D	BODY-ASTM A 216 GR.WCB, PLUG: A216 GR.WCB + 0.003"ENP	BW, 150, B-16.25
BOLT GROUP						
BOLT.STUD	00.500	48.000		B-18.2	BOLT:A193 GR.B7, NUT:A194 GR.2H	
GASKET GROUP						
GASKET	00.500	24.000		B-16.20-ANSI B16.5	SP.WND METTALIC WITH GRAPHITE FILLER	SPIRAL, 150
GASKET	26.000	48.000		B-16.20-ANSI B16.47A	SP.WND METTALIC WITH GRAPHITE FILLER	SPIRAL, 150

Note: For all Valves, valve data sheets shall also be referred, stringent requirement among data sheet and above details shall be followed.

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PIPE CLASS	15HLT
DESIGN CODE	ASME B31.8
RATING	150#
BASE MATERIAL	CARBON STEEL
CA	1.5 MM
SPECIAL REQUIREMENT	Low Temperature Service
SERVICE	Natural Gas, Utilities (water, inst. air, plant air, nitrogen, carbon dioxide)

Temperature (Deg. C) and Pressure (Kg/cm²g) Ratings

Temperature	-45	38	93
Pressure	18.63	18.63	17.92

NOTES:

1. All vents and drains shall be provided with gate valve with blind flange assembly unless otherwise indicated in P&ID.
2. NDT of welds shall be as follows:
Radiography : All butt welds 100%
MPI : Socket welds 100%
3. Piping design as per ASME B 31.8, OISD 226 & PNGRB Guidelines
4. Charpy V notch test and hardness test shall be conducted for pipes, fittings and flanges at (-) 45°C.
5. All branch connections including vent, drain, pressure and temperature connection shall be as per branch connection table.
6. For valves, refer valve data sheets.

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

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	ON LINES ≥ 2.0 "	As per P&ID or 0.75". Refer std Drawing
Temp. Connection	1.5"	Flanged, installation as per std. Drawing, except skin temperature measurement.
Press. Connection	0.75"	SW nipple with Plug/ Ball Valve to spec. as per Refer std. Drawing

Branch Table

							T	6	BRANCH PIPE (INCH)
							T	T	
						T	T	T	
					T	T	T	W	
				T	T	T	T	S	
			T	T	T	S	S	S	
		T	T	T	T	S	S	S	
	T	T	T	T	S	S	S	S	
T	T	T	T	S	S	S	S	0.05	
0.05	0.75	1	1.5	2	3	4	6		
PIPE RUN Size (INCH)									

CODES

T
W
S

DESCRIPTION

Tees
Weldolet
Sockolet

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Item	Lower Size (Inch)	Upper Size (Inch)	Sch. / Thk.	Dmn. STD	Material (Charpy)	Description
PIPE GROUP						
PIPE	00.500	00.750	S160	B-36.10	ASTM A 333 GR.6	PE, SEAMLESS
PIPE	01.000	01.500	XS	B-36.10	ASTM A 333 GR.6	PE, SEAMLESS
PIPE	02.000	02.000	XS	B-36.10	ASTM A 333 GR.6	BE, SEAMLESS
PIPE	03.000	06.000	STD	B-36.10	ASTM A 333 GR.6	BE, SEAMLESS
NIPPLE	00.500	01.500	M	B-36.10	ASTM A 333 GR.6	PBE, SEAMLESS
FLANGE GROUP						
FLNG.WN	00.500	06.00	M	B-16.5	ASTM A 350 GR.LF2	150, RF/125AARH
FLNG.BLIND	00.500	06.00		B-16.5	ASTM A 350 GR.LF2	150, RF/125AARH
FLNG.FIG.8	00.500	06.00		ASME B16.48	ASTM A 350 GR.LF2	150, FF/125AARH
FITTING GROUP						
ELBOW.90	00.500	00.75		B-16.11	ASTM A 350 GR.LF2	SW, 6000
ELBOW.90	01.000	01.500		B-16.11	ASTM A 350 GR.LF2	SW, 3000
ELBOW.90	02.000	6.000	M	B-16.9	ASTM A 420 GR.WPL6	BW, 1.5D
ELBOW.45	00.500	00.75		B-16.11	ASTM A 350 GR.LF2	SW, 6000
ELBOW.45	01.000	01.500		B-16.11	ASTM A 350 GR.LF2	SW, 3000

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ELBOW.45	02.000	6.000	M	B-16.9	ASTM A 420 GR.WPL6	BW, 1.5D
T.EQUAL	00.500	00.75		B-16.11	ASTM A 350 GR.LF2	SW, 6000

Item	Lower Size (Inch)	Upper Size (Inch)	Sch. / Thk.	Dmn. STD	Material (Charpy)	Description
T.EQUAL	01.000	01.500		B-16.11	ASTM A 350 GR.LF2	SW, 3000
T.EQUAL	02.000	06.000	M	B-16.9	ASTM A 420 GR.WPL6	BW
T.RED	00.500	00.75		B-16.11	ASTM A 350 GR.LF2	SW, 6000
T.RED	01.000	01.500		B-16.11	ASTM A 350 GR.LF2	SW, 3000
T.RED	02.000	06.000	M, M	B-16.9	ASTM A 420 GR.WPL6	BW
REDUC. CONC	02.000	06.000	M, M	B-16.9	ASTM A 420 GR.WPL6	BW
REDUC. ECC	02.000	06.000	M, M	B-16.9	ASTM A 420 GR.WPL6	BW
SWAGE. CONC	00.500	03.000	M, M	BS-3799	ASTM A 350 GR.LF2	PBE
SWAGE.ECC	00.500	03.000	M, M	BS-3799	ASTM A 350 GR.LF2	PBE
CAP	00.500	01.500		B-16.11	ASTM A 350 GR.LF2	SCRF, 3000
CAP	02.000	06.000	M	B-16.9	ASTM A 420 GR.WPL6	BW
PLUG	00.500	01.500		B-16.11	ASTM A 350 GR.LF2	SCRM, 3000
COUPLING FULL	00.500	00.75		B-16.11	ASTM A 350 GR.LF2	SW, 6000

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COUPLING FULL	01.000	01.500		B-16.11	ASTM A 350 GR.LF2	SW, 3000
COUPLING HALF	00.500	00.75		B-16.11	ASTM A 350 GR.LF2	SW, 6000
COUPLING HALF	01.000	01.500		B-16.11	ASTM A 350 GR.LF2	SW, 3000

Item	Lower Size (Inch)	Upper Size (Inch)	Sch. / Thk.	Dmn. STD	Material (Charpy)	Description
O'let						
WELDOLET	02.000	06.000	M, XXS	MSS-SP97	ASTM A 350 GR.LF2	BW
SOCKOLET	00.500	00.750		MSS-SP97	ASTM A 350 GR.LF2	SW, 6000
SOCKOLET	01.000	01.500		MSS-SP97	ASTM A 350 GR.LF2	SW, 3000
VALVES GROUP						
VLV.GLOBE	00.50	01.500		BS EN 15015761	BODY-ASTM A 350 GR.LF2,TRIMSTELLIT ED, STEMSS304	SW, 800, 3000, B-16.11
VLV.GLOBE	02.000	06.000		BS-1873	BODY-ASTM A 350 GR.LF2,/ ASTM A 352 GR.LCB	FLGD, 150, B-16.5, RF/125AARH
VLV.CHECK	00.50	01.500		BS EN 15015761	BODY-ASTM A 350 GR.LF2,	SW, 800, 3000, B-16.11
VLV.CHECK	02.000	06.000		API-6D/BS-1868	BODY-ASTM A 350 GR.LF2,/ ASTM A 352 GR.LCB TRIM-STELLIT ED	FLGD, 150, B-16.5, RF/125AARH
VLV.BALL	00.500	01.500		BS EN 15017292	BODY-ASTM A352 GR.LCB / ASTM A350 GR.LF2 CL.1,TRIM-BODY SEAT-RPTFE	SW, 800, 3000, B-16.11

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VLV.BALL	02.000	06.000		API-6D	BODY-ASTM A352 GR.LCB / ASTM A350 GR.LF2 CL.1,	FLGD, 150, B-16.5, RF/125AARH
VLV.BALL	02.000	06.000		API-6D	BODY-ASTM A352 GR.LCB / ASTM A350 GR.LF2 CL.1,	BW, 150, B-16.25
BOLT GROUP						
BOLT.STUD	00.500	6.000		B-18.2	BOLT:A320 GR.L7, NUT:A194 GR.4	
GASKET GROUP						
GASKET	00.500	6.000		B-16.20- ANSI B16.5	SP.WND SS316+ GRAFOIL	SPIRAL, 150

Note: For all Valves, valve data sheets shall also be referred, stringent requirement among data sheet and above details shall be followed.

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PIPE CLASS	30HC
DESIGN CODE	ASME B31.8
RATING	300#
BASE MATERIAL	CARBON STEEL
CA	1.5 MM
SPECIAL REQUIREMENT	Non IBR
SERVICE	Natural Gas, Utilities (water, inst. air, plant air, nitrogen, carbon dioxide)

Temperature (Deg. C) and Pressure (Kg/cm²g) Ratings

Temperature	-29	38	93	149	204	260	316
Pressure	52.02	52.02	47.45	46.05	44.64	42.18	40.66

NOTES:

1. All vents and drains shall be provided with gate valve with blind flange assembly unless otherwise indicated in P&ID.
2. NDT of welds shall be as follows:
Radiography : All butt welds 100%
MPI : Socket welds 100%
3. Piping design as per ASME B 31.8, OISD 226 & PNGRB Guidelines
4. Charpy V notch test and hardness test shall be conducted for pipes, fittings and flanges at (-) 29°C.
5. Corrosion allowance of 1.5 mm has been considered for terminal piping.
6. All branch connections including vent, drain, pressure and temperature connection shall be as per branch connection table.
7. For valves, refer valve data sheets as enclosed.
8. Design Factor 0.5
9. 9. Ball Valve to be used in main pipeline shall have butt welded ends.

ITEM	SIZE	DESCRIPTION
Maintenance joints	ALL	Flanged, to be kept minimum
Pipe joints	1.5" & BELOW	SW coupling
	2.0" & ABOVE	Butt welded
Drains	ON LINES <= 1.5"	Refer std. drawing

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	ON LINES $\geq 2.0"$	As per P&ID or 0.75". Refer std. drawing
Vents	ON LINES $\leq 1.5"$	Refer std. drawing
	ON LINES $\geq 2.0"$	As per P&ID or 0.75". Refer std. drawing
Temp. Connection	1.5"	Flanged, installation as per std. drawing, except skin temperature measurement.
Press. Connection	0.75"	SW nipple with Plug/ Ball Valve to spec. as per Refer std drawing

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Branch Table

[illegible]

CODES	DESCRIPTION
T	Tees
W	Weldolet
S	Sockolet

Item	Lower Size (Inch)	Upper Size (Inch)	Sch . / Thk	Dmn. STD	Material (Charpy)	Description
PIPE GROUP						
PIPE	00.500	00.750	S160	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS
PIPE	01.000	01.500	XS	B-36.10	ASTM A 106 GR.B	PE, SEAMLESS
PIPE	02.000	04.000	XS	B-36.10	ASTM A 106 GR.B (CHARPY)	BE, SEAMLESS
PIPE	06.000	08.000	6.4	B-36.10	API 5L GR.X-52	BE, HFW/SMLS
PIPE	10.000	12.000	6.4	B-36.10	API 5L GR.X-56	BE, HFW/SMLS
NIPPLE	00.500	01.500	M	B-36.10	ASTM A 106 GR.B	PBE, SEAMLESS
FLANGE GROUP						
FLNG.SW	00.500	01.500	M	B-16.5	ASTM A 105	300, RF/125AARH
FLNG.WN	02.000	24.000	M	B-16.5	ASTM A 105 (CHARPY)	300, RF/125AARH
FLNG.BLIND	00.500	01.500		B-16.5	ASTM A 105	300, RF/125AARH
FLNG.BLIND	02.000	24.000		B-16.5	ASTM A 105 (CHARPY)	300, RF/125AARH
FLNG.FIG.8	00.500	01.500		ASME- B 16.48	ASTM A 105	300, FF/125AARH

Item	Lower Size (Inch)	Upper Size (Inch)	Sch . / Thk	Dmn. STD	Material (Charpy)	Description
FLNG.FIG.8	02.000	08.000		ASME- B 16.48	ASTM A 105 (CHARPY)	300, FF/125AARH
SPCR&BLND	10.000	24.000		ASME- B 16.48	ASTM A 105 (CHARPY)	300, FF/125AARH
FITTING GROUP						
ELBOW.90	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
ELBOW.90	01.000	01.500		B-16.11	ASTM A 105	SW, 3000

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ELBOW.90	02.000	24.000	M	B-16.9	ASTM A 234 GR.WPB (CHARPY)	BW, 1.5D
ELBOW.45	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
ELBOW.45	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
ELBOW.45	02.000	24.000	M	B-16.9	ASTM A 234 GR.WPB (CHARPY)	BW, 1.5D
T.EQUAL	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
T.EQUAL	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
T.EQUAL	02.000	24.000	M	B-16.9	ASTM A 234 GR.WPB (CHARPY)	BW
T.RED	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
T.RED	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
T.RED	02.000	24.000	M, M	B-16.9	ASTM A 234 GR.WPB (CHARPY)	BW
REDUC. CONC	02.000	24.000	M, M	B-16.9	ASTM A 234 GR.WPB (CHARPY)	BW
REDUC. ECC	02.000	24.000	M, M	B-16.9	ASTM A 234 GR.WPB (CHARPY)	BW
SWAGE. CONC	00.500	03.000	M, M	BS-3799	ASTM A 105 (CHARPY)	PBE
SWAGE. ECC	00.500	03.000	M, M	BS-3799	ASTM A 105 (CHARPY)	PBE
CAP	00.500	00.750		B-16.11	ASTM A 105	SCRF, 6000
CAP	01.000	01.500		B-16.11	ASTM A 105	SCRF, 3000
CAP	02.000	24.000	M	B-16.9	ASTM A 234 GR.WPB (CHARPY)	BW
PLUG	00.500	00.750		B-16.11	ASTM A 105	SCRM, 6000
PLUG	01.000	01.500		B-16.11	STM A 105	SCRM, 3000
CPLNG.FULL	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
CPLNG.FULL	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
CPLNG.HALF	00.500	0.750		B-16.11	ASTM A 105	SW, 6000

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Item	Lower Size (Inch)	Upper Size (Inch)	Sch . /Thk .	Dmn. STD	Material (Charpy)	Description
CPLNG.HALF	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
CPLNG.LH	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
CPLNG.LH	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
CPLNG.RED	00.500	00.750		B-16.11	ASTM A 105	SW, 6000
CPLNG.RED	01.000	01.500		B-16.11	ASTM A 105	SW, 3000
O'let						
SOCKOLET	00.500	00.750		MSS-SP97	ASTM A 105	SW, 6000
SOCKOLET	01.000	01.500		MSS-SP97	ASTM A 105	SW, 3000
WELDOLET	02.000	08.000	M, XX	MSS-SP97	ASTM A 105 (CHARPY)	BW
VALVE GROUP						
VLV.GATE	00.500	01.500		API-602	BODY-ASTM A 105,TRIM-STELLITED,STEM 13%	SW, 800, 3000, B-16.11
VLV.GATE	02.000	24.000		API 600/ISO 10434	BODY-ASTM A 105/ ASTM A 216 GR.WCB STELLITED, STEM- SS304	FLGD, 300, B-16.5, RF/125AARH
VLV.GLOBE	00.500	01.500		BS EN ISO 15761	BODY-ASTM A 105,TRIM-STELLITED,STEM- 13%	SW, 800, 3000, B-16.11
VLV.GLOBE	02.000	24.000		BS 1873	BODY-ASTM A 105 / ASTM A 216 GR.WCB , TRIM-13% CR.STEEL	FLGD, 300, B-16.5, RF/125AARH
VLV.CHECK	00.500	01.500		BS EN ISO 15761	BODY-ASTM A 105, TRIM- STELLITED	SW, 800, 3000, B-16.11
VLV.CHECK	02.000	24.000		API-6D/BS-1868	BODY-ASTM A 105 / ASTM A 216 GR.WCB	FLGD, 300, B-16.5, RF/125AARH

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FOR CITY GAS DISTRIBUTION PROJECT OF NEGDC**

Item	Lower Size (Inch)	Upper Size (Inch)	Sch . /Thk .	Dmn. STD	Material (Charpy)	Description
VLV.BALL	00.500	01.500		BS EN 15017292	BODY-ASTM A 105,	SW, 800, B-16.11, RF/125AARH
VLV.BALL	02.000	24.000		API-6D	BODY-ASTM A 216 GR.WCB/ ASTM 105	FLGD, 300, B-16.5, RF/125AARH
VLV.BALL	02.000	24.000	M	API-6D	BODY-ASTM A 216 GR.WCB/ASTM 105,	BW, 300, B-16.25
VLV.PLUG	00.500	01.500		BS-5353	BODY-ASTM A 105, PLUG-A105 +0.003" ENP	SW, 800#, 3000, B-16.11
VLV.PLUG	02.000	24.000		API-6D	BODY- A 216GR. WCB, PLUG: A216 GR.WCB + 0.003" ENP	FLGD, 300, B-16.5, RF/125AARH
VLV.PLUG	02.000	24.000	M	API-6D	BODY-ASTM A 216 GR.WCB, PLUG: A216 GR.WCB + 0.003"ENP	BW, 300, B-16.25
BOLT GROUP						
BOLT.STUD	00.500	30.000		B-18.2	BOLT:A193 GR.B7, NUT:A194 GR.2H	
GASKET						
GASKET	00.500	24.000		B-16.20-ANSI B16.5	SP.WND METTALIC WITH GRAPHITEFILLER	SPIRAL, 300
GASKET	26.000	30.000		B-16.20-ANSI B16.47A	SP.WND METTALIC WITH GRAPHITEFILLER	SPIRAL, 300

Note: For Valve Material, valve data sheet shall also be referred, stringent requirement among data sheet and above details shall be followed.

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PIPE CLASS

30HLT

DESIGN CODE	ASME B31.8
RATING	300#
BASE MATERIAL	CARBON STEEL
CA	1.5 MM
SPECIAL REQUIREMENT	Low Temperature Service
SERVICE	Natural Gas, Utilities (water, inst. air, plant air, nitrogen, carbon dioxide)

Temperature (Deg. C) and Pressure (Kg/cm²g) Ratings

Temperature	-45	38	93	120	149	204
Pressure	48.86	48.86	46.05	45.54	44.99	43.59

NOTES:

1. All vents and drains shall be provided with gate valve with blind flange assembly unless otherwise indicated in P&ID.
2. NDT of welds shall be as follows:
Radiography : All butt welds 100%
MPI : Socket welds 100%
3. Piping design as per ASME B 31.8, OISD 226 & PNGRB Guidelines
4. Flanged end shall be as per ASME B 16.5 for valve up to 24" (excluding 22"), for 22" as per MSS-SP-44.
5. Charpy V notch test and hardness test shall be conducted for pipes, fittings and flanges at (-) 45°C.
6. All branch connections including vent, drain, pressure and temperature connection shall be as per branch connection table.
7. For valves, refer valve data sheets.

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

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Vents	ON LINES $\leq 1.5"$	Refer std. drawing
	ON LINES $\geq 2.0"$	As per P&ID or 0.75". Refer std. drawing
Temp. Connection	1.5"	Flanged, installation as per std. drawing, except skin temperature measurement.
Press. Connection	0.75"	SW nipple with Plug/ Ball Valve to spec. as per Refer std. drawing

Branch Table

													T	16	BRANCH PIPE (INCH)	
													T	T		14
												T	T	T		12
												T	T	T		10
												T	T	T		8
												T	T	T		6
												T	T	T		4
												T	T	T		3
												T	T	T		2
												T	T	T		1.5
												T	T	T		1
												T	T	T		0.75
												T	T	T		0.05
0.05	0.75	1	1.5	2	3	4	6	8	10	12	14	16				
PIPE RUN Size (INCH)																

CODES

T
W
S

DESCRIPTION

Tees
Weldolet
Sockolet

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Item	Lower Size (Inch)	Upper Size (Inch)	Sch. / Thk.	Dmn. STD	Material (Charpy)	Description
PIPE GROUP						
PIPE	00.500	00.750	S160	B-36.10	ASTM A 333 GR.6	PE, SEAMLESS
PIPE	01.000	01.500	XS	B-36.10	ASTM A 333 GR.6	PE, SEAMLESS
PIPE	02.000	02.000	XS	B-36.10	ASTM A 333 GR.6	BE, SEAMLESS
PIPE	03.000	14.000	STD	B-36.10	ASTM A 333 GR.6	BE, SEAMLESS
NIPPLE	00.500	00.750	M	B-36.10	ASTM A 333 GR.6	PBE, SEAMLESS
NIPPLE	01.000	01.500	M	B-36.10	ASTM A 333 GR.6	PBE, SEAMLESS
FLANGE GROUP						
FLNG.SW	00.500	01.500	M	B-16.5	ASTM A 350 GR.LF2	300, RF/125AARH
FLNG.WN	02.000	14.000	M	B-16.5	ASTM A 350 GR.LF2	300, RF/125AARH
FLNG.BLN D	00.500	14.000		B-16.5	ASTM A 350 GR.LF2	300, RF/125AARH
FLNG.FIG.8	00.500	08.000		ASME- B 16.48	ASTM A 350 GR.LF2	300, FF/125AARH
SPCR&BLN D	10.000	14.000		ASME- B16.48	ASTM A 350 GR.LF2	300, FF/125AARH
FITTINGS						
ELBOW.90	00.500	00.750		B-16.11	ASTM A 350 GR.LF2	SW, 6000
ELBOW.90	01.000	01.500		B-16.11	ASTM A 350 GR.LF2	SW, 3000
ELBOW.90	02.000	14.000	M	B-16.9	ASTM A 420 GR.WPL6	BW, 1.5D
ELBOW.45	00.500	00.750		B-16.11	ASTM A 350 GR.LF2	SW, 6000
ELBOW.45	01.000	01.500		B-16.11	ASTM A 350 GR.LF2	SW, 3000
ELBOW.45	02.000	14.000	M	B-16.9	ASTM A 420 GR.WPL6	BW, 1.5D
T.EQUAL	00.500	00.750		B-16.11	ASTM A 350 GR.LF2	SW, 6000
T.EQUAL	01.000	01.500		B-16.11	ASTM A 350 GR.LF2	SW, 3000

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Item	Lower Size (Inch)	Upper Size (Inch)	Sch. / Thk.	Dmn. STD	Material (Charpy)	Description
T.EQUAL	02.000	14.000	M	B-16.9	ASTM A 420 GR.WPL6	BW
VALVE GROUP						
VLV.BALL	00.500	01.500		BS EN ISO 17292	BODY-ASTM A352 GR.LCB / ASTM A350 GR.LF2 CL.1,	SW, 800, 3000, B-16.11
VLV.BALL	02.000	14.000		API-6D	BODY-ASTM A352 GR.LCB / ASTM A350 GR.LF2 CL.1,	FLGD, 300, B-16.5, RF/125AARH
VLV.GATE	00.500	01.500		API-602	BODY-ASTM A 350 GR.LF2,TRIM-STELLITED,STEM- SS	SW, 800, 3000, B-16.11
VLV.GATE	02.000	14.000		API 600/ ISO 10434	BODY-ASTM A 350 GR.LF2,/ ASTM A 352 GR.LCB STELLITED,STEM- SS304	FLGD, 300, B-16.5, RF/125AARH
VLV.GLOBE	00.500	01.500		BS EN ISO 15761	BODY-ASTM A 350 GR.LF2,TRIM-STELLITED,STEM- SS304	SW, 800, 3000, B-16.11
VLV.GLOBE	02.000	14.000		BS-1873	BODY-ASTM A 350 GR.LF2,/ ASTM A 352 GR.LCB	FLGD, 300, B-16.5, RF/125AARH
VLV.CHECK	00.500	01.500		BS EN ISO 15761	BODY-ASTM A 350 GR.LF2,TRIM- STELLITED	SW, 800, 3000, B-16.11
VLV.CHECK	02.000	14.000		API-6D/BS-1868	BODY-ASTM A 350 GR.LF2,/ ASTM A 352 GR.LCB TRIM-STELLITED	FLGD, 300, B-16.5, RF/125AARH
VLV.PLUG	00.500	01.500		BS-5353	BODY-ASTM A 350 GR.LF2, PLUG: A350 GR.LF2 + 0.003" ENP	SW, 800, 3000, B-16.11
VLV.PLUG	02.000	14.000		API-6D	BODY-ASTM A 352 GR.LCB / A350 GR.LF2,	FLGD, 300, B-16.5, RF/125AARH

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VLV.PLUG	02.000	14.000		API-6D	BODY-ASTM A 352 GR.LCB/ ASTM A350GR.LF2,	BW, 300, B-16.25
BOLT & GASKET						
BOLT.STUD	00.500	14.000		B-18.2	BOLT:A320 GR.L7, NUT:A194 GR.4	
GASKET	00.500	14.000		B-16.20- ANSI B16.5	SP.WND METTALIC WITH GRAPHITEFILLER	SPIRAL, 300

Note: For all Valves, valve data sheets shall also be referred, stringent requirement among data sheet and above details shall be followed.

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STANDARD SPECIFICATION, ITP, DRAWING



VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR WELDING OF ONSHORE HYDROCARBON PIPELINE

VCS-SS-PP-2019

					
04	29.04.2022	RP	MC	HK	GW
03	04.01.2022	SR	MC	HK	HK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By
UNCONTROLLED COPY : If printed					
CONTROLLED COPY : If in soft and signed					

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	27.08.2018					Issued as Standard Specification.
		PK	MD	AD	SK	
01	19.09.2019					Re-issued as Standard Specification
		SS	MC	AD	SK	
02	28.01.2020					Document numbering updated from VPC-SS-PL-0045 to VPC-SS-PP-2019.
		MB	MC	AD	SK	
03	04.01.2022					Revised as marked
		SR	MC	HK	HK	
04						VCS QMS Integration
	29.04.2022	RP	MC	HK	GW	

ABBREVIATIONS:

ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
BS	British Standard
CRT	Cathode Ray Tube
CTOD	Crack Tip Opening Displacement
GMAW	Gas Metal Arc Welding
GTAW	Gas Tungsten Arc Welding
HAZ	Heat Affected Zone
HV	Vickers Hardness
IIW	International Institute of Welding
IQI	Image Quality Indicator
ISO	International Organization for Standardization
MPI	Magnetic Particle Inspection
PQR	Procedure Qualification Record
SMAW	Shielded Metal Arc Welding
UT	Ultrasonic Testing
UTS	Ultimate Tensile Strength
WPS	Welding Procedure Specification

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1.0 SCOPE

This specification covers the welding of carbon and low-alloy steel pipeline used in the transmission of hydrocarbons, covers welding of distribution systems. This specification applies to new construction of pipeline projects. The welding may be done by a shielded metal arc welding, submerged arc welding, gas tungsten arc welding, gas metal arc welding, flux cored arc welding, plasma arc welding or oxyacetylene welding process or by a combination of these processes using a manual, semiautomatic or mechanized welding technique or a combination of these techniques. The welds may be produced by position or roll welding or by a combination position and roll welding.

This specification also covers the procedures for radiographic, magnetic particle, liquid penetrant and ultrasonic testing as well as the acceptance standards for destructive testing in Procedure Qualification and Non-Destructive testing methods viz. Radiographic, Magnetic Particle, Liquid Penetrant, Ultrasonic and visual.

It is intended that all work performed in accordance with this specification meets or exceeds the requirements of this specification

Any approval granted by the COMPANY shall not relieve the CONTRACTOR of his Responsibilities and guarantees.

2.0 APPLICABLE CODE AND STANDARDS

All welding work, equipment for welding, heat treatment, other auxiliary functions and the welding personnel shall meet the requirements of the latest editions (editions in force at the time of floating the enquiry) of the codes, standards and specifications listed below:

- a) Code for Gas Transmission and Distribution Piping Systems, ASME B 31.8
- b) Standard for welding of Pipelines and Related Facilities, API 1104
- c) Specification for welding Electrodes and Filler Materials ASME Sec. II C
- d) Non-Destructive examination, ASME Sec. V

3.0 BASE MATERIAL

In general carbon steel is used in this specification. The details of material specifications are given in the welding Specification Chart attached along with

other project data sheets. The CONTRACTOR will arrange and maintain the record of test certificates of all the materials for the reference of the welding engineer.

4.0 WELDING CONSUMABLES

- a) The CONTRACTOR shall provide at his own expense all the welding consumables necessary for the execution of the job such as electrodes, oxygen, acetylene etc. and These shall bear the approval of the COMPANY.
- b) The welding electrodes / filler wires supplied by the CONTRACTOR shall conform to the class specified in the welding specification chart attached along with other project data sheets. The materials shall be of the make approved by the COMPANY.
- c) The electrode shall be suitable for the welding process recommended and the base metal used. Physical properties of the welds produced by an electrode recommended for the welding of a particular base metal shall not be lower than the minimum values specified for the base metal unless otherwise specified in the Welding Specification Chart and shall correspond to the physical properties of the class of electrode adopted. The choice of electrode shall be made after conducting the required tests on the electrodes as per relevant standards, and shall be the sole prerogative of the COMPANY.
- d) The CONTRACTOR shall submit batch test certificates from each electrode manufacturers giving details of physical and chemical tests carried out by them for each batch of electrodes to be used.
- e) Electrode Qualification test records shall be submitted as per the Exhibit-A (attached) in respect of the electrodes tested by the CONTRACTOR for obtaining the approval of the COMPANY.
- f) All electrodes shall be purchased in sealed containers and stored properly to prevent deterioration. The electrodes removed from the containers (except cellulosic coated electrodes) shall be kept in the holding ovens, at the temperature recommended by the electrode manufacturer. Ovens shall be used for the low hydrogen electrodes only. Out-of-the oven time of electrodes before they are consumed shall not exceed the limits recommended by the electrode manufacturer. The electrodes shall be handled with care to avoid any damage to the flux covering. Different grades of electrodes shall be stored separately. Cellulosic electrodes used shall however be used as per the specific recommendations of manufacturer.

- g) The electrodes used shall be free from rust, oil, grease, earth and other foreign matter, which affect the quality of welding.
- h) **Shielding Gas**: The composition and the purity of shielding gas when required by the welding
- Processes other than shielded metal arc welding, when permitted by the COMPANY shall bear the approval of the COMPANY. Where appropriate, gases or gas mixture of the following quality shall be used.
- I. Argon gas complying with BS 4365.
 2. Carbon dioxide gas complying with type 1 specified in BS 4105
 3. Gas mixtures that have been proved to be satisfactory as a result of procedure approval tests.
- When a gas mixture is used, which has specified additions, e.g. 2% O₂, 5% CO₂ the variation of such addition shall not exceed $\pm 10\%$ of that stated. Moisture content shall correspond to a dew point of -30°C or lower.

5.0 EQUIPMENT & ACCESSORIES

The CONTRACTOR shall have sufficient number of welding and cutting equipment, Auxiliaries and accessories of sufficient capacities to meet the target schedules.

- 5.1 All the equipment for performing the heat treatment, including transformers, thermocouples, pyro-meters, automatic temperature recorders with suitable calibration arrangements, etc. shall be provided by the CONTRACTOR, at his own expense and these shall bear the approval of the COMPANY. Adequate means of measuring current and voltage shall be available.
- 5.2 Redoing of any work necessitated by faulty equipment or operation used by the CONTRACTOR, will be done at his own expense.

6.0 WELDING PROCESSES

- 6.1 Welding of various materials under this specification shall be carried out using Shielded Metal Arc Welding process (SMAW) with the approval of the COMPANY.
- 6.2 The welding processes to be employed are given in the welding specification chart attached along with other project data sheets. Any deviation desired by the CONTRACTOR shall be obtained through the express consent of the COMPANY.
- 6.3 Automatic process shall be employed only with the express approval of the COMPANY. The welding procedure adopted and the consumables used shall be specifically approved.
- 6.4 A combination of different welding processes or a combination of electrodes of different classes / makes could be employed for a particular joint only after duly

qualifying the welding procedures to be adopted and obtaining the approval of the COMPANY.

7.0 BEVEL CLEANING / BEVEL INSPECTION

The Line Pipe supplied by COMPANY shall have bevel ends as specified in the applicable specification for the Line Pipe attached with the Bid Package. Any modification thereto, if required by the CONTRACTOR due to his special welding technique, shall be carried out by the CONTRACTOR at his own cost. Before welding, all the rust and the foreign matter shall be removed from the beveled ends by power operated tools. This shall be affected inside and outside and for a minimum distance of 25 mm from the edge of the weld bevel. The bevels shall be thoroughly inspected at this stage. If any of the ends of the pipe joints are damaged to the extent that, in the opinion of the COMPANY, satisfactory weld spacing cannot be obtained and local repair by grinding cannot be successfully done, the damaged ends shall be cut and beveled to the satisfaction of the COMPANY, with an approved beveling machine. Manual cutting and weld repairs of bevels is not allowed. Should laminations, split ends or inherent manufacturing defects in the pipe be discovered, the lengths of pipe containing such defects shall be removed from the line to the satisfaction of COMPANY. On pipes, which have been cut back, a zone extending 25 mm back from the new field bevel, shall be ultrasonically tested to the requirement of the line pipe specification to ensure freedom from laminations. The new bevel shall be 100% visual and 100% dye penetrant/MPI tested. A report shall be written for all the testing and records kept.

8.0 ALIGNMENT AND SPACING

Immediately prior to line-up CONTRACTOR shall inspect the pipe ends inside and outside for damage, dents, laminations etc. Pipe for welding shall be set up, correctly spaced, allowing for the temperature changes during welding. In correct alignment shall in no circumstances be sprung into position. Temporary attachments of any kind shall not be welded to the pipe. Welds joining the sections of the pipeline, valve installation or similar welds classified as tie in welds shall be made in the trench. Otherwise, the alignment and welding shall be made alongside the ditch with the pipe supported on skids and pack pads or other suitable means approved by COMPANY, at least 500 mm above the ground unless approved by the COMPANY in specific cases.

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

Every effort shall be made to reduce misalignment by the use of the clamp and rotation of the pipes to the best fit. For pipe of same nominal wall thickness the offset shall not exceed 1.6 mm. The offset may be checked from outside using dial gauges. Any branch connection sleeve, etc. shall be at least 150 mm from any other weld. The welds for fittings shall be so located that the toe of the weld shall not come within 50 mm of any other weld. Cold dressing is permissible only in cases of slight misalignment and may only be carried out with a bronze headed hammer. Hot dressing shall not be permitted. When welding pipes of different wall thickness (as directed by COMPANY) a special transition piece shall be used. This shall have a minimum of 1:4 taper. The welds shall be subject to both ultrasonic and radiographic inspection.

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

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

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

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

9.0 WEATHER CONDITIONS

The parts being welded and the welding personnel shall be adequately protected from rain and strong winds. In the absence of such a protection no welding shall be

carried out. The completed welds shall be suitably protected in case of bad weather conditions.

10.0 WELDING

10.1 Root Pass

- a) The root pass shall be made with the electrodes/filler wires recommended in the welding specification chart attached along with the other project data sheets. The size of the electrodes used shall be as per the approved welding procedure.
- b) Position or roll welding may be permitted. The vertical up method of welding shall be used for the root pass of the tie-ins, special crossings, fittings and special parts, fillet welds, repairs and when an external line up clamp is used. The downhill welding may be used for the root run welding of tie-ins and special crossings when (a) the edges are machined or have equivalent preparation (b) line up clamps are used and the fit up is geometrically and mechanically similar to one of the ordinary line welding without misalignment or unevenness.
- c) The root pass of butt joints shall be executed properly so as to achieve full penetration with complete fusion of the root edges. Weld projection inside the pipe shall not exceed 3 mm wherever not specified by the applicable code.
- d) Any deviations desired from the recommended welding technique and electrodes indicated in the welding specification chart shall be adopted only after obtaining express approval of the COMPANY.
- e) Welding shall be continuous and uninterrupted during a pass.
- f) On completion of each run, craters, welding irregularities, slag etc., shall be removed by grinding and chiseling.
- g) While the welding is in progress care shall be taken to avoid any kind of movement of the components, shocks, vibration and stresses to prevent occurrence of weld cracks.
- h) Fillet welds shall be made by shielded metal arc welding process irrespective of the thickness and class of piping. Electrode size shall not exceed 3.25 mm diameter for the socket joints. At least two passes shall be made on the socket weld joints.
- i) Peening shall not be used.

10.2 Joint Completion

In case of manual welding, for sizes 12" and above, the first pass shall be carried out by a minimum of two welders, working simultaneously and so placed as to cause minimum distortion of the pipe.

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

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

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

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

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

The time lapse between the second and the third pass shall be as stated in the procedure specification, normally not exceeding five minutes. After completion of the third or following passes, welding operations may be suspended, so allowing the joint to cool down, provided that the thickness of the weld metal deposited is equal to at least 50% of the pipe thickness. Upon restarting, depending on the materials, wall thickness and welding process, a preheating of at least 100°C shall be applied. Subsequent passes up to weld completion shall be protected to avoid rapid cooling, if meteorological conditions so dictate. Cleaning between the passes shall be done carefully so as to reduce the possibility of inclusions.

The electrode starting and finishing points shall be staggered from pass to pass. Arc-strikes outside the bevel on the pipe surface are not permitted. Arc-strike or arc-burn on the pipe surface outside the weld, which are caused accidentally by electrical arcs between the electrode, electrode holder, welding cable or welding cable round and the pipe shall be removed by grinding in accordance with a procedure approved by the COMPANY and the repair checked by ultrasonic, radiographic, magnetic particle or dye penetrant tests which the COMPANY feels

necessary. The pipe wall thickness after grinding shall not be less than the minimum thickness limit permitted for the pipe. Repair of arc strikes by welding is prohibited.

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

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

11.0 HEAT TREATMENT

11.1 Preheating

- a) Preheating requirements for the various materials shall be as per the welding Specification chart attached along with other project data sheets.
- b) Preheating shall be performed using resistance or induction heating methods. Pre-heating for tie-in welds, repair welds or welds at point spreads may be done using a propane gas burner ring with prior approval from PMC/owner. The contractor may be asked to demonstrate the effectiveness of the arrangement.
- c) Preheating shall extend uniformly to at least three times the thickness of the joint, but not less than 50 mm, on both sides of the weld.
- d) Preheating temperature shall be maintained over the whole length of the joint during welding. Temperature indicating crayons or other temperature indicating devices shall be provided by the CONTRACTOR to check the temperature.

11.2 Post Weld Heat Treatment

- a) Post weld heat treatment, wherever required for joints between pipes and fittings, pipe body and supports shall be carried out by the CONTRACTOR at his expense as per the relevant specifications, applicable standards and the instructions of the COMPANY.
- b) The heat treatment of welded joints shall be carried out as per the requirements laid down in ASME B31.8 and other special requirements mentioned in welding Specification chart.
- c) The CONTRACTOR shall submit for the approval of the COMPANY, well before Carrying out actual heat treatments the details of the post weld heat treatment Procedure, as per Exhibit 'B' attached, that he proposes to adopt for each of the Materials/assembly/part involved.
- d) Post weld heat treatment shall be done in a furnace or by using an electric resistance or induction heating equipment, as decided by the COMPANY.

- e) While carrying out local post weld heat treatment, technique of application of heat must ensure uniform temperature attainment at all points of the portion being heat- treated. Care shall be taken to ensure that width of heated band over which specified post weld heat treatment temperature is attained is at least as that specified in the relevant applicable standards/codes.
- f) The width of the heated band centered on the weld shall at least be equal to the width of weld plus 2" (50 mm). The temperature gradient shall be such that the length of the material on each side of the weld, at a temperature exceeding half the heat treatment temperature, is at least $2.5 \sqrt{rt}$ where r is the bore radius and t is the pipe thickness at the weld.
- g) Throughout the cycle of heat treatment, the portion outside the heat band shall be suitably wrapped under insulation so as to avoid any harmful temperature gradient at the exposed surface of pipe. For this purpose, temperature at the exposed surface of the pipe shall not be allowed to exceed 400°C.
- h) The temperature attained by the portion under heat treatment shall be recorded by means of thermocouple pyrometers. Adequate number of thermocouples shall be attached to the pipe directly at equally spaced locations along the periphery of the pipe joint. The minimum number of thermocouples attached per joint shall be 2 up to 10" dia and 3 for 12" dia and above. However, the COMPANY can increase the required minimum number of thermocouples to be attached if found necessary.
- i) Automatic temperature recorders, which have been suitably calibrated, shall be Employed. The calibration chart of each recorder shall be submitted to the COMPANY prior to starting the heat treatment operation and its approval shall be Obtained.
- j) Immediately on completion of the heat treatment, the post weld heat treatment charts/records along with the hardness test results on the weld joints (whenever required as per the welding specification chart) shall be submitted to COMPANY for its approval.
- k) Each joint shall bear an identification number, which shall be maintained in the piping sketch to be prepared by the CONTRACTOR. The joint identification number shall appear on the corresponding post weld heat treatment charts. The same identification numbers shall also be followed for identification of corresponding radiographic films. The chart containing the identification number and the piping sketch shall be submitted to the COMPANY in suitable folders.
- l) Vickers hardness/Brinell hardness of the heat affected zone as well as of the weld metal, after heat treatment shall be measured using a suitable hardness tester and shall not exceed the maximum hardness specified in the welding

specification chart. The weld joint shall be subjected to reheat treatment, when hardness measured exceeds the specified limit, at the CONTRACTOR'S own expense.

- m) The CONTRACTOR shall arrange for the hardness testing and shall maintain the Records of all the joints tested. These records shall be checked by the plant COMPANY'S inspector.

12.0 INSPECTION & TESTING

12.1 General

- a) The COMPANY'S Inspector shall have free access to all the concerned areas, where the actual work is being performed. The CONTRACTOR shall also afford the COMPANY'S inspector all means and facilities necessary to carry out inspection.
- b) The COMPANY is entitled to depute its own inspector to the shop or field where prefabrication and erection of pipelines are being done, with (but not limited to) the following objectives:
- i) To check the conformance to relevant standards and suitability of various Welding equipment and the welding performance.
 - ii) To supervise the welding procedure qualification.
 - iii) To supervise the welders' performance qualification.
 - iv) To check whether shop/field welding being executed is in conformity with the relevant specifications and codes of practice followed in pipe construction.
- c) CONTRACTOR shall intimate sufficiently in advance the commencement of the Qualification tests, welding works and acceptance tests, to enable the COMPANY'S inspector to be present to supervise them.

12.2 Welding Procedure Qualification

- a) Welding procedure qualification shall be carried out in accordance with the relevant requirements of API 1104 latest edition (edition in force at the time of floating the enquiry) or other applicable codes and other job requirements by the CONTRACTOR at his expense. The CONTRACTOR shall submit the welding procedure specifications in format as per Exhibit-C (attached) immediately after the receipt of the order.
- b) COMPANY'S inspector will review, check and approve the welding procedure submitted and shall release the procedure for procedure qualification tests. The Procedure qualification test shall be carried out by the CONTRACTOR under field conditions at his own expense. A complete set of the test results in format as per Exhibit-C (attached) shall be submitted to the COMPANY'S Inspector for approval immediately after completing the procedure qualification test and at least 2 weeks before the commencement of actual work. Standard tests as

specified in the code shall be carried out in all cases. In addition to these tests, other tests like radiography, macro/micro examination, hardness tests, dye penetrant examination, Charpy v-notch etc. shall be carried out on the specimens. It shall be the responsibility of the CONTRACTOR to carry out all the tests required to the satisfaction of the COMPANY'S Inspector. The destructive testing of welded joints shall be as per Annexure - 1.

12.3 Welder's Qualification

- a) Welders shall be qualified in accordance with the API 1104 and other applicable specifications by the CONTRACTOR at his expense. The butt weld test pieces of the qualification test shall meet the radiographic test requirements specified in Clause 12.5 and Annexure-3 of this specification. The COMPANY'S inspector shall witness the test and certify the qualification of each welder separately. Only those welders who have been approved by the COMPANY'S inspector shall be employed for welding. CONTRACTOR shall submit the welder qualification test reports in the standard format as shown in Exhibit - D and obtain express approval, before commencement of the work. It shall be the responsibility of CONTRACTOR to carry out qualification tests of welders.
- b) The welders shall always have in their possession the identification card as shown in Exhibit-E and shall produce it on demand by the COMPANY'S Inspector. It shall be the responsibility of the CONTRACTOR to issue the identity cards after the COMPANY has duly certified it.
- c) No welder shall be permitted to work without the possession of identity card.
- d) If a welder is found to perform a type of welding or in a position for which he is not qualified, he shall be debarred from doing any further work. All welds performed by an unqualified welder shall be cut and redone by a qualified welder at the expense of the CONTRACTOR.

12.4 Visual Inspection

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

12.5 Non Destructive Examination

The non-destructive examination shall mainly consist of examination using x-ray radiography as detailed in Annexure 3.

Radiographic examination of one hundred percent (100%) girth welds will be required by the COMPANY. Welds shall meet the standards of acceptability as set forth in API 1104 and as well as the requirements laid in subsequent paragraphs.

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

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

All the requirements mentioned in the specification shall be arranged and executed by the CONTRACTOR through his own resources. In addition, ultrasonic inspection is required in the following cases as per Annexure - 2 of this Specification.

- a) When 20 mm or more are cut from the pipe end as supplied, the ends shall be ultrasonically inspected for an additional length of 20 mm to assure no laminations exist.
- b) When in the opinion of COMPANY, ultrasonic inspection is required to confirm or clarify defects indicated by radiography.
- c) When automatic procedure is used at least 10 cm on each weld shall be ultrasonically inspected at COMPANY's discretion.
- d) UT on Golden Joints.

All fillet and groove welds other than those radiographed shall be subjected to dye penetrant! MP inspection. The non- destructive test system used for inspecting welds must be approved by the COMPANY.

12.5.1 Acceptance Criteria

Weld quality as judged on the basis of the acceptability criteria mentioned below:

- i) Any weld, which as a result of radiographic and/or ultrasonic examination in the opinion of COMPANY exhibits imperfections greater than the limits, stated in API 1104 latest edition or as superseded in this article shall be considered defective and shall so be marked with an identification point marker.
- ii) In addition to the API 1104 requirements, the welds containing cracks including crater cracks regardless of size or location are unacceptable.

Lack of fusion and lack of root penetration may be permitted only up to a maximum individual length of 25mm. Cumulative length of the defect shall not exceed 25 mm in any 300 mm length of weld. For welds less than 300 mm length, the aggregate length shall not exceed 8 percent of the weld length. Defects situated in line and separated by less than the length of the shortest defect shall be considered as one defect. However, no Lack of fusion or lack of root penetration is permitted at any intersections of welds.

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

12.6 Destructive Testing

The COMPANY has the authority to order the cutting of up to 0.1 % of the total number of welds completed for subjecting to destructive tests at no extra cost to

COMPANY. The destructive testing of weld joints shall be made as per Annexure - 1. In addition, welds already cut out for defects for any reason may also be subjected to destructive testing. The sampling and the re-execution of welds shall be carried out by the CONTRACTOR at his own expense. If the results are unsatisfactory, welding operations shall be suspended and may not be restarted until the causes have been identified and the CONTRACTOR has adopted measures, which guarantee acceptable results. If it is necessary in the COMPANY's opinion the procedure shall be requalified. The weld joint represented by unsatisfactory welds shall stand rejected unless investigation proves otherwise.

13.0 REPAIRS OF WELDS

13.1 With the prior permission of COMPANY welds, which do not comply with the standards of acceptability, shall be repaired or the joint cut out and re-welded. A separate welding procedure specification sheet shall be formulated and qualified by CONTRACTOR for repair welds simulating the proposed repair to be carried out. Separate procedures are required to be qualified for (a) through thickness repair (b) partial thickness repair (c) cover pass repair and (d) Double repair. Welders shall be qualified in advance for repairs. The root pass, for repairs opening the root, shall be replaced by the vertical uphill technique. The procedure shall be proven by satisfactory procedure test to API-1104 including the special requirements of the specification, and shall also be subjected to metallographic examination, hardness surveys and Charpy tests to determine the effects of repair welding on the associated structure.

Root sealing or single pass repair deposit shall not be allowed. Internal root defects shall be ground thoroughly and welded with a minimum of two passes. However, while grinding for repairs, care shall be taken to ensure that no grinding marks are made on the pipe surface anywhere.

The repair shall be subjected, as a minimum requirement to the same testing and inspection requirements as the original weld. After the repair of the circumferential weld, re-radiography of the full joint shall be carried out. Any repaired area that is wide, irregular or rough shall be rejected and a full cut out shall be done.

Repairs are limited to a maximum of 30% of the weld length. Not more than two repairs are permitted on the same location. All repairs shall be carried out the day after initial radiography or earlier. A full report of all repairs made shall be submitted every day to the COMPANY.

13.2 Weld Rejected by Accumulation of Defects

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

ANNEXURE-I

1.0 DESTRUCTIVE TESTING OF WELDED JOINT - BUTT WELDS

1.1 Preparation

Having passed the visual and the non-destructive inspection, the test weld shall be subjected to mechanical test.

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

Weld specimens shall be taken from the positions indicated in fig.1, 2, 3 & 4 of this specification from areas as free from defects as possible; for this reason, it is necessary to take the previous non-destructive tests into account. The minimum number of tests to be carried out is given in Table - 1 of this specification.

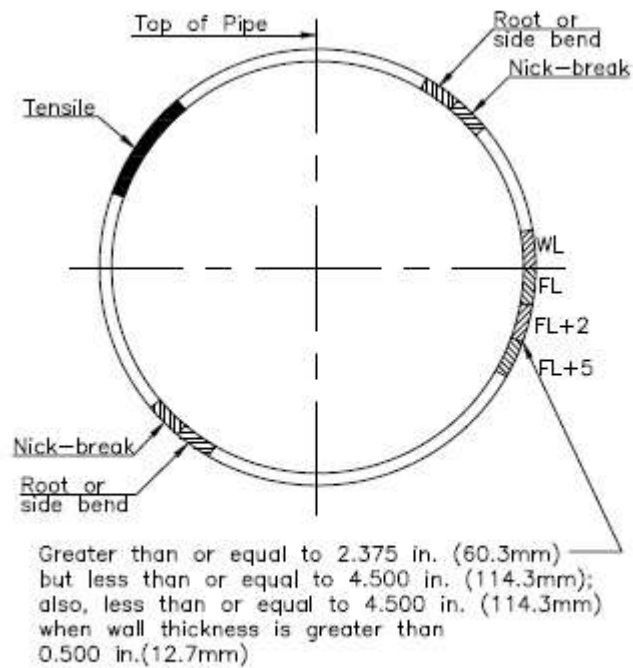
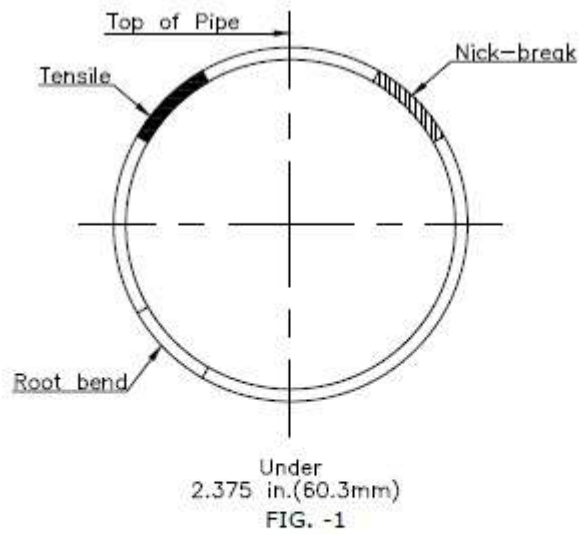
The test shall be carried out at laboratories approved by the COMPANY. The specimens shall be prepared in accordance with the figures given in the paragraphs that refer to the individual test.

1.2 Tensile Strength

Specimens shall be taken from the position indicated in fig.1, 2, 3 & 4 of this specification and Table-1 of this specification.

1.2.1 Method

The test shall be carried out in accordance with API 1104.



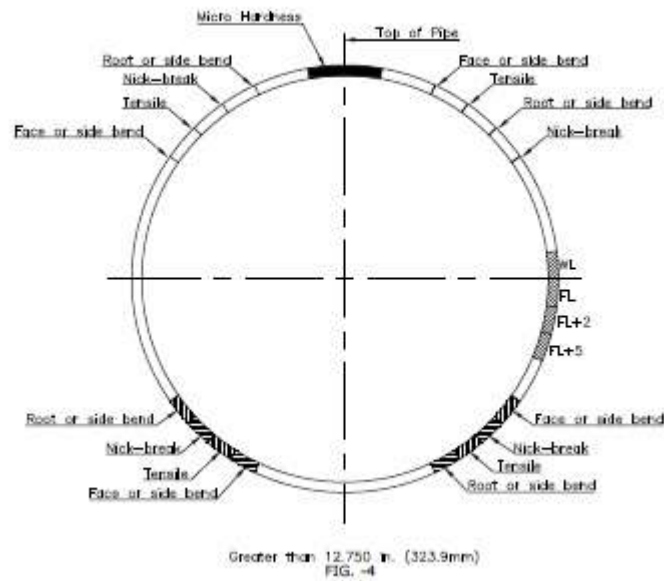
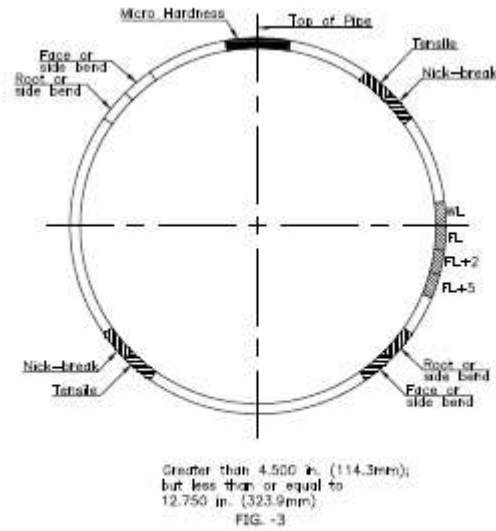


TABLE 1

OUTSIDE DIAMETER OF PIPE (mm)	NUMBER OF SPECIMENS							
	TENSILE STRENGTH	NICK BREAK	ROOT BEND	FACE BEND	SIDE BEND	MACRO & HARDNESS	IMPACT	TOTAL
	WALL THICKNESS $\leq$ (12.7 mm)							
<60.3	1	2	2	0	0	0	0	5
60.3 to 114.3	1	2	2	0	0	0	12	17
>114.3 to 323.9	2	2	2	2	0	2	12	22
>323.9	4	4	4	4	0	2	12	30
	WALL THICKNESS > (12.7 mm)							
$\leq$ 114.3	1	2	0	0	2	0	12	17
>114.3 to 323.9	2	2	0	0	4	2	12	20
>323.9	4	4	0	0	8	2	12	30

1.3 Nick-Break Test

1.3.1 Preparation

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

1.4 Macroscopic Inspection

1.4.1 Preparation

Specimens shall be taken from the positions indicated in Fig. 1 of this specification and shall be prepared in accordance with ASTM E2 and E3. The width of the macro section has to be at least three times the width of the weld. The section is to be prepared by grinding and polishing and etched to clearly reveal the weld metal and heat affected zone.

1.4.2 Method

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

1.4.3 Requirements

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

1.5 Hardness Test

1.5.1 Preparation

The prepared macro section is to be used for hardness testing using the vickers method with 10 kg load indentations are to be made along traverses each approximately 1 mm below the surface at both side of the weld.

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

One indentation at each side of the weld along each traverse has to be made on parent metal. Reference is made to Fig. 3 of this specification. The indentations are to be made in the adjacent region as well as on the opposite side of the macro section along the specified traverses.

1.5.2 Method

The test shall be carried out in accordance with recommendation ISO R81, Vickers hardness, using a laboratory type machine controlled as pre-recommendation ISO R 146 and using a diamond pyramid penetrator set at 2.37 rad (136") with a load of 10 kg.

1.5.3 Requirements

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

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

1.6 Charpy V-Notch Impact Test

1.6.1 Specimens shall be taken from the position indicated in Fig. 2, 3 & 4 of this specification. The test specimens will be prepared in accordance with API 1104. Charpy V-Notch specimens shall have dimensions as given in Fig. 6 of the specification. Three test specimens shall be taken from each sample and they shall be cut and worked so that their length is transversal and perpendicular to the weld bead with the notch position as shown in Fig. 6 of this specification. The notch shall be to the roller surface perpendicular to the roller surface. The test shall be conducted at -29 deg C and as per ASTM A370.

1.6.2 Requirements (Note 1)

The impact energy shall be:

Test specimen in (mm)	Average of three specimen (Note 2) joule (Min.)	Minimum single value (Note 1)
10.0	27.0	22.0
7.5	21.5	17.5
5.0	18.5	15.0
2.5	10.0	8.0

Note:

- (1) These values are specified for resistance to brittle fracture only. Where additional requirements are specified in project data sheet (Ex. pipeline materials with arrest properties i.e., a higher upper shelf Charpy V energy for resistance against propagating ductile fractures) the same shall be followed.
- (2) Only one value is permitted to be lower than average value up to the value specified.

1.7 Bend Test Requirements

The Bend test Specimens shall be made and tested as per the requirements of API 1104 Latest edition (edition in force at the time of floating enquiry). The acceptance criteria shall be as per API 1104.

ANNEXURE-2

1.0 ULTRASONIC INSPECTION

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

1.1 General:

The CONTRACTOR who carries out the ultrasonic inspections shall have sufficient no. of qualified personnel, equipment and instruments at his disposal to be able to affect the tests without hindering or delaying the pipeline assembly operations. The CONTRACTOR appointed to carry out ultrasonic inspections shall supply all the instruments necessary for their execution on site.

1.2 Specification for Ultrasonic Testing Procedure Qualification

Before work begins, the CONTRACTOR shall present a specification describing the proposed U.T. procedure qualification. This specification shall state, all the parameters described in API 1104 and the following information:

- a) Type of U.T. Equipment used;
- b) Type and dimensions of transducers
- c) Frequency range
- d) Details for calibration
- e) Coupling medium
- f) Inspection technique
- g) Record details
- h) Reference to the welding procedure where it is intended to adopt the specification
- I) Temperature range of the joints to be inspected.

1.3 Qualification of Ultrasonic Inspection Procedure

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

This test shall be conducted in the presence of the COMPANY.

1.4 Test Procedure

Circumferential welds shall be inspected from both sides using angle probes. The surface with which the probe comes into contact shall be free of metal spatter, dirt, iron oxide, and scales of any type; therefore, it shall be necessary to clean a strip at least 50 mm wide on both sides of the weld with steel-wire brushes and anyhow the cleaned strip must be at least wide enough to allow one and a half skip examination.

If, during the test, echoes of doubtful origin appear, it shall be necessary to inspect a convenient area on the pipe surface, close to the weld, with a straight beam transducer in order to check whether any manufacturing defects are present which could have interfered with the ultrasonic beam.

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

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

The characteristics of the above listed instruments and equipment shall guarantee:

- a) That the required standards of the inspection procedure, as previously established and approved by the COMPANY, are satisfied.
- b) Continuous operation

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

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

1.5 Ultrasonic Instruments

The ultrasonic instrument:

- a) Shall be pulse echo type, able to generate, receive and display, on the screen a Cathode Ray Tube (CRT), pulse at frequencies between 1 and 6 MHz. The useful part of the CRT screen shall be at least 70mm wide and at least 50mm high shall have variable amplification, with steps of 1 or 2 dB over a range of at least 60 dB.

- b) the regulation control shall be accurate to within ± 1 dB and this accuracy shall be certified by the instrument manufacturer.
- c) may be powered by a battery or an electric generator. In the first case, the autonomy of operation (endurance) of the instrument shall be sufficient to carry on working without frequent interruptions, and the instrument shall be equipped with an automatic switch which switches it off when the battery runs down; in the second case, there must be a voltage stabilizing device with a tolerance of ± 2 Volts.

1.6 Probes

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

1.7 Reference Sample Pieces

The efficiency of the equipment used, the effective refraction angle of the probe, and the beam output point, shall be checked using a VI and V2 sample block, IIW type or the calibration block ASTM E-428.

For manual ultrasonic testing and automated ultrasonic testing, the reference sample pieces shall be as described in API 1104, Nineteenth Edition, para 11.4.5.

1.8 Calibration

The calibration, qualification of the testing procedure shall be done as provided in API 1104.

1.9 Regulation of Amplification during Production Testing

Scanning sensitivity shall be as provided in API 1104 para 11.4.7.2 & 11.4.7.3.

1.10 Qualification of Ultrasonic Testing Operators for Automatic UT. Before the inspection begins or during the same inspection, the COMPANY may require a qualification test for the ultrasonic equipment operators.

The operators shall be fully qualified as per a recognized standard (ASME Sec V or equivalent) and they shall have as minimum level II as described in API 1104. The operators shall be able to:

- a) calibrate the equipment;
- b) perform an operational test under production conditions;
- c) interpret the screen picture;
- d) evaluate the size and location of reflectors
- e) interpret the type of defects detected

The COMPANY has the option of checking the ability of personnel employed for ultrasonic

Testing by means of qualification tests.

1.11 Evaluation of Indications given by Ultrasonic Tests

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

If, under these conditions, the height of the defect echo is equal to or greater than that of the reference echo, the defect shall be evaluated according to clause 12.5 of this specification. If the defect has also been detected by the radiographic and/or visual examination, the dimensions shall be judged according to the type of examination which detects the greater defect. Returns that are less than 50% of the reference echo will not be considered. If returns are above 50% but lower than 100% of the reference echo, and if the operator has good reasons to suspect that the returns are caused by unfavorably oriented cracks, he shall inform the COMPANY. Moreover, when there is a defect to be repaired, such defect shall be removed for a length corresponding to the one where no more return echo is given.

1.12 Other Equipment

The use of rules calibrated in centimeters, attached if possible, to the probe, for the precise location of the position of welding defects, is recommended. Defect location is affected by measuring the projection distance between the probe output and the reflecting surface.

The operators carrying out the tests shall have, besides the probing instrument, tools for cleaning the pipe surface (files, brushes, etc.) as well as the coupling liquid or paste appropriate for the temperature of the section to be examined.

ANNEXURE-3

RADIOGRAPHY

1.0 SCOPE

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

The welded joints shall include the following:

- i) Full girth welds on the mainline construction including double jointing of pipe, if adopted.
- ii) Welds for installation of block valves, insulating joints and other appurtenances and tie-ins.
- iii) Welds at scraper launching and receiving barrels.
- iv) Terminal Piping

2.0 APPLICABLE STANDARDS

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

- i) API 1104, Standard for welding Pipelines and Related Facilities
- ii) ANSI B 31.8, Code for Gas Transmission and Distribution Piping Systems.
- iii) ANSI B 31.4, Code for Transportation System for Hydrocarbons, Liquid Petroleum Gas, Anhydrous Ammonia and Alcohols.
- iv) ASTM E 94, Recommended practice for Radiographic Testing
- v) ASTM E 142, Standard Method for Controlling Quality of Radiographic Testing
- vi) The American Society for Nondestructive Testing. Recommended Practice no. SNT-TC-IA Supplement A.

3.0 PROCEDURE

3.1 The radiographic examination procedure to be adopted shall be submitted by the CONTRACTOR as per Exhibit-F.

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

- i) Lead foil intensifying screens, at the rear of the film shall be used for all exposures.
- ii) Type 2 and 3 films as per ASTM E-94 shall be used.

- iii) A densitometer shall be used to determine film density. The transmitted film density shall be between 2.0 and 3.5 throughout the weld. The unexposed base density of the film shall not exceed 0.30.
 - iv) Radiographic identification system and documentation for radiographic interpretation reports and their recording system.
- 3.3 The CONTRACTOR shall qualify each procedure in the presence of the COMPANY prior to use.
- 3.4 The procedure of radiographic examination shall produce radiographs of sufficient density, clarity and contrast so that defects in the weld or in the pipe adjacent to the weld are clearly discernible.
- 3.5 One Check shot of the full joint on main line welds shall be taken per 100 circumferential welds or one per day of the production whichever is more for cross checking the correctness of the radiographs of weld joints executed by the contractors. For taking check shots on completed/accepted sections, contractor has to separately mobilize either internal crawler/external X-ray unit, as appropriate.
- 3.6 All the girth welds of mainline shall be subjected to 100% radiographic examination. The CONTRACTOR shall furnish all the radiographs to the COMPANY, immediately after processing them, together with the corresponding interpretation reports on approved format. The details of the radiographs along with the joint identification number shall be duly entered in a register and signed by the CONTRACTOR and submitted to the COMPANY for approval.
- 3.7 When the radiation source and the film are both on the outside of the weld and located diametrically opposite each other, the maximum acceptable length of film for each exposure shall not exceed the values given. The minimum film overlap, in such cases, shall be 40mm. The ellipse exposure technique may be used on nominal pipe sizes of 2 inch and smaller provided that the source of film distance used is a minimum of 12 inch.
- 3.8 Three copies of each acceptable radiographic procedure (as per Exhibit-F) and three copies of radiographic qualification records shall be supplied to COMPANY. One set of the qualifying radiographs on the job shall be kept by the CONTRACTOR's authorized representative to be used as a standard for the quality of production radiographic during the job. The other two sets shall be retained by COMPANY for its permanent record.
- 3.9 Three copies of the exposure charts relating to material thickness, kilo voltage, source of film distance and exposure time shall also be made available to COMPANY by the CONTRACTOR.
- 3.10 The CONTRACTOR shall, on a daily basis, record for each radiograph (1) radiograph's number, (2) approximate chainage of weld location, (3) whether or not the welds meet the specified acceptance standards and (4) the nature and approximate location of unacceptable defects observed. It must be possible to relate back to a particular butt weld and welder on piping drawing and pipeline alignment drawing.

- 3.11 Each day's production of processed radiographs shall be properly packaged separately, identified by at least the (1) date, (2) radiographic unit, (3) job locations, (4) starting and ending progress survey stations and (5) shall include original and three copies of the daily radiographic record. The package shall be submitted to the COMPANY daily when possible, but in no event later than noon of the following day.
- 3.12 The CONTRACTOR shall provide all the necessary facilities at site, such as a dark room with controlled temperature, film viewer etc. to enable the COMPANY to examine the radiographs.
- 3.13 The CONTRACTOR, if found necessary, may modify the procedure of radiographic examination suiting to the local conditions prevailing. This shall, however, be subject to the approval of the Company.
- 3.14 COMPANY shall have free access to all the CONTRACTOR's work facilities in the field.
- 3.15 Any approval granted by the COMPANY shall not relieve the CONTRACTOR of his responsibilities and guarantees.

4.0 RADIATION SOURCE

- 4.1 Radiographic examination shall be carried out using X-radiations; radiographic examination by Gamma rays using slow speed films may be allowed, at the discretion of the COMPANY, in case of inaccessible joints. Radiography by Gamma ray for tie-in-joints shall be acceptable provided D4 AGF A film or equivalent is used and the required sensitivity obtained.
- 4.2 Whenever possible, pipeline welds will be inspected by placing the radiation source inside the pipe. on the pipeline axis. with a radiation of 6.28 red. (360).

5.0 LEVEL OF QUALITY

The quality level of Radiographic sensitivity required for radiographic inspection shall be at least equivalent to the values in Figure-7.

6.0 PENETRAMETERS

The Image Quality Indicator (abbreviation: IQI) shall be used for the qualification of the welding procedure and during normal line production. Radiographic sensitivity shall be measured with the wire image quality indicator (Penetrameter). The Penetrameter shall be selected according to DIN-54109 or ISO-I 027. For radiographs made with the source on the outside, a Penetrameter shall be placed on each side of the film with the smaller wire of the Penetrameter turned towards the end of the film itself. When a complete weld is radiographed in a single exposure using a source inside the piping, four penetrameters approximately equally spaced around the circumference shall be used. During the procedure qualification, IQI shall be placed both on the source side and on the film side.

The sensitivity obtained with IQI on the source side shall not be less than the values shown in Fig. 7 of this specification. The sensitivity limit may be considered to have

been reached when the outline of the IQI, its identification number and the wire of the required diameter show up clearly on the radiograph.

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

7.0 FILM IDENTIFICATION MARKERS

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

8.0 PROTECTION AND CARE OF FILM

- 8.1 All unexposed films shall be protected and stored properly as per the requirements of API1104 standard and ASTM E.94.
- 8.2 The exposed and unexposed film shall be protected from heat, light, dust and moisture. Sufficient shielding shall be supplied to prevent exposure of film to damaging radiation prior to and following the use of the film for radiographic exposure.

9.0 RE-RADIOGRAPHY

- 9.1 The weld joints shall be re-radiographed in case of unsatisfactory quality of the radiographs, at the expense of the CONTRACTOR.
- 9.2 All the repaired weld joints shall be re-radiographed at no extra cost to the COMPANY in the same manner as that followed for the original welds. In addition, the repaired weld areas shall be identified with the original identification number plus the letter R to indicate the repair.
- 9.3 When evaluating repair film, radiographers shall compare each section (exposure) of the weld with the original film to assure repair was correctly marked and original defect removed.
- 9.4 The COMPANY will review prior to any repair of welds, all the radiographs of welds that contain, according to the CONTRACTOR's interpretation, unacceptable defects. The final disposition of all unacceptable welds shall be decided by the COMPANY.

10.0 QUALIFICATION OF RADIOGRAPHERS

- 10.1 Pipeline radiographers shall be qualified in accordance with the requirement of API 1104 and to the full satisfaction of COMPANY.
- 10.2 Certification of all the radiographers, qualified as per 10.1 above, shall be furnished by the CONTRACTOR to the COMPANY before a radiographer will be

permitted to perform production radiography. The certificate record shall include:

- i) Background and Experience Record
- ii) Training Course Record
- iii) Technical Examination Record
- iv) Doctor's report on radiographer's Jacque 0-1 acuity eye test
- v) Date of qualification

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

11.0 PRESERVATION OF RADIOGRAPHS

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

12.0 EQUIPMENT AND ACCESSORIES

- 12.1 CONTRACTOR shall make necessary arrangements at his own expense, for providing the radiographic equipment, radiographic films and all the accessories for carrying out the radiographic examination for satisfactory and timely completion of the job.
- 12.2 For carrying out the mainline radiographic examination the CONTRACTOR shall be equipped with suitable mobile/stationary type dark rooms. These shall have all the required facilities for film processing. Film viewer used shall be equipped with the film illuminator that has a light source of sufficient intensity and suitably controlled to allow viewing film densities up to 4.0 without damaging the film.

13.0 RADIATION PROTECTION

- 13.1 CONTRACTOR shall be responsible for the protection and personnel monitoring of every man with or near radiation sources.
- 13.2 The protection and monitoring shall comply with local regulations.
- 13.3 In view of visual hazards in the handling of Radioactive source of material, CONTRACTOR shall be solely responsible for complying with all rules and regulations set forth by Atomic Energy Commission or any other Government agencies of India in this regard and COMPANY shall not be responsible and shall be kept indemnified by the CONTRACTOR for default (s) of whatever nature by the CONTRACTOR. Safety equipment as considered adequate by the COMPANY

for all necessary personnel shall be made available for use and maintained for immediate and proper use by the CONTRACTOR.

14.0 DISPLAY OF SAFETY INSTRUCTIONS

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

15.0 ENFORCEMENT OF SAFETY REGULATIONS

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

16.0 FIRST AID AND INDUSTRIAL INJURIES

- 16.1 CONTRACTOR shall maintain first aid facilities for its employees and those of sub-Contractors.
- 16.2 CONTRACTOR shall make outside arrangements for ambulance service and for treatment of industrial injuries. Names of those providing these services shall be furnished to COMPANY prior to start of work and their telephone no. Shall be posted prominently in CONTRACTOR'S field office.
- 16.3 All critical industrial injuries shall be reported promptly to the COMPANY and a copy of CONTRACTOR's report covering each personal injury requiring the attention of physician shall be furnished to the COMPANY.

17.0 NO EXEMPTION

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



EXHIBIT- A

ELECTRODE QUALIFICATION TEST RECORD

- A.** Tested at (Site name) : Date:
- Manufacturer's Name :
- Brand Name: :
- Batch Number & Size tested :
- Classification & Code :
- Intended for welding in position: :
- In combination with (if any) :
- Code of Reference (used for testing) :
- Special Requirements (if any) :
- B.** All-weld Tensile Test :
- Base Material used :
- Pre-heat temperature :
- Post weld heat treatment details: :
- Visual examination :
- Radiographic examination results :
- Tensile test results :

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

C. Impact Test Results

- Test Temperature : Notch in
- Type of Specimens (Charpy) :
- Size of Specimens

Specimen No.	Impact Value	Average
1		
2		
3		
4		
5		

D. Chemical Analysis Results

Electrode Size Result :

Batch No. :

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

.....
**PREPARED BY
(CONTRACTOR)**

.....
**REVIEWED BY
(CONTRACTOR)**

.....
**APPROVED
(PMC/OWNER)**

EXHIBIT- B

STRESS RELIEF HEAT TREATMENT PROCEDURE SPECIFICATION

Name of the Heat-treater :
Name of the Project : Specification Reference No.

1. General Detail:
Name of the Equipment:
Name of the Assembly/Part:
Drawing No:
Material:
2. Furnace Details
Type of Heating : Gas/Oil/Elect.
Res/ induction Type of Heating
Capacity (Size)
Maximum Temp. (C) :
Method of temp. Measurement
Atmosphere Control :
3. Heat Treatment Cycle Details
Charging Temp. C
Rate of heating, C/Hr.
Soaking Temp. C
Soaking Time, hrs.
Rate of Cooling, C/Hr.
Mode of Cooling
4. Other Details, if any :
Notes:

The following documents shall be furnished along with the specifications:

- i) Material test certificates
- ii) Assembly/Part Drawing.

.....
**PREPARED BY
CONTRACTOR)**

.....
**REVIEWED BY
(CONTRACTOR)**

.....
**APPROVED BY
(PMC/OWNER)**

EXHIBIT- C

QUALIFICATION WELD REPORT													
Date _____		Test No. _____		Test Type: _____		Procedure _____		Welder _____					
Location _____		Welder (s) _____											
Material Grade 1 _____													
Material Grade 2 _____													
Outside Diameter _____				Wall Thickness _____									
Joint Type _____				Bevel Angle _____									
Backing Type (if applicable) _____				Roll or Fixed Position _____									
RECORDED WELDING PARAMETERS													
Pass	Process and Direction of Welding	Filler Metal Classification and Diameter	Shielding Gas type and flow rate or shielding flux	Preheat / Interpass Temperature	Voltage	Amperage	Travel Speed	Heat Input					
Root Bead													
Second Bead													
Note: Number of weld beads are not intended to be limited by this table and the table should be adjusted to present all required passes. Time between passes: Root Bead to 2 nd Bead: _____, 2 nd bead to 3 rd bead: _____ Cooling Method (if applicable) _____ PWHT _____													
MECHANICAL TEST RESULTS													
TENSILE TESTS Report Number : _____				NICK BREAK TEST Report Number : _____									
Specimen Number	Tensile 1	Tensile 2	Tensile 3	Tensile 4	Specimen Number	Nick 1	Nick 2	Nick 3	Nick 4	Nick 5	Nick 6	Nick 7	Nick 8
Location					Location								
Original specimen dimensions					Result								
Original specimen area					BEND TESTS Report Number: _____								
Maximum load					Specimen Type and Number								
Tensile strength					Location								
Fracture Location					Result								
Remarks													
Test made at _____							Date _____						
Tested by _____							Supervised by _____						

Sample Qualification Weld Report Form

WELDING PROCEDURE SPECIFICATION								
								WPS Number _____
Process(es)/Method of Application _____								
Material grade(s) _____								
Outside diameter _____				Wall thickness _____				
Joint type _____				Bevel angle _____				
Backing type (if applicable) _____				Roll or fixed position _____				
Direction of welding _____				Number of welders _____				
Preheat temperature _____				Interpass Temperature _____				
Method of Heating _____								
Filler metal(s) and Flux _____								
Flame characteristics _____				Cleaning and/or grinding tools _____				
Type and removal of lineup clamp _____				Minimum number of passes _____				
Maximum time between root pass and start of the second pass _____				Maximum time between second pass and start of third pass _____				
Method of cooling _____				PWHT procedure _____				
JOINT DESIGN								
SEQUENCE OF BEADS								
WELDING PARAMETERS								
Pass	Process / Electrical Characteristics	Filler Metal Group or Classification	Electrode Size	Shielding Gas Type and Flow Rate or Shielding Flux	Voltage Range	Amperage Range	Travel Speed Range	Heat Input Range
Root Bead								
Second Bead								
Note: Number of weld beads are not intended to be limited by this table and the table should be adjusted to present all required passes.								
Supporting qualification weld report No(s) _____								
Approved by: _____								

Sample Qualification Weld Report Form

.....
**PREPARED BY
CONTRACTOR)**

.....
**REVIEWED BY
(CONTRACTOR)**

.....
**APPROVED BY
(PMC/OWNER)**



EXHIBIT- D

Example of record form for welder qualification test

Welder test certificate	Test no
Project/Contract	Date
Contractor	Inspector
Welder's name	
Address	
Pipe material	
Pipe thickness	
Pipe outside diameter	
Welding process	Root
	Fill and Cap
Reason for failure	
Visual	
Non-destructive testing	
Butt joint	
Fillet weld	
'Number of attempts	
Comments	
Accepted date/Time	

Signed by Contractor

Signed by Inspector

*Delete as necessary



EXHIBIT- E

Welder's Identification Card

Name	:	
Identification	:	Photograph
Date of Testing	:	
Valid till	:	
Approval of Welding	:	
Welding Position	:	
Material	:	
Diameter	:	
Diameter range approved	:	
Wall thickness	:	
Thickness range approved	:	
Type of welding consumables	:	

Approved by:

Employers' Signature with seal

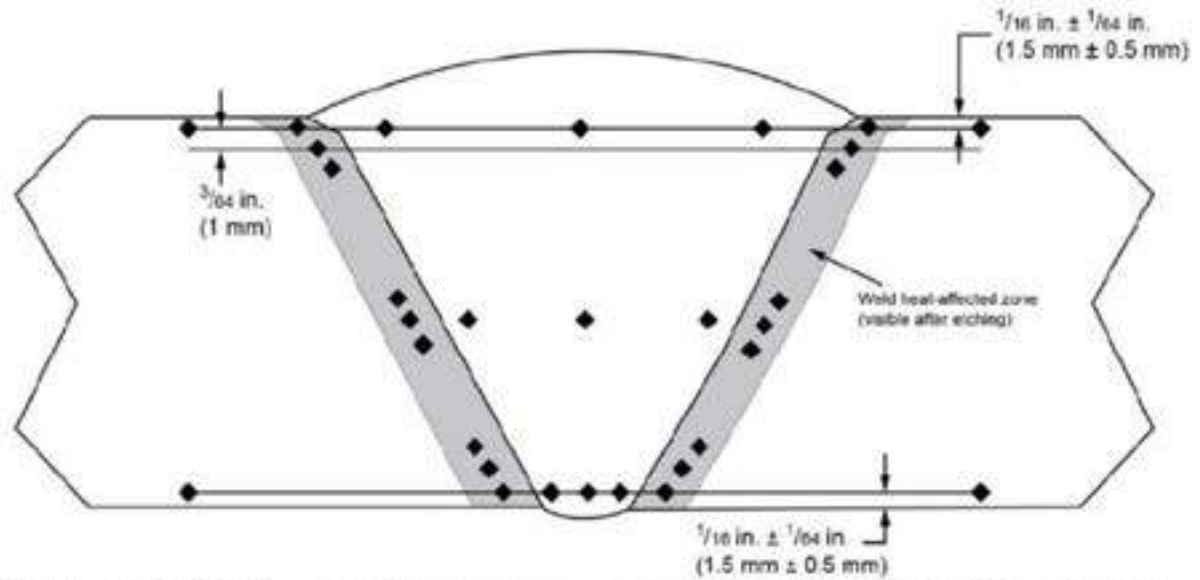
EXHIBIT- F

Radiographic Procedure for Pipe Welding

1. Location
2. Date of Testing
3. Name of Supervised Contractor
4. Material
5. Dia & Thickness
6. Type of weld joint
7. Radiation Source (X-ray, iridium)
8. Type of equipment (External/Internal)
9. Intensifying screens and material
10. Filter type and placement mask, Diaphragm Lead screen etc. adjacent to radiation source or specimen,
11. Exposure Geometry (Source focal spot size, object to film distance, radiation angle with respect to weld and film).
12. Limit of film coverage
13. Film type and make
14. Exposure Conditions (rna, KV, time)
15. Processing (time temperature for development stop bath or rinse, fixation, washing, drying etc.)
16. Density
17. Sensitivity
18. Type of penetrameter
19. Essential wire to be seen on source side:
20. Essential wire accepted for film side viewing:

Approval of the COMPANY

Signature of CONTRACTOR with seal



NOTE Heat-affected zone (HAZ) hardness impressions must be entirely within the HAZ and located as close as possible to the fusion boundary (between the weld metal and HAZ). The wall thickness of the specimen may prevent all the indents as shown from being made, particularly along the mid-point of the specimen.

HARDNESS TESTING – BUTT WELDS

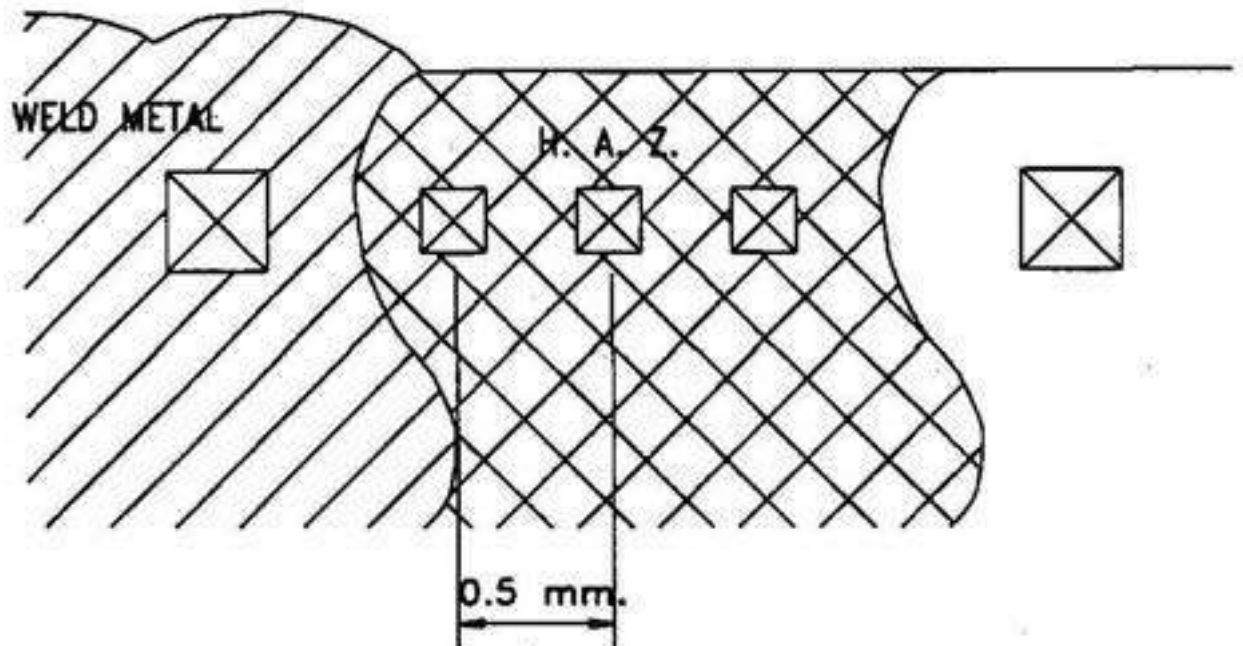
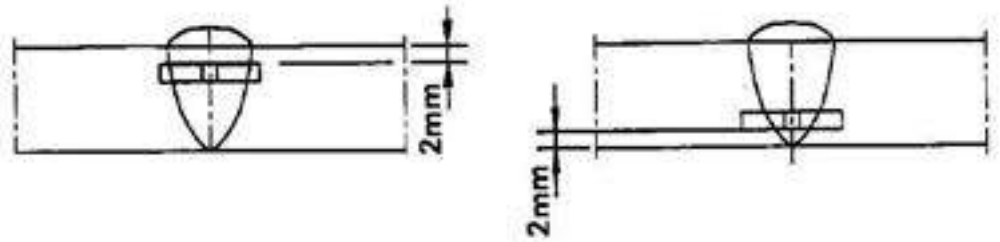


FIGURE 5
HARDNESS TESTING OF WELD JOINTS – SCHEMATIC

NOTCH POSITIONS

CENTER OF WELD



FUSION LINE (F.L)



2mm FROM F.L



5mm FROM F.L

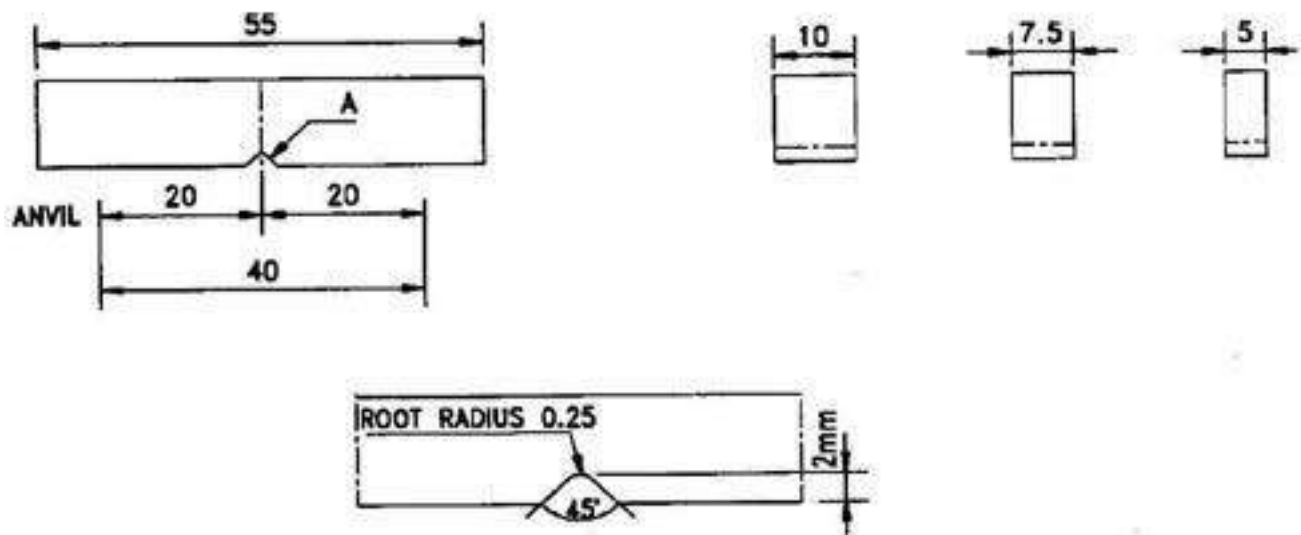


FIGURE 6
CHARPY V – NOTCH TEST SPECIMEN

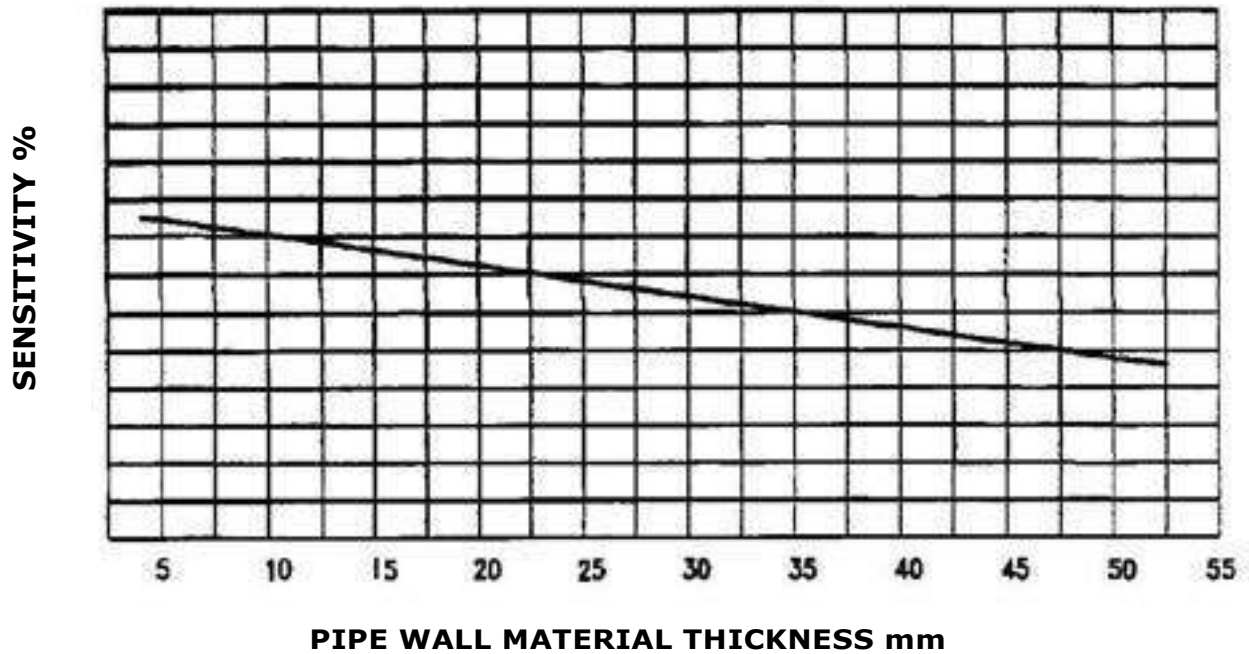


Figure-7

NOTE:-

FOR PRODUCTION RADIOGRAPHY, SENSITIVITY REDINGS BASED ON FILM ON SIDE PENTRAMETERS ARE TO BE JUDGED AS PER RESULT FROM THE PROCEDURE QUALIFICATION WITH PENTRAMETERS PLACED ON THE SOURE SIDE



VCS QUALITY SERVICES PVT. LTD.

WELDING SPECIFICATION FOR FABRICATION OF PIPING

VCS-SS-PP-2509

01	30.06.2022	RP	MC	HK	GW
00	28.01.2020	MB	AK	AD	SK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

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Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
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Abbreviations:

ASME	:	American Society of Mechanical Engineers
ASNT	:	American Society for Non-destructive
Testing AWS	:	American Welding Society
BPVC	:	Boiler & Pressure Vessel Code
CFH	:	Cubic Feet per Hour
DWDI	:	Double Wall Double Image
DWSI	:	Double Wall Single Image
GTA	:	Gas Tungsten Arc
GTAW	:	Gas Tungsten Arc Welding
IBR	:	Indian Boiler Regulations
IQI	:	Image Quality Indicator
NDT	:	Non Destructive Testing
PQR	:	Procedure Qualification Record
RT	:	Radiographic Testing
SMAW	:	Shielded Metal Arc Welding
SWSI	:	Single Wall Single Image
UTS	:	Ultimate Tensile Strength

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(This specification shall be used in conjunction with Welding Specification Charts).

1.0 GENERAL

This specification shall be followed for the fabrication of all types to welded joints of piping system within the battery limits of the plant.

The welded pipe joints shall include the following:

- a) All pipe joints, longitudinal butt welds, circumferential butt welds and socket welds.
- b) Attachments of forgings, flanges and other supports to pipes.
- c) Welded manifold headers and other sub-assemblies.
- d) Welded branch connections with or without reinforcing pads.
- e) Joints in welded/fabricated piping components.
- f) The attachments of smaller connections for vents drain drips and other instrument tapping s.

Any approval granted by the Engineer-in-Charge or Owner's inspector, shall not relieve the Contractor of his responsibilities and guarantee.

This specification shall not be applicable for welding of pipelines for transportation of liquid petroleum, gas and other similar products in onshore and off shore.

2.0 APPLICABLE CODES & STANDARDS

All welding work, equipments for welding, heat treatment, other auxiliary functions and the welding personnel shall meet the requirements of the latest editions of the following accepted standards and procedures unless otherwise specified in the Welding Specification Chart and the Technical Notes attached thereof. In the case of conflicting requirements, the requirements mentioned in Welding Specification Chart/Technical Notes shall be applicable.

- i. ASME Code for Pressure Piping - ASME B31.3
- ii. ASME Boiler & Pressure Vessel Code, Sec II Part C, Material Specifications: Welding Rods, Electrodes and Filler metals.
- iii. ASME Boiler & Pressure Vessel Code, Section V, Non-destructive examination.
- iv. ASME Boiler & Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels.
- v. ASME Boiler & Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.
- vi. The Indian Boiler Regulations - I.B.R.

In the event of any differences due to the additional requirements mentioned in this specification, over and above those obligatory as per codes, this specification shall be binding.

3.0 BASE METAL

3.1 In general, use of carbon steel, alloy steel and stainless steel is envisaged. The details of the material specifications are given in the Welding Specification Chart.

3.2 The Contractor shall provide the manufacturer's test certificates for every heat of the materials

supplied by him.

4.0 WELDING CONSUMABLES

- 4.1** The Contractor shall provide, at his own expense, all the welding consumables necessary for the execution of the job such as electrodes, filler wires, argon etc. and these should bear the approval of the Engineer-in-Charge.
- 4.2** The welding electrodes and filler wires supplied by the Contractor shall conform to the class specified in the Welding Specification Chart. The materials shall be of the make approved by the Engineer-in-Charge.
- 4.3** Electrode qualification test records should be submitted as per the Exhibit-A (attached) in respect of the electrodes tested by the Contractor, for obtaining the approval of the Engineer-in-Charge.
- 4.4** The Contractor shall submit batch test certificates, from the electrode manufacturers, giving details of physical and chemical tests carried out by them, for each batch of electrodes to be used.
- 4.5** All electrodes shall be purchased in sealed containers and stored properly to prevent deterioration. The electrodes removed from the containers shall be kept in holding ovens at temperatures recommended by the electrode manufacturer. "Out of the oven time" or electrodes, before they are consumed, shall not exceed the limits recommended by the electrode manufacturer. The electrodes shall be handled with care to avoid any damage to the flux covering.
- 4.6** All low hydrogen type of electrodes shall be rebaked at 350°C for 1 hour minimum and stored in ovens kept at 80-100°C before use. Recommendations of the electrode manufacturer shall be followed, if available.
- 4.7** The electrodes, filler wires and flux used shall be free from rust, oil, grease, earth and other foreign matter which affect the quality of welding.
- 4.8** Tungsten electrodes used shall conform to ASME Sec. II C SFA 5.12 specification. Thoriated Tungsten electrodes shall not be permitted due to possible radiation hazard. Instead, ceriated Tungsten Electrodes (EWCe-2 or equivalent) shall be used for GTA Welding.

5.0 SHIELDING & PURGING GAS

- 5.1** Argon gas used in GTA welding for shielding purposes shall be 99.995% pure. The purity of the gas shall be certified by the manufacturer. The rate of flow for shielding purposes shall be established through procedure qualification tests. Normally this rate may be 12-20 CFH.
- 5.2** Argon gas with a purity level of 99.995% shall be used for purging.
- 5.3** When GTAW process alone or a combination of GTAW and SMAW processes is recommended for the production of a particular joint, the purging shall be maintained during the root pass and for the first filling pass to minimize oxidation on the inner side of the pipe, unless otherwise specified in Welding Specification Chart.
- 5.4** Initial purging shall be maintained for sufficient period of time so that at least 4-5 times the volume between the dams is displaced, in order to completely remove the entrapped air. In no case should the initial purging period be less than 10 minutes. High gas pressure should be avoided.

5.5 After initial purging, the flow of the backing gas should be reduced to a point where only a slight positive pressure prevails. For systems, which have a small volume (up to 1/2 cubic foot) to be purged, a gas flow rate of 6-CFH is usually adequate. Systems of larger volume may require higher flow rates and these should be established during procedure qualification tests.

5.6 Gas backing (purging) is not required for socket type of welded joints.

5.7 Dams, used for conserving inert gas during purging, shall be removed after completion of the welding, and shall be accounted for. Wherever, removal of dams is not possible after welding, use of water-soluble dams should be made.

6.0 EQUIPMENTS & ACCESSORIES

6.1 The Contractor should have the arrangement of sufficient number of welding and cutting equipments, auxiliaries, and accessories of sufficient capacities so as to meet the target/schedule.

6.2 All the equipments for performing the heat treatment, including transformers, thermocouples, pyro-meters, automatic temperature recorders (with suitable calibration arrangement etc.) shall be provided by the Contractor at his own expenses and these should bear the approval of the Engineer-in-Charge.

6.3 Contractor shall make arrangements at his own expense, for providing the radiographic equipments radiographic films, processing equipment all other darkroom facilities and all the equipments/materials required for carrying out the dye-penetrant/magnetic particle test/ultrasonic testing for satisfactory and timely completion of the job.

6.4 Redoing of any work, necessitated by faulty equipments or operation used by the Contractor, will be done at his own expense.

7.0 WELDING PROCESS

7.1 Welding of various materials under this specification shall be carried out using one or more of the following processes with the approval of the Engineer-in-Charge.

- Shielded Metal Arc Welding Process (SMAW)
- Gas Tungsten Arc Welding Process (GTAW)

7.2 The welding processes to be employed are given in the Welding Specification Chart. Any deviation desired by the Contractor shall be obtained through the express consent of the Engineer-in-Charge.

7.3 Automatic and semi-automatic welding processes shall be employed only with the express approval of the Engineer-in-Charge. The welding procedure adopted and consumables used shall be specifically approved.

7.4 A combination of different welding processes could be employed for a particular joint only after duly qualifying the welding procedure to be adopted and obtaining the approval of Engineer-in-Charge.

8.0 EDGE PREPARATION

8.1 General

The edges to be welded shall be prepared to meet the joint design requirements by any of the following methods recommended:

a) Carbon Steel

Gas cutting, machining or grinding methods shall be used. After gas cutting, oxides shall be removed by chipping or grinding.

b) Low Alloy Steels (containing up to 5% Chromium).

Gas cutting, machining or grinding methods shall be used. After gas cutting, machining or grinding shall be carried out on the cut surface.

c) High alloy steel (> 5% Chromium) and stainless steels, nickel alloys:

Plasma cutting, machining or grinding methods shall be used. After plasma cutting, cut surfaces shall be machined or ground smooth.

8.2 Cleaning

a) The ends to be welded shall be properly cleaned to remove paint, oil, grease, rust, oxides, sand, earth and other foreign matter. The ends shall be completely dry before the welding commences.

b) On completion of each run, craters, welding irregularities, slag etc., shall be removed by grinding and chiseling. Wire brushes used for cleaning stainless steel joints shall have stainless steel wires and the grinding wheels used for grinding stainless steel shall be of a suitable type. Separate grinding wheels and wire brushes should be used for carbon steels and stainless steels.

9.0 ALIGNMENT & SPACING

9.1 Components to be welded shall be aligned and spaced as per the requirements laid down in applicable code. Special care must be taken to ensure proper fitting and alignment when the welding is performed by GTAW process. Flame heating for adjustment and correction of ends is not permitted unless specifically approved by the Engineer-in-Charge.

9.2 A wire spacer of suitable diameter may be used for maintaining the weld root opening while tacking, but it must be removed after tack welding and before laying the root bead.

9.3 For pipes of wall thickness 5 mm and above, the ends to be welded shall be secured in position with the aid of couplers, yokes and 'C' clamps, to maintain perfect alignment. Yokes shall be detached after the completion of weld, without causing any surface irregularity. Any irregularity caused on the pipe surface must be suitably repaired to the satisfaction of the Engineer-in-Charge.

9.4 Tack welds, for maintaining the alignment, of pipe joints shall be made only by qualified welders using approved WPS. Since the tack welds become part of the final weldment they shall be executed carefully and shall be free from defects. Defective tack welds must be removed prior to the actual welding of the joints.

9.5 Tacks should be equally spaced. Minimum number of tacks shall be:

3 tacks	-	for 2 1/2" and smaller dia. pipes
4 tacks	-	for 3" to 12" dia. pipes
6 tacks	-	for 14" and larger dia. pipes

9.6 Welding shall commence only after approval of fit-up by the Engineer-In-Charge.



10.0 WEATHER CONDITIONS

- 10.1** The parts being welded and the welding personnel should be adequately protected from rain and strong winds. In the absence of such a protection no welding shall be carried out.
- 10.2** During field welding using GTAW process, particular care shall be exercised to prevent any air current affecting the welding process.

11.0 WELDING TECHNIQUE

11.1 Root Pass

- a) Root pass shall be made with electrodes/filler wires recommended in the welding specification chart. For fillet welding, root welding shall be done with consumables recommended for filler passes. The preferred size of the electrodes is 2.5 mm diameter (12 SWG) but in any case not greater than 3.25 mm (10 SWG).
- b) Upward technique shall be adopted for welding pipe held fixed with its axis horizontal.
- c) The root pass of butt joints should be executed so as to achieve full penetration with complete fusion of the root edges. Weld projection inside the pipe shall be as per applicable code. It shall be limited 3mm max. When the applicable code does not place any restriction.
- d) Any deviation desired from the recommended welding technique and electrodes indicated in the welding specification chart should be adopted only after obtaining express approval of the Engineer-in-Charge.
- e) Welding shall be uninterrupted.
- f) While the welding is in progress care should be taken to avoid any kind of movement of the components, shocks, vibrations and stresses to prevent occurrence of weld cracks.
- g) Peening shall not be used.

11.2 Joint Completion

- a) Joint shall be completed using the class of electrodes, recommended in the Welding Specification Chart. Size of the electrode shall not exceed 4 mm in diameter for stainless steels and alloy steels used for low temperature applications.
- b) Two weld beads shall not be started at the same point in different layers.
- c) Butt joints shall be completed with a cover layer that would affect good fusion at the joint edges and a gradual notch free surface.
- d) Each weld joint shall have a workmanship like finish. Weld identification work shall be stamped clearly at each joint, just adjacent to the weld. Metal stamping shall not be used on thin pipe having wall thickness less than 3.5mm. Suitable paint shall be used on thin wall pipes for identification.
- e) Rust preventive/protective painting shall be done after the weld joint has been approved.

11.3 Dissimilar Welds

Where welds are to be produced between carbon steels and alloy steels preheat and post weld heat treatment requirements shall be those specified for corresponding alloy steels and filler

wire/electrodes shall correspond to ER 70 S-G or AWS E-7016/7018 type. For welds between two dissimilar Cr-Mo low alloy steels, preheat and post weld heat treatments shall be those specified for higher alloy steel and electrodes used shall correspond to those specified for steel of lower alloy content. For carbon steel or alloy steel to stainless welds, use of filler wire/electrodes EIER-309/E-310/E NiCr Fe-3 shall be made. The welding procedure, electrodes/filler wires to be used shall be approved by the Engineer-in-Charge.

12.0 HEAT TREATMENT

12.1 Preheating

- a) No welding shall be performed without preheating the joint to 10°C (50°F) when the ambient temperature is below 10 degree.
- b) Preheating requirements for the various materials shall be as per the Welding Specification Chart attached.
- c) Preheating shall be performed using resistance or induction heating methods. Preheating by gas burners, utilizing oxy-acetylene or oxy-propane gas mixtures, with neutral flame may also be carried when permitted by the Engineer-in-Charge.
- d) Preheating shall extend uniformly to at least three times the thickness of the joint, but not less than 50 mm, on both sides of the weld.
- e) Preheating temperature shall be maintained over the whole length of the joint during welding. Temperature recorders shall be provided by the Contractor to record the temperature.

12.2 Post Heating

In case of alloy steel materials such as Cr-Mo steels, if the post weld heat treatment is not performed immediately after welding, the weld joint and adjacent portion of pipe, at least 50 mm on either side of weld, shall be uniformly heated to 300°C. This temperature shall be maintained for half an hour minimum, and then wrapped with mineral wool before allowing it to cool to room temperature. If the Post Heating temperature specified in the Welding Specification Charts exceeds 300°C, the same shall be followed. Similarly, if the welding specification chart specifies post-heat time, the same shall be applicable. Post weld heat treatment as specified in the Welding Specification Chart shall be carried out later on.

12.3 Post Weld Heat Treatment (PWHT)

- a) Post weld heat treatment, wherever required for joints between pipes, pipes and fittings, pipe body and supports shall be carried out as per the welding specification chart, applicable codes standards and the instructions of the Engineer-in-Charge. In this regard procedure qualification to be done before carrying out PWHT in production welds.
- b) The Contractor shall submit for the approval of the Engineer-in-Charge, well before carrying out actual heat treatment, the details of the post weld heat treatment procedure as per Exhibit B attached, that he proposes to adopt for each of the materials/assembly/part involved.
- c) Post weld heat treatment shall be done in a furnace or by using an electric resistance or induction-heating equipment, as decided by the Engineer-in-Charge.
- d) While carrying out local post weld heat treatment, technique of application of heat must ensure uniform temperature attainment at all points of the portion being heat- treated. Care shall be taken to ensure that width of heated band over which specified post weld

heat treatment temperature attained is at least that specified in the relevant applicable standards/codes. Control of temperature shall be done using microprocessor/computer controlled system. The desired time-temperature cycle shall be entered into the microprocessor/computer.

- e) Throughout the cycle of heat treatment, the portion outside the heated. band shall be suitably wrapped under insulation so as to avoid any harmful temperature gradient at the exposed surface of pipe. For this purpose temperature at the exposed surface should not be allowed to exceed 50% of the peak temperature.
- f) The temperature attained by the portion under heat treatment shall be recorded by means of thermocouple pyrometers. Adequate number of thermocouples should be attached to the pipe directly at equally spaced location along the periphery of the pipe joint. The minimum number of thermocouples attached per joint shall be 1 up to 6" dia., 2 up to 10" dia. and 3 for 12" dia. and above. However, the Engineer-in-Charge can increase the required number of thermocouples to be attached if found necessary.
- g) Automatic temperature recorders, which have been suitably calibrated, shall be employed for measuring & recording temperature. Both, the actual time-temperature graph and the designed time temperature graph shall be available on every chart. The time-temp graph shall be submitted to Engineer-in-Charge immediately on completion of Stress Relieving Cycle the calibration record of each recorder should be submitted to the Engineer-in-Charge prior to starting the heat treatment operations and his approval should be obtained.
- h) Manufacturer's test certificate shall be submitted for the thermocouples materials and record shall be maintained by the Contractor.
- i) Immediately on completion of the Heat Treatment, the Post Weld Heat Treatment charts/records along with the hardness test results on the weld points, wherever required as per the Welding Specification Chart, shall be submitted to Engineer-in- Charge for his approval.
- j) Each weld joint shall bear a unique identification number, which shall be maintained in the piping sketch to be prepared by the Contractor. The weld joint identification number should appear on the corresponding post weld heat treatment charts. The chart containing the identification numbers and piping sketch shall be submitted to the Engineer-in-Charge in suitable folders.

13.0 CLEANING OF THE WELD JOINT

All weld joints shall be free from adherent weld spatters slag, sward, dirt or foreign matter. This can be achieved by brushing. For stainless steels, brushes with only stainless steel bristles shall be used.

14.0 INSPECTION AND TESTING

14.1 General

- a) The Owner's inspector shall have free access to all concerned areas, where the actual work is being performed. The contractor shall also accord the Owner's Inspector all means and facilities necessary to carry out inspection.
- b) The Owner is entitled to depute his own inspector to the shop or field where prefabrication and erection of pipe lines is in progress for (but not limited to) the following objectives:

- i. To check the conformance to relevant standards and suitability of various welding equipments and the welding performance.
 - ii. To witness the welding procedure qualification.
 - iii. To witness the welder performance qualification.
 - iv. To check whether shop/field welding being executed is in conformity with the relevant specifications and codes of practice followed in piping construction.
- c) Contractor shall intimate sufficiently in advance the commencement of qualification tests, welding works and acceptance tests, to enable the Owner's inspector to be present to supervise them, as decided by the Engineer-In-Charge.

14.2 Welding Procedure Qualification

Welding procedure qualification shall be carried out in accordance with the applicable requirements of ASME Sec. IX latest edition and/or other applicable codes and the job requirements. The contractor shall submit the welding procedure specification in format as per Exhibit-C (attached) immediately after the receipt of the order. Owner's inspector will review, check and approve the welding procedure submitted and shall release the procedure for qualification tests. The procedure qualification test shall be carried out by the Contractor at his own expense. A complete set of test results in the format as per Exhibit-D attached) shall be submitted to the Owner's inspector for his approval immediately after completing the procedure qualification test and at least 2 weeks before the commencement of actual work. Standard test as specified in the code shall be carried out in all cases. In addition to these tests, other tests like macro/micro examination, hardness tests, dye penetrant examination, charpy V-notch, Corrosion tests, impact tests etc. shall be carried out on specimens depending upon the type of base material, operating conditions and requirements laid down in the detailed drawings and specifications. It shall be the responsibility of the Contractor to carry out all the tests required to the satisfaction of the Owner's inspector.

14.3 Welder's Qualification

- a) Welders shall be qualified in accordance with the ASME Section-IX or other applicable codes. The Owners inspector reserves the right to witness the test and certify/approve the qualification of each welder separately. Only those welders who have been approved by the Owner's Inspector shall be employed for welding. Contractor shall submit the welder qualification test reports in the format as per Exhibit-E (attached) and obtain express approval before commencement of work. It shall be the responsibility of Contractor to carry out qualification tests of welders. For welding of the steam piping, falling under the purview of Indian Boiler Regulations, only those welders with IBR Certification, qualified by Boiler Inspectorate, and acceptable to the local Boiler Inspector authority shall be employed.
- b) The welders shall always have in their possession; an identification card containing information contained in Exhibit-G and shall produce it on demand by the Engineer-In-Charge or his representative. It shall be the responsibility of the Contractor to issue the identify cards after it has been duly certified by the, owner's Inspector.
- c) No welder shall be permitted to work without the possession of the identify card.
- d) If a welder is found to perform a type of welding or in a position for which he is not

qualified, he shall be debarred from doing any further work. All welds performed by an unqualified welder shall be cut and redone by a qualified welder at the expense of the Contractor.

14.4 Visual Examination

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

14.5 Radiographic Examination

- a) Contractor shall appoint agency for carrying out the radiography works at site from the list of agency enclosed in the bid document or separately supplied by owner/ VCS.
- b) The Radiographic Examination procedures to be adopted shall be submitted by the contractor as per Exhibit-F and shall be got approved from the Owner's Inspector prior to employment. A person qualified to ASNT Level-II or ASNT Level-III in Radiographic testing shall prepare the procedure. The Radiography Procedure shall be established to demonstrate that the required sensitivity can be consistently achieved under the most unfavorable parameters (e.g. source to film distance, geometric unsharpness, thickness etc.). The radiographic technique and procedure adopted shall conform of the requirements mentioned in Article 2 as well as Article 22 of ASME Sec. V. The IQI sensitivity obtained shall be equal to or better than the requirements mentioned in Article 2 of ASME Sec. V. Source side penetrameter shall be used in establishing radiographic procedure/ technique. The acceptance criteria shall be as per the relevant codes of Fabrication and overriding requirements if mentioned elsewhere in the technical specifications of the contract. The Contractor shall be responsible for carrying out Radiography; rectification of defects and re-radiography of welds repaired/rectified at his cost.
- c) The extent of Radiography shall be as per specifications to be supplied to the Contractor. For welds between dissimilar materials, the extent of Radiographic Examination shall be the more stringent of the two recommended for the materials being welded. Wherever random Radiography is called for, in a particular piping class, the dissimilar materials weld joints shall essentially be included.
- d) Type of Radiation source and film to be used shall be as per Exhibit-H for carrying out radiographic examination. However if specifications (as given elsewhere in the contract) for some critical material require usage of X-Radiation, then Radiography shall be done using X-Rays only.
- e) The Contractor shall fulfill all the statutory and owner's safety requirements while handling X-ray and Gamma-ray equipment s.
- f) In case of random radiography, the joints for Radiography shall be selected by the Owner's Inspector and the Radiography shall be performed in his presence, if he instructs the contractor to do so. The contractor shall furnish all the radiographs, to the Owner's Inspector immediately after processing along with evaluation by a person qualified to ASNT

Level-II in Radiographic testing, in line with Article 2 of ASME Sec. V. The certificate of ASNT/ISNT Level II qualification of the NDT personnel shall be submitted to owner's inspector for his approval prior to start of job.

- g) The Contractor shall provide the Owner's Inspector, all the necessary facilities at site such as a dark room with controlled temperature, illuminator (viewer) suitable for varying densities, a duly calibrated electronic densitometer with batteries, magnifying glass, tracing papers, ruler, marking pencils etc. to enable him to review the radiographs.
- h) Where random radiography is specified, the first weld of each welder shall be completely radiographed. In the case of pipe of size 6" and below, the first two welds shall be completely radiographed.
- i) For each weld performed by a welder found unacceptable, two additional checks shall be carried out on welds performed by the same welder. This operation is iterative and the of two additional welds for each weld deemed unsatisfactory shall be continued till such time that two consecutive welds of satisfactory quality are found for every defective weld.
- j) The Contractor shall carry out these additional radiographic testing at his own expense. To avoid the possibility of too many defective welds by a single welder remaining undetected for a long period to time, the Contractor shall promptly arrange for Radiographic Examination so that there is no accumulation of defective joints.
- k) Contractor shall quote rates for X-ray as well as Gamma Ray for joints indicated to be radiographed by X-ray in Table of Exhibit-H.

14.5.1 Check shots

- a) Owner / Engineer - in - charge or his representative shall select 5% of the total joints radiographed on a day for check shots. Contractor shall carry out check shots as directed.
- b) Weld profiles of check shots shall be compared with weld profile observed in the earlier Radiographs. In the event of anyone variation in the check shots and earlier Radiographs, contractor shall re-shoot the entire lot of joints radiographed by particular Radiography agency on the particular date. All the re-shot films shall be compared with the originally submitted films.

14.6 Liquid Penetrant and Magnetic Particle Examination

- a) Whenever such tests are specified, the tests shall be carried out on joints chosen by the Owner's inspector, as per ASME Section V article 6 and 7 respectively. The tests are to be performed by a person possessing a valid ASNT/ISNT Level-II qualification in the method being used.
- b) For austenitic stainless steels and other nonmagnetic materials, liquid (dye) penetrant test shall be carried out. For carrying out this test, the materials shall be brought within a temperature limit of 15°to 50°C.

14.7 Hardness Test

Hardness requirements for welds shall be as per the Welding Specification Chart Non Destructive Examination Specification attached elsewhere in the contract. Hardness testing shall be carried out by Vickers Hardness Tester during welding procedure qualification and shall be cross sectional. For production welds, hardness testing shall be carried out by portable

digital hardness testers. Poldi hardness tester shall not be permitted. Contractor shall produce documentary evidence/calibration certificate to the Owner's Inspector and obtain approval of the hardness testing equipment.

14.8 Proof Tests

Hydrostatic and pneumatic tests shall be performed as per the requirements laid down by respective flushing and Testing specification/applicable codes to demonstrate the soundness of the welds. The tests shall be conducted after fulfilling the requirement of visual examinations radiography etc. and after the entire work has been certified by the Owner's inspector to be fit for being subjected to such tests.

15.0 REPAIRS OF WELDS

- a) Defects ascertained, through the inspection methods, which are beyond acceptable limits shall be removed after the joint is completely radiographed by the process of chipping and grinding.
- b) When the entire joint is judged unacceptable, the welding shall be completely cut and edges suitably prepared as per required alignment tolerances. The re-welded joint shall again be examined following standard practices.
- c) No repair shall be carried out without prior permission of the Owner's inspector.
- d) Repairs and/or work of defective welds shall be done in time to avoid difficulties in meeting the construction schedules.

16.0 DOCUMENTS TO BE SUBMITTED BY CONTRACTOR (4 COPIES EACH)

- a) Electrode and Welding Consumable Qualification Records as per Exhibit-A, for the Welding Consumables tested and approved for the work.
- b) Batch Test Certificates, for the Electrodes used, obtained from the Electrode Manufacturers.
- c) Proposed Heat Treatment Procedure as per Exhibit-B
- d) Heat Treatment Charts.
- e) Weld joint hardness test results.
- f) Welding Procedure Specifications as per Exhibit-C immediately after receipt of the order.
- g) Welding Procedure Qualification records as per Exhibit-D.
- h) Welder Performance Qualification records as per Exhibit-E immediately after conducting Welder Qualification Tests.
- i) Radiography Procedure as per Exhibit-F and other NDT procedures.
- j) Radiographic test Report along with Radiographs and other NDT reports.
- k) Piping Sketch (Isometric) giving all the details regarding the pipe specifications, welded joints, joints radiographed magnetic particle, tested, ultrasonic tested, penetrant tested, joints heat treated, WPS used, welders identification number, etc.

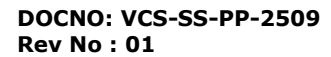


EXHIBIT-A

Sheet 2 of 3

C) Impact Test Results

Test Temperature : Notch in :
Type of Specimens (Charpy) : Size of Specimens :

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

D) Chemical Analysis Results

Electrode Size Result :
Batch No. :

%C	%S	%P	%Si	%Mn	%Cr	%Ni	%Mn	Other

E) Fillet Weld Test Results :

Welding Positions :

Base Materials :

Size of electrode used :

Visual Inspection Results :

1)

2)

3)

EXHIBIT-A

Sheet 3 of3

Macro Test Results :
Fracture Test Results :
Remarks :

F) Other Test Results

1. Transverse tensile test :

In combination with :
Base material used :
Position of welding :
Preheat temperature :
Post weld heat treatment :
Radiography :

Identification No.	U.T.S	Fracture in	Remarks

2. Guided Bend Test :

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

G) Any other tests :

H) Conclusions :

PREPARED BY
(CONTRACTOR)

REVIEWD
(CONTRACTOR)

APPROVED BY
(VCS/OWNER)



EXHIBIT-B

Sheet 1 of 1

STRESS RELIEF HEAT TREATMENT PROCEDURE SPECIFICATION

Contractor : _____

Name of the Heat treater : _____

Name of the Project : _____ Specification

Reference No. _____

1. General Details _____ Other Details

Name of the

Equipment: _____

Type of Heating: Elec. Res. / Induction

(Tick mark applicable method) Maximum
Permissible Temp at Uncovered Parent
Metal _____

Width of heated band _____

Width of Insulation _____

2. Material: _____

No. of Thermocouples (Dia wise)

Type of Thermo couples _____

3. Heat Treatment Cycle Details

Charging temp °C _____

Rate of heating ° C /Hr. _____

Soaking Temperature, °C _____

Soaking Time, Hrs. _____

Rate of Cooling ° C/Hr. _____

Method of Cooling _____

4. Other details, if any _____



EXHIBIT -C
SHEET 1 OF 3

FORMAT FOR WELDING PROCEDURE SPECIFICATION (WPS)

Company Name _____ by _____
Welding Procedure Specification No. _____ Date _____
Welding Process (es) _____ Type (s) _____
(Automatic, Manual, Machines or Semi Auto)

JOINTS

Joint Design _____
Backing (Yes) _____ (No) _____
Backing Material (Type) _____

Sketches Production Drawings. Weld Symbols Written

Description should show the general arrangement of the parts to be welded. Where applicable, the root spacing and the details of weld groove may be specified.

(At the option of the Manufacturer sketches may be attached to illustrate joint design weld layers and bead sequence e.g. for notch toughness procedures, for multiple process procedures, etc.)

BASE METALS

P.No. _____ Group No. _____ to P. No. _____ Group No. _____
OR

Specification type and grade _____
to Specification type and grade _____
OR

Chem. Analysis and Mech. Prop. _____
to Chem. Analysis and Mech. Prop. _____

Thickness Range:

Base Metal: Groove _____ Fillet _____

Deposited Weld Metal: Groove _____ Fillet _____

Pipe Dia Range: Groove: _____ Fillet _____
Other _____



EXHIBIT C
SHEET 2 OF 3

**FILLER
METALS**

F.No. _____ Other _____
A.No. _____ Other _____
Spec. No. (SFA) _____
AWS No.(Class) _____
Size of filler metals _____

(Electrodes, Cold Wire, Hot Wire etc.)

Electrode-Flux (Class) _____
Flux Trade Name _____
Consumable Inset _____
Each base metal/filler metal combination should be recorded individually.
WPSNO _____ Rev. _____

POSITIONS: Position(s) of Groove _____ Welding Progression: UP _____ Down _____ Positions of fillet _____	POSTWELDED HEAT TREATMENT Temperature Range _____ Time Range _____
PREHEAT Preheat Temp. Mon. _____ Interpass Temp. Max. _____ Preheat Maintenance _____	GAS Shielding Gas (es) _____ Percent Composition (mixtures) _____ Flow Rate _____ Gas Backing _____ Trailing Shielding Gas Composition _____

ELECTRICAL CHARACTERISTICS

Current AC or DC _____ Polarity _____
Amps (Range) _____ Volts (Range) _____
(Amps and volts range should be recorded for each electrode size, position, and thickness, etc.
This information may be listed in a tabular form similar to that shown below).
Tungsten Electrode Size and Type _____
(Pure Tungsten, 2% Ceriated, etc.)
Mode of Metal Transfer for GMA W _____
(Spray arc, short circuiting arc, etc.)
Electrode Wire feed speed range _____

EXHIBIT-C
SHEET 3 OF 3

TECHNIQUE

String or Weave Bead _____

Orifice or Gas Cup Size _____

Initial and Interpass Cleaning (Brushing, Grinding, etc.) _____

Method of Back Gouging _____

Oscillation _____

Contact Tube to Work Distance _____

Multiple or Single Pass (per side) _____

Multiple or Single Electrodes _____

Travel Speed (Range) _____

Peening _____

Other _____

Weld Layer(s)	Process	Filler metal		Current		Volt Range	Travel Speed Range	Other
		Class.	Dia.	Type polarity	Amp. Range			
								e.g. Remarks, Comments, Hot wire Addition, Technique Torch Angle, etc.



EXHIBIT-D
SHEET 1 OF 2

FORMAT FOR PROCEDURE QUALIFICATION RECORD (PQR)
RECORD ACTUAL CONDITIONS USED TO WELD TEST
COUPON

Company Name _____
Procedure Qualification Record No. _____ Date _____
WPS No. _____
Welding Process (es) _____
Types (Manual, Automatic, Semi-Auto) _____

JOINTS

Groove Design of Test Coupon

(For combination qualification the deposited weld metal thickness shall be recorded for each Filler metal or process weld)

BASE METALS Material Spec. _____ Type of Grade _____ P.No. _____ to P.No. _____ Thickness of Test Coupon _____ Diameter of Test Coupon _____ Other _____	POSTWELD HEAT TREATMENT Temperature _____ Time _____ Other _____
FILLER METALS Weld Metal Analysis A No _____ Size of Filler Metal _____ Filler Metal E.No. _____ SFA Specification _____ AWS Classification _____ Other _____	GAS Type of Gas on Gases _____ Composition of Gas Mixture _____ Other _____
POSITION Position of Groove _____ Weld Progression (Uphill, Downhill) _____ Other _____ 	ELECTRICAL CHARACTERISTICS Current _____ Polarity _____ Amps _____ Tungsten Electrode Size _____ Other _____



**WELDING SPECIFICATION FOR FABRICATION OF
PIPING**

**DOCNO: VCS-SS-PP-2509
Rev No : 01**

PREHEAT	TECHNIQUE
Preheat Temp. _____	Travel Speed _____
Inter pass Temp. _____	String or Weave Bead _____
	Oscillation _____
	Multi pass or Single Pass (per side) _____
	Single or Multiple Electrodes _____
	Other _____



EXHIBIT-D

SHEET 2 OF 2

GUIDED BEND TESTS

Type of Figure No	Result

TOUGHNESS TESTS

Specimen No.	Notch Location	Notch Type	Test Temp.	Impact Value	Lateral Exp.		Drop Weight	
					% Shear	Mils	Break	No Break

FILLET WELD TEST

Result Satisfactory: Yes ____ No ____ Penetration into Parent Metal: Yes ____ No ____

Macro Results _____

OTHER TESTS

Type of Test _____

Deposit Analysis _____

Other _____

Welder s Name _____ Clock No. _____ Stamp No. _____

Test Conducted by _____ Laboratory Test No. _____

We certified that the statements in this record are correct and test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Date _____ Manufacturer _____

By _____

(Detail of record of tests are illustrative only and may be molded to conform to the type and number of tests required by codes and specifications).



EXHIBIT-E

SHEET 1 OF 2

FORMAT FOR MANUFACTURER'S RECORD FOR WELDER OR WELDING OPERATOR
QUALIFICATION TESTS

Welder Name _____ Check No. _____ Stamp No. _____

Using WPS No. _____ Rev. _____

The above welder is qualified for the following ranges

<u>Variable</u>	<u>Record Actual Values Used in Qualification</u>	<u>Qualification Range</u>
Process	_____	_____
Process Type	_____	_____
Backing (metal, Weld metal, flux, etc.,)	_____	_____
Material Spec.	_____ to _____	_____ to _____
Thickness		
Groove	_____	_____
Filler	_____	_____
Diameter		
Groove	_____	_____
Filler	_____	_____
Filler Metal		
Spec. No.	_____	_____
Class	_____	_____
F. No.	_____	_____
Position	_____	=====
Weld Progression	_____	_____
Gas Type	_____	_____
Electrical Characteristics		_____
Current	_____	_____
Polarity	_____	_____



EXHIBIT-E

SHEET 2 OF 2

Guided Bend Test Results

Type and Fig.No.	Result

Radiographic Test Results

For alternative qualification of groove welds by radiography

Radiographic Results _____

Fillet Weld Test Results

Fracture Test (Describe the location, nature and size of any crack or tearing of the specimen _____
Length and Per Cent of Defects _____ inches _____ %

Macro Test Fusion _____

Appearance - Fillet Size (ing) _____ x _____ Convexity or Concavity _____

Test Conducted by _____ Laboratory - Test No. _____

We certify that the statements in this record are correct and that the test welds were prepared.
Welded and tested in accordance with the requirements of Section IX of the ASME Code.

Date _____

Organization _____

By _____

(Details of record tests are illustrative only and may be modified to conformation to the type & number of tests required by the Code).

Note: Any essential variables in addition to those above shall be recorded

EXHIBIT F

RADIOGRAPHIC PROCEDURE QUALIFICATION RECORD FOR PIPE

WELDING

1. Location
2. Date of Testing
3. Name of the Contractor/Agency
4. Material: Carbon steel/Alloy Steel/Stainless
4. Technique: DWSIISWSI/DWDI
5. Diameter & Thickness
6. Type of Weld Joint
7. Radiation Source
8. Intensifying Screens/Lead Screens
9. Geometric Relationship:
10. Limit of Film Coverage:
11. Film Type and Make:
12. Exposure Time:
13. Processing:
14. Density:
15. Sensitivity:
- 16.* Type of penetrameter:
(Source side)
- 17.* Type of penetrameter:
(Film side)

Signature of Contractor/Agency with Seal

Approval of VCS s Inspector

Ref. Para regarding recommended practice on placement of penetrameters Article 22, SE 142, ASME Sec. V.

For "Random Radiography" lines placement of penetrameters as per Article 2, ASME, Sec. V is permitted.

EXHIBIT - G

WELDER'S IDENTIFICATION CARD

1. Name
2. Identification
3. Date of Testing
4. Process
5. Thickness Range
6. Diameter Range
7. F. No.
8. Date of approval of welding
9. Position(s)

Photograph

Approved by:

Employer's Signature with Seal

EXHIBIT - H

Type of Source and Films to be used for RADIOGRAPHY

NOMINAL WALL THICKNESS(T) IN mm		SHOP WELDED JOINTS		IN-SITU WELDS	
		SOURCE	FILM : CEN Class	SOURCE	FILM : CEN Class
T ≥ 19	All Materials	Gamma Ray	C5	Gamma ray	C5
8 ≤ T < 19	Carbon steel	Gamma ray	C4	Gamma ray	C4
< 8	All other materials	Gamma ray	C3	Gamma ray	C3
	Carbon Steel Other than Inspection Class IV *	Gamma ray	C3	Gamma ray	C3/C1
	All Other Materials and Carbon Steel of Inspection Class IV *	X-Ray	C4	X-ray with C4 or Equivalent to be used. Gamma Ray (Se 75 Source only) with C3/C2 Equivalent may be allowed only if in the assessment of owner's inspector, Joints are in accessible for X-ray equipment and radiographic sensitivity is achieved.	

Note: Integral to above table

- 1) Films slower than the above may have to be used, if required radiographic sensitivity is not achieved consistently.

COMPARISON OF FILM FROM DIFFERENT MANUFACTURERS.

CEN Classification	KODAK	AGFA	FUJI
---	CX	D8	---
C5	AA400	D7	IX100
C4	T200	D5	IX80
C3	MX125	D4	IX50
C2	M100	D3	---
C1	DR50	D2	IX25
---	SR**	---	---

****Special films, extremely fine grain & very high resolution**



VCS Quality Services Pvt. Ltd.

STANDARD SPECIFICATION FOR INSPECTION, FLUSHING & TESTING OF PIPING SYSTEM

VCS – SS – PP - 2501

01	27.01.2022	<i>R. Srinivasan</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY : If printed

CONTROLLED COPY : If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	12.10.2019					
		MB	AK	AD	SK	
01	27.01.2022	<i>Revised</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	VCS QMS Integration
		SR	MC	HK	GW	

ABBREVIATIONS:

ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing of Materials
API	American Petroleum Institute
LPG	Liquefied Petroleum Gas



**STANDARD SPECIFICATION
FOR INSPECTION, FLUSHING & TESTING OF
PIPING SYSTEM**

**DOCNO: VCS-SS-PP-2501
Rev No : 01**

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1.0 SCOPE

This specification covers the general requirements for inspection, flushing and testing of piping systems.

Flushing and testing of all piping systems shall be witnessed by the Company Representative.

2.0 REFERENCE CODES, STANDARDS AND SPECIFICATIONS

Reference has been made in this specification to the latest edition (edition in force at the time of floating the enquiry) of the following codes.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

B31.4 : Pipeline Transportation system for liquids
and Slurries
B31.8 : Gas Transmission and Distribution Piping
Systems. B31.3
: Process piping

3.0 INSPECTION

During various stages and after completion of fabrication and erection, the piping system shall be inspected by the Company representative to ensure that:

- Proper piping material has been used.
- Piping has been erected as per drawings and instructions.
- All supports have been installed correctly.
- Test preparations mentioned in this specification have been carried out.

4.0 FLUSHING

- Flushing of all lines shall be done before pressure testing.
- Flushing shall be done by 'fresh potable water' or by dry compressed air wherever water flushing is not desirable to clean the pipe of all dirt, debris or loose foreign material.
- Required pressure for water flushing shall meet the fire hydrant pressure or utility water pressure. For air flushing, the line/ system shall be pressurized by compressed air at the required pressure which shall be 50 psi maximum. The pressure shall then be released by quick opening of a valve, already in line or installed temporarily for this purpose. This procedure shall be repeated as many times as required till the inside of the pipe is fully cleaned.
- In line instruments like control valves, orifice plates, rotameters, safety valves and other instruments like thermowells which may interfere with flushing shall not be included in flushing circuit.
- The screens/ meshes shall be removed from all permanent strainers before flushing. Screens/ meshes shall be reinstalled after flushing but before testing.
- During flushing temporary strainers shall be retained. These shall be removed, cleaned and reinstalled after flushing, but, before testing.
- In case any equipment such as Filter, Scrubbers column, vessel etc. form part of

piping circuit during flushing, this shall be done with the approval of Company representative. However, equipments thus included in the circuit shall be completely drained and dried with compressed air after flushing is completed.

- During flushing discharged water/ air shall be drained to the place directed by the
- Company representative. If necessary, proper temporary drainage shall be provided by the contractor.
- Care shall be taken during flushing so as not to damage/ spoil work of other agencies. Precautions shall also be taken to prevent entry of water/ foreign matter into equipment's, electric motors, instruments, electrical installations etc. in the vicinity of lines being flushed.
- The contractor shall carry out all the activities required before, during and after the flushing operation, arising because of flushing requirements, such as but not limited to the following:
- Dropping of valves, specials, distance pieces, inline instruments and any other piping part before flushing. The flanges to be disengaged for this purpose shall be envisaged by the contractor and approved by the Company representative. These flanges shall be provided with temporary gaskets at the time of flushing.
- After flushing is completed and approved, the valve distance pieces, piping specials etc. shall be reinstalled by the contractor with permanent gaskets. However, flanges at equipment nozzles and other places where isolation is required during testing, only temporary gaskets shall be provided.

5.0 EXTENT OF TESTING

- With the exclusion of instrumentation, piping systems fabricated or assembled in the field shall be tested irrespective of whether or not they have been pressure tested prior to site welding or fabrication.
- To facilitate the testing of piping systems, vessels and other equipments may be included in the system with the prior approval of Company representative if the test pressure specified is equal to or less than that for the vessels and other equipments.
- Pumps, compressors and other rotary equipments shall not be subjected to field test pressure. Lines which are directly open to atmosphere such as vents, drains, safety valves discharge need not be tested, but all joints shall be visually inspected. Wherever necessary, such lines shall be tested by continuous flow of fluid to eliminate the possibility of blockage.
- However, such lines if provided with block valve shall be pressure tested up to the last block valve.
- Seats of all valves shall not be subjected to a pressure in excess of the maximum cold working pressure of the valve. Test pressure applied to valves shall not be greater than the manufacturer's recommendation nor less than that required by the applicable code. Where allowable seat pressure is less than test pressure, test shall be made through an open valve.

- Instruments in the system to be tested shall be excluded from the test by isolation or removals, unless approved otherwise by the Company representative. Restrictions which interfere with filling, venting, draining such as orifice plates etc. shall not be installed unless testing is complete.
- Control valves shall not be included in the test system. Where bypasses are provided test shall be performed through the bypass and/ or necessary spool shall be used in place of the control valve.
- Pressure gauges which are part of the finished system, but cannot withstand test pressure shall not be installed until the system has been tested. Where piping systems to be tested are directly connected at the battery limits to piping for which the responsibility-rests with other agencies, the piping to be tested shall be isolated from such piping by physical disconnection such as valve or blinds.

5.1 GENERAL REQUIREMENTS / TEST-PREPARATION FOR TESTING

- Testing shall be carried out with permanent gaskets installed unless specified otherwise or instructed by the Company representative.
- No pressure test shall be carried out against closed valve unless approved by the Company representative.
- The Company representative shall be notified in advance by the Contractor, of the testing sequence and programme, to enable him to be present for witnessing the test.
- Before testing, all piping shall be cleaned by flushing to make it free from dirt, loose scale, debris and other loose foreign materials.
- All piping systems to be hydrostatically tested shall be vented at the high points and the systems purged of air before the test pressure is applied.
- Wherever in the line any void exists due to any reasons, like absence of control valves, safety valves, check valves etc. it shall be fitted with temporary spools.
- All joints welded, screwed or flanged shall be left exposed for examination during the test. Before pressurizing the lines, each weld joint shall be cleaned by wire brush to free it from -rust and any other foreign matter.
- Where a system is to be isolated at a pair of companion flanges, a blank shall be inserted between the companion flanges. Minimum thickness of the blank shall be designed in accordance with applicable design code.
- Open ends of piping system where blanks cannot be used, such as pumps, compressors, turbines or wherever equipment or pipe spools have been recovered or disconnected prior to hydrostatic testing, shall be blinded off by using standard blind flanges of same rating as the piping system being tested.
- Pressure gauges used in testing shall be installed as close as possible to the lowest point in the piping system to be tested, to avoid overstressing of any of the lower portions of the system.

- For longer lines and vertical lines, two or more pressure gauges shall be installed at locations decided by the Company representative.
- For lines containing check valves any of the following alternatives shall be adopted for pressure testing:
 - Whenever possible pressurize up-stream side of valve.
 - Replace the valve by a temporary spool and reinstall the valve after testing.
- Provide blind on valve flanges and test the upstream and downstream of the line separately and remove the blind after testing. At these flanges, temporary gaskets shall be provided during testing and shall be replaced by-permanent gaskets subsequently.
- For check valves in lines 1 1/2" and below flapper or seat shall be removed during testing (if possible). After completion of testing the flapper/ seat shall be refitted.
- Gas lines when hydrostatically tested shall be provided with additional temporary supports during testing as directed by the Company representative.
- Piping which is spring or counter-weight supported shall be temporarily supported, where the weight of the fluid would overload the support. Retaining pins for spring supports shall be removed only after testing is completed and test fluid is completely drained.
- When testing any piping system, air or steam of approximately 2 kg/ cm²g may be used as preliminary test to detect missing gaskets etc. as this avoids the necessity of draining the line to make repairs. However, steam shall not be used for this purpose, if the steam temperature is more than the design temperature of the line.
- For jacketed pipes testing of core pipes shall be done on individual pieces where the pipe is continuously jacketed, before it is jacketed. The outer jacket shall be tested separately as a system. For piping with discontinuous jacketing, the core pipe and the jacket shall be tested as separate continuous systems.

5.2 TESTING MEDIA, TEST PRESSURE AND TEST PRESSURE GAUGES

5.2.1 TESTING MEDIA

In general, all pressure tests shall be hydrostatic using iron free water, which is clean and free of silt. Maximum chloride content in water for hydrostatic testing for SS piping shall be 15-20 ppm.

Air shall be used for testing only if water would cause corrosion of the system or overloading of supports etc. in special cases as directed by Company representative.

If operating fluid in the line is much lighter than testing fluid, the additional weight of testing fluid may render piping supports (as designed) inadequate. This will call for additional temporary supports. The typical examples are flare and vapour lines. It is preferable that hydrostatic testing is avoided in such systems and instead pneumatic testing may be specified.

Where air/ water tests are undesirable, substitute fluids such as gas oil, kerosene, methanol etc. shall be used as the testing medium, with due consideration to the hazards

involved. These test fluids shall be specified in the line list given to the contractor.

5.2.2 TEST PRESSURE

The hydrostatic/ pneumatic test. pressure shall be as indicated in the line list or as per the instruction of Company representative.

The selection of the piping system for one individual test shall be based on the following:

- Test pressure required as per line list. Maximum allowable pressure for the material of construction of piping.
- Depending upon the above-requirements and based on construction progress, maximum length of piping shall be included in each test.

5.2.3 TEST PRESSURE GAUGE

All gauges used for field; testing shall have suitable range so that the test pressure of various systems falls in 35% to 65% of gauge scale range. Pressure gage dial shall be minimum of 150 mm. Size of Bourdon shall not be less than 75% of nominal diameter of dial range. Gauge shall be of a good quality and in first class working condition.

Prior to the start of any test or periodically during the field test programme, all test gauges shall be calibrated using a standard dead weight gauge tester or other suitable approved testing apparatus. Any gauge showing an incorrect zero reading or error of more than $\pm 2\%$ of full-scale range shall be discarded. The Company representative shall check the accuracy of master pressure gauge used for calibration. Calibration certificate shall be furnished for the pressure gauges.

5.3 TESTING PROCEDURE

5.3.1 HYDROSTATIC TEST

All vents and other connections used as vents shall be left open while filling the line with test fluid for complete removal of air. In all lines for pressurizing and depressurizing the system, temporary isolation valves shall be provided if valved vents, drains do not exist in the system.

Pressure shall be applied only after the system/ line is ready and approved by the Company representative.

Pressure shall be applied by means of a suitable test pump or other-pressure source which shall be isolated from the system as soon as test pressure is reached and stabilized in the system.

A pressure gauge shall be provided at the pump discharge for guidance in bringing the system to the required pressure.

The pump shall be attended constantly during the test by an authorized person. The pump shall be isolated from the system whenever the pump is to be left unattended.

Test pressure shall be maintained for a sufficient length of time to permit thorough inspection of all joints for leakage or signs of failure. Any joint found leaking during a

pressure test shall be retested to the specified pressure after repair. Test period shall be maintained for a minimum of four hours.

The pump and the piping system to be tested are to be provided with separate pressure indicating test gauges.

Care shall be taken to avoid increase in the pressure due to temperature variation during the test.

5.3.2 PNEUMATIC TEST

When testing with air, pressure shall be supplied by means of a compressor. The compressor shall be portable type with a receiver, after cooler and oil separator.

Piping to be tested by air shall have joints covered with a soap and water solution so that the joints can be examined for leaks.

All other details shall be same as per hydrostatic testing procedure (specified above).

5.4 COMPLETION OF TESTING

After the hydrostatic test has been completed, pressure shall be released by opening the vents, in a manner and at a rate so as not to endanger personnel or damage equipments. All vents shall be opened before the system is to be drained and shall remain open till all draining is complete, so as to prevent formation of vacuum in the system. After draining, lines/ systems shall be dried by air. In services like dry air, ethylene etc., small traces of water can cause problem. For such lines hot air drying is to be done after hydro test.

After testing is completed the test blinds shall be removed and equipment/ piping isolated during testing shall be connected using the specified gaskets, bolts and nuts. These connections shall be checked for tightness in subsequent pneumatic tests to be carried out by the contractor for complete loop/ circuit including equipments (except rotary equipments).

Pressure test shall be considered complete only after approved by the Company representative. Defects, if any, noticed during testing shall be rectified immediately and retesting of the system/ line shall be done by the contractor at his cost.

5.5 TEST RECORDS

Records in triplicate shall be prepared and submitted by the contractor for each piping system, for the pressure test done in the Performa provided/ approved by the Company representative.



VCS QUALITY SERVICES PVT. LTD.

DESIGN GUIDE FOR RADIOGRAPHY REQUIREMENTS

VCS-SS-PP-2506

01	30.06.2022	RP	MC	HK	GW
00	28.01.2020	MB	AK	AD	SK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

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REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	28.01.2020					
		MB	AK	AD	SK	
01	30.06.2022					VCS QMS Integration
		RP	MC	HK	GW	

Abbreviations:

API	:	American Petroleum Institute
ASME	:	American Society of Mechanical Engineers
AWS	:	American Welding Society
BS	:	British Standards
IQI	:	Image Quality Indicator

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	Radiography of welds in pipes of wall thickness below 10 mm (When X-rays are not used)	

1.0 GENERAL

Gamma-ray techniques in general are less sensitive compared to X-ray techniques for penetrated thicknesses of less than 50 mm. For the thinner material, the larger is the difference in sensitivity between radiographs taken with X-ray and Gamma-rays. The "flaw sensitivity" with use of Gamma-rays will be inferior to that of good X-ray techniques. The guidelines have been prepared to specify and implement the radiography requirements at design stage and later on, at fabrication & inspection stages.

2.0 SCOPE

This guide describes the radiography requirements covering the following:

- Design Requirements

- Type of Radiography film

- Material of construction for Image Quality Indicator (IQI)

- Placement of (IQI)

3.0 RADIOGRAPHY REQUIREMENTS

3.1 Design Requirements

The quality of radiographs for the job shall be as per the requirements of the design code and shall be judged by placement of the type of IQI as identified by the same code. The radiographs shall be taken with the help of X-rays source. The use of Gamma-rays (Ir-192) can be considered, wherever it is possible to get the required "Radiography Sensitivity" as per the requirements by the technique adopted for the purpose.

In order to permit the use of Gamma-rays for radiography in place of X-rays, it is necessary that the radiography procedure gives details of the following:

- Type of film

- Diameter/Thickness of the material

- Type of intensifying screens

- Source to Film Distance (SFD) and others (such as film density), which are desired in establishing the required sensitivity level as per the design code

- Type of source and source size

Radiography sensitivity is primarily influenced by factors such as:

- Film selection

- Intensifying screen selection

- Geometric Sharpness

- Film density

For critical services for effective thickness of 10 mm and below, radiography shall be carried out

with X-rays only. When X-ray is not feasible, Gamma radiography can be considered (ANNEXURE-I). The effective wall thickness shall be the actual pipe wall thickness for single wall exposure and twice the thickness for double wall exposure.

3.2 Type of Radiography Films

3.2.1 The type of description given regarding quality of films in different codes may not align with the description given by various film manufacturers. Therefore, for the purpose of this guide, the following is the examples of some of the film relating to various descriptions:

	Carestream (Kodak)	GE (Agfa Gevaert)
Ultra-fine-grain High contrast	Industrex DR50	D2
	Industrex MX125	D4
Fine grain	Industrex AA400	D7
High contrast	Industrex T200	-

3.2.2 Fuji films are also available in the Indian Market. Their equivalent can be worked out based on their literature and actual experiments.

3.2.3 When Gamma radiography is employed only ultra-fine grained high contrast film shall be used.

3.3 Material of Construction of IQI

In the case of low alloyed ferrous materials, IQI of low carbon steel is normally adequate. For highly alloyed ferrous materials which are usually referred to as steels, an IQI made of that particular special steel, for example stainless steel, may be used where there is extensive application of a particular alloy.

For aluminium or magnesium alloys, where there is insufficient application to justify the production of IQI from the same alloy the IQI of pure aluminium or pure magnesium respectively should be used.

For copper and its alloys, IQI of copper should be used.

Whenever it is considered impractical to get IQI of required material, the equivalent shall be established at site based on actual experiments.

In addition to the above, reference also shall be made to ASME Sec.V for selection of IQI material and its identification.

3.4 Placement of IQI

3.4.1 In order to judge the quality of radiography, the IQI should be placed covering the area under examination as indicated in the enclosed Fig.1 (a) and 1(b) along with other details:

Area marker

Date of radiograph

Thickness

Joint number

Welder number

Job number

And additionally, if desired, contractor mark may also be placed.

The IQI shall be so placed, that the smallest hole (wire of the lowest diameter) is towards the outer end of the film away from the centre.

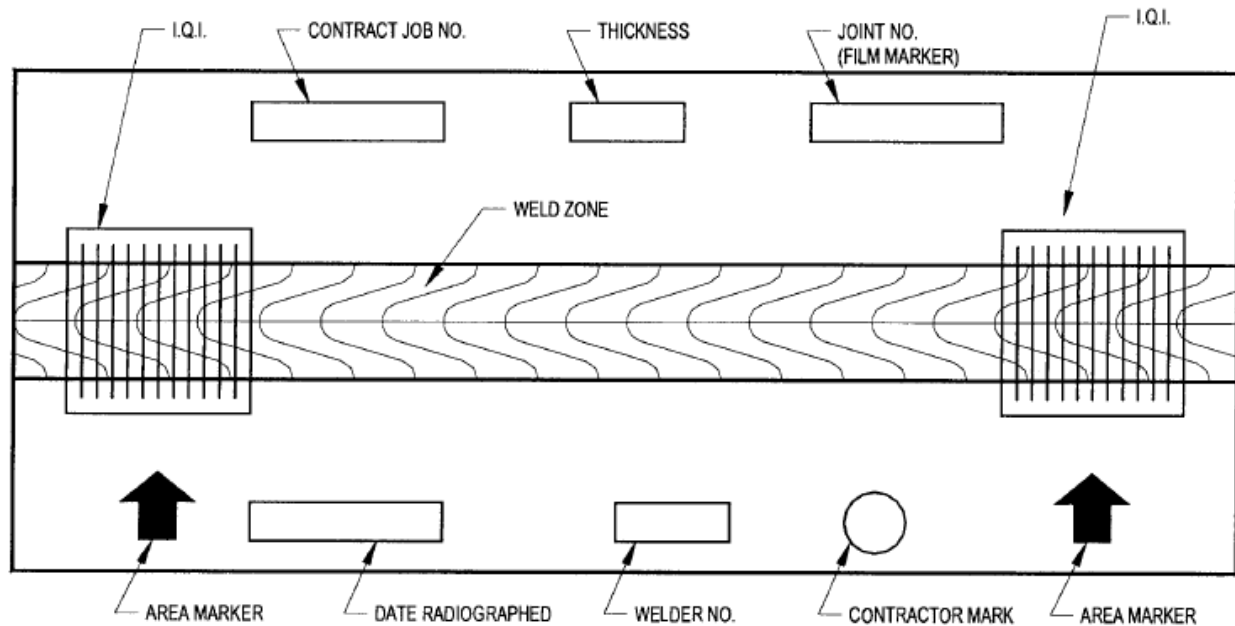


FIG.1 (a): FILM IDENTIFICATION AND PLACEMENT OF PENETRIMETERS

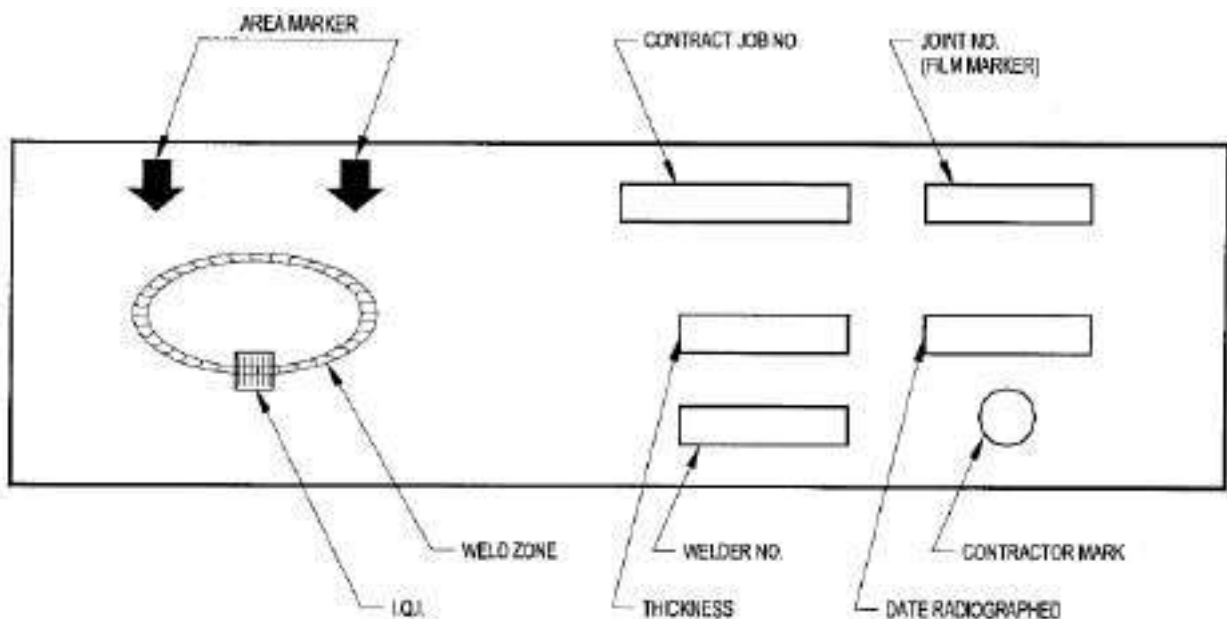


FIG.1 (b): FILM IDENTIFICATION AND PLACEMENT OF PENETRIMETERS
(DOUBLE WALL DOUBLE IMAGE)

ANNEXURE-1

Radiography of welds in pipes of wall thickness below 10 mm (When X-rays are not used)

For radiography of welds in pipes of wall thicknesses below 10 mm and upto 5 mm, the guidance for this work is given below in relation to the double wall single image method.

The requirements should be followed so far as possible with the following:

- A. Only Se-75 should be used.
- B. Only ultra-fine-grain or fine-grain films may be used, preferably the former one.
- C. The source should be placed on the side of the pipe remote from the film, so that the source to film distance is approximately the same as the pipe outside diameter. The source should normally be in the plane of the weld centre line and in contact with or close to the weld. By agreement between the contracting parties, the source may be placed in some other position, after due consideration has been taken of the effects of this on the image formation.
- D. The film should be curved around the pipe so as to ensure good contact with the weld.

The details of radiography procedure so established shall be recorded by the radiography agency and duly approved by Engineer-in-Charge.



VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR HYDROSTATIC TESTING OF ONSHORE PIPELINES

VCS- SS – PP -2014

					
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ABBREVIATIONS

ASME	:	American Society of Mechanical Engineers
API	:	American Petroleum Institute
OISD	:	Oil Industry Safety Directorate (of India)
SMYS	:	Specified Minimum Yield Strength

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1.0 SCOPE

- 1.1** This specification covers the minimum requirements of supply and various activities to be performed by Contractor for hydrostatic testing of cross-country steel pipelines transporting hydrocarbons in liquid or gaseous phase under high pressure.

This specification does not cover the requirements of EGP/caliper pigging, drying/pre-commissioning of the tested pipelines.

- 1.2** This specification shall be read in conjunction with scope of work, specifications, documents, drawings and other requirements indicated in and included in the Contract between the Company and the Contractor. Unless specified otherwise, all sections of this specification shall apply to all specifications referred in this specification

2.0 REFERENCE DOCUMENTS

- 2.1** The latest edition of following Codes and Standards are referenced in this specification and all provisions of these reference codes and standards shall be applicable.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- ASME B 31.4 : Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids.
- ASME B 31.8 : Gas Transmission and Distribution Piping Systems.
- ASME Sec. VIII Div. 1 : Boiler and Pressure Vessels Code - Rules for Construction of Pressure Vessels.

AMERICAN PETROLEUM INSTITUTE (API)

- API RP 1110 : Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids or Carbon Dioxide.

PNGRB REGULATIONS:

- G.S.R 808(E) T4S : Regulations for Natural Gas Pipelines
- G.S.R. Infra/ T4S/ P&PPPL: Regulations for Petroleum and Petroleum products pipelines
- G.S.R. 612(E) T4S : Regulations for CGD Network

- 2.2** In case of conflict between the various requirements of this specification and reference codes, standards, regulations and specifications mentioned above, more stringent requirement shall govern.

3.0 GENERAL REQUIREMENT

- 3.1** The Contractor shall ensure that the complete pipeline section undergoing hydrostatic test is mechanically complete in all respects, i.e welds have been accepted and the pipeline has been laid and backfilled, all mechanical and civil works completed. This has to be ensured keeping in view that, Once the section has been hydrotested, no one shall be authorized to re-open the pipeline section without prior approval of the company. Hydrostatic test shall include those sections which have been previously tested viz. Rail/ road crossings, major water crossings including test on banks and in place after installation.
- 3.2** Hydrostatic test shall be performed on the entire length of the pipeline in accordance with approved Hydrostatic Test procedure and Diagrams clearly indicating the number of test sections and minimum and maximum test pressures in each test sections. The maximum length of each test section shall not exceed 50 Kms.
- 3.3** For pipeline sections (i.e. River Crossing, Railway Crossing, HDD Crossing, National Highway Crossing, etc.) which in Company's opinion, once installed would require an inordinate amount of effort for repair in case of a leak, a provisional pre-test shall be conducted. However, after installation, such pre-tested sections shall be tested again along with the entire pipeline.
- 3.4** All works required for hydrostatic testing shall start only after obtaining prior approval from the Company.
- 3.5** The hydrostatic pressure testing operations shall be carried out by an experienced Test Engineer who shall have no other duty during the hydrostatic testing operations. The Test Engineer(s) shall be in full charge of all activities related to hydrostatic testing operations.
- 3.6** All headers, pre-test headers along with fittings, flanges and attachments shall be pre-tested before putting these for testing purpose.

4.0 TEST PROCEDURE

The Contractor shall submit a comprehensive hydrostatic test procedure to the Company for approval. The procedure shall also include all temporary materials and equipment to successfully complete hydro testing, but not be limited to the followings:

- a) A diagram for the system to be tested, indicating all fittings, vents, valves, temporary connection, relevant elevations and ratings. The diagram shall also indicate injection locations and intake and discharge lines.
- b) A diagram indicating the lengths, elevation charts, and locations of the test sections.
- c) Pipeline details of the test section pipe diameter, wall thickness and material

- d) Source of water for testing and test water discharge location for each test section
- e) Estimated quantity of water for filling and pressurizing
- f) Details of chemicals/ inhibitors and the dosage
- g) Cleaning, gauging, flushing, and filling procedures including type and number of pigs, details of gauging pig.
- h) Procedures for Pig Tracking System (which shall be used in case of pig getting stuck inside pipeline).
- i) Procedures for location and rectification of dents/ buckles/ other deformation, etc.
- j) Temperature stabilization procedure.
- k) Pressure testing procedure including all calculations and test section isolation details.
- l) Procedure for detection, location and rectification of leaks.
- m) Safety precautions and procedures.
- n) Repair procedures for coating damage at thermocouple locations.
- o) Formats to be used for recording the test data.
- p) Procedure for dewatering and neutralization of corrosion inhibitor of the pipeline sections(s) after testing.

The Contractor shall not commence hydrostatic testing activities until the testing procedure is approved.

5.0 SAFETY PRECAUTIONS DURING THE HYDROTEST

The Contractor shall take all necessary safety precautions during the hydrotest. As a minimum, the following shall be taken during the hydrostatic test:

- a) Provision shall be made for the installation of no-admittance signs to unauthorized personnel from the roads to the R.O.U.
- b) Warning signs stating 'PIPELINE UNDER TEST-KEEP OFF' with local language translation shall be placed where the pipeline is uncovered, and particularly where the provisional traps/ test headers and stations are located. Such areas shall be suitably fenced in such a way as to prevent access of unauthorised personnel and no unauthorised personnel shall be closer than 40 m to the testing equipment or pipeline under test. Warning tapes and signboards shall also be placed near the crossings and regular intervals along the route to warn the public around those areas.
- c) The test station shall be placed in such a location as to prevent it from being affected by a catastrophic failure in the test head.

- d) Once dewatering is over the sectionalizing valves and other valve assemblies tested previously, shall be installed at locations shown in the drawings and in accordance with the procedures contained in the relevant specifications.
- e) All thermocouples installed in the pipeline shall be removed and damage corrosion coating shall be repaired using Company approved materials and procedure.

6.0 TEST PRESSURE AND DURATION

6.1 TEST PRESSURE

Unless otherwise specified in the Contract, the minimum hydrostatic test pressure for different classes shall be as follows:

For pipeline handling hydrocarbon in gaseous phase:

Class 1	:	1.25 times the design pressure as per ASME 31.8
Class 2	:	1.25 times the design pressure as per ASME 31.8
Class 3 and Class 4	:	1.5 times the design pressure as per ASME 31.8

For pipeline handling hydrocarbon in liquid phase:

All Location	:	1.25 times the design pressure for pipeline Handling liquids including Liquefied Petroleum Gas (LPG).

The test pressure shall be generated at the highest point in the section under test. At any point in the test section, hoop-stress due to test pressure and static head shall not exceed 95% of the Specified Minimum Yield Strength (SMYS) of pipe material.

6.2 TEST DURATION

The duration of the hydrostatic test shall be 24 hours after thermal stabilization.

7.0 EQUIPMENT AND INSTRUMENTATION

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

7.1 EQUIPMENT

The equipment to be provided shall include, but not be limited to, the following in sufficient numbers along with spares:

- a) Pigs for cleaning, gauging, flushing and filling.

Cleaning pigs with spring loaded steel wire brushes. For internally coated pipes, the pigs shall be provided with nylon/polyurethane brushes. . The first Cleaning pig shall be equipped with pig tracking device with a minimum battery span of 72 hours.

•

- Four cup batching pigs / Bi Directional Pigs
 - Magnetic Pigs
 - Gauging pigs fitted with gauge plate.
- b) The Contractor shall provide a sufficient number of pigs, including spares. Fill pumps:
- The Contractor shall determine the type and number of fill pumps in order to guarantee the following:
- Differential head : 20% greater than the maximum required
 - Flow rate : Minimum ~~400~~ 200 m³/hr; Maximum ~~1000~~ 500 m³/hr for 24" and above pipeline.
: Minimum ~~200~~ 100 m³/ hr; Maximum 400 m³/ hr up to 18" Pipeline
- If a single pump is used, a standby unit must be available.
- c) Pressurizing pump:
- Variable speed positive displacement pumps equipped with a stroke counter to pressurize the pipeline, capable of generating pressure of 20 bar (g) over and above the required test pressure of the section. Contractor shall also ensure availability of standby pressurizing pump.
- d) Two Positive displacement meters/ Turbine meters to measure the volume of water used for filling the line. These meters shall be provided with a calibration certificate not older than three months.
- e) Portable tanks/ Break tanks of sufficient size to provide a continuous supply of water to the pump during filling and pressurizing.
- f) Injection facilities to inject chemicals/ inhibitors into the test medium in the required proportions.
- g) The temporary test header shall be installed at both ends of section. Proper piping and valving arrangements shall be available to allow launching and receiving of each pig independently

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

7.2 INSTRUMENTATION

The instrumentation to be provided shall include, but not be limited to, the following in sufficient numbers along with spares:

- a) Calibrated Bourdon pressure gauges of suitable pressure range and accuracy.
- b) Dead weight testers with an accuracy of 0.01 bar, measuring with least count of 0.05 bar and provided with a calibration certificate not older than three months.

- c) 48 hours recording pressure gauges complete with pressure recording charts duly tested with dead weight tester prior to use. These shall be installed at the test head. The gauge shall having following specification:
- Accuracy : $\pm 0.1\%$ of the full-scale value
- Recording : continuous on tape or disk, graph width 100 mm
- Feed : 7.5 °/ hr for disk diagrams, 20 mm/ hr for tape diagrams
- Recording : Range to be such as to record pressure between 50% and 90% of the diagram width
- d) Temperature recorders for fill water.
- Accuracy : $\pm 1\%$ of the scale range
- Scale -10 °C to +40 °C
- recording : continuous on tape or disk, graph width 100 mm
- Feed : 7.5 °/ hr for disk diagrams, 20 mm/ hr for tape diagrams
- e) Environmental temperature shall be recorded from the beginning of pressurization to the end of the test by means of a recording thermometer featuring the following characteristics:
- Accuracy : $\pm 1\%$ of the scale range
- Scale - 0 °C to + 60 °C
- Recording : continuous on tape or disk, graph width 100 mm
- Feed : 7.5 °/ hr for disk diagrams, 20 mm/ hr for tape diagrams
- f) Thermocouples for measuring the pipe wall temperatures, with an accuracy of ± 0.1 °C
- g) Two laboratory thermometers of range 0 °C to 60 °C and with accuracy of ± 0.2 °C to be used in thermo wells.
- h) Means to measure the volume of water necessary to drop the line pressure by 0.5 bar (container with scales or graduated cylinder).
- i) Injection facilities to inject additives into the test medium in the required proportions.
- j) Communications equipment stable for a continuous connection between the beginning and the end of test section and with the inspection team along the line, in accordance with the requirements of local authorities.
- k) The temporary scraper traps shall be installed according to the test section fixed in the test procedure manual. Proper piping and valve arrangements shall be available to

allow launching and receiving of each pig independently.

The test heads shall be sized in conformity with ASME specification Section VIII, Division 2.

l) Thermocouples for measuring the temperature of the pipe wall shall be installed on the pipeline to be tested at the following locations:

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

Thermocouples shall be attached on the external surface of the pipe after removal of external coating and shall be adequately protected by padding with minimum 500 mm soil. After successful testing, the thermocouples shall be removed and damaged coating shall be repaired as per applicable coating repair procedure, approved by Company. For soil temperature measurements, the thermocouple shall be buried at pipe centerline depth at a distance of 500 mm from the pipe wall.

m) Digital pressure/ temperature monitoring and chart recording systems can be used in lieu of the components listed above provided that the individual pressure/ temperature sensors included in the system have a level of accuracy and can be field calibrated in a manner similar to those instruments listed above. Instruments shall be portable and rugged in construction with minimum weather proof rating of IP-66. They shall display pressure and temperature readings on the screen and shall have adequate memory for recording the same. The instrument shall have computer interface to export the stored data after completion of test.

8.0 HYDROSTATIC TESTING

8.1 Equipment and/ or parts which need not or must not be subjected to the test pressures or which must not be tested with water, must be disconnected or separated from the pipeline to be tested.

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

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

8.3 TEST MEDIUM

The test medium shall be soft non-aggressive water supplied by the Contractor. The water to be used shall be filtered, shall not be contaminated and free from sand or silt. Contractor shall submit laboratory test reports of water used for testing. The possible use of sea water shall be subjected to its degree of cleanness, the possibility of obtaining a pre-determined salinity neutralization. The

Contractor shall furnish and install all temporary piping, which may be necessary to connect from source of water to its pump and manifolds/ tankages.

8.4 INHIBITORS

Contractor shall provide Company approved corrosion inhibitors, oxygen scavengers and bactericides to be added to the test water.

Contractor shall note the following:

- All chemicals for hydro testing shall be procured from approved vendors. Chemicals older than three months shall not be used.
- Company representative shall inspect the chemical containers and take random samples prior to its use. Contractor shall get the samples tested in a govt nominated Govt./PSU/other competent laboratories. Contractor shall get the samples tested, testing shall be carried out for accelerated % corrosion inhibition efficiency, % SRB and TBC killing efficiency test. Company reserves the right to witness the testing. The test report shall be submitted to Company for approval prior to undertaking hydro testing works.
- Only those chemicals which have passed the above tests shall be used for hydro testing.
- Chemicals shall be injected by dosing pump only and mixing in open tank shall not be allowed.

Inhibitors shall be uniformly mixed with the test water in the dosage recommended by the Manufacturer depending upon the water used and in sufficient concentration to ensure the inhibitor remains active for the duration of the test, and any possible delays to testing.

The following products are acceptable for corrosion inhibition of the water used for hydro testing:

- REMIDOL 4000 of M/s Chemtreat India Ltd., Navi Mumbai.
- HIBITOL 2000 of M/s Renkal Chemical, Navi Mumbai.
- INDION 175 of M/s Ion Exchange India Ltd., Hyderabad.
- VISCO 3900 of M/s NALCO EXXON

Indicative dosage for inhibitor is as follows:

• Upto 6 months	:	500 mg/l
• Above 6 months	:	750 mg/l

However, the exact dosage rates shall be as per the hydro test water analysis and manufacturer recommendations.

8.5 CLEANING

Before filling operation, the Contractor shall clean the pipeline by air driven pigs

provided with spring loaded nylon/polyurethane brushes for internal coated Pipes & wire brush cleaning pigs for internal uncoated pipes to remove all mill scale, rust, sand, etc. from the inside of pipe section. For this purpose, temporary headers for air cleaning shall be attached to the pipeline. The number of pig runs depends upon the cleaning results and shall be determined by the Owner/Consultant at site.

Water column of 1- 2% of test section shall be injected in front of the first cleaning Pig for flushing.

8.6 Magnetic Pigging

After the successful acceptance of cleaning, Magnetic pig run shall be used to clean "constructional metallic debris" of the pipeline.

For internally coated pipes, adequate care shall be taken by using soft cups so that no damage takes place to the internal coating of the pipe.

Contractor shall decide the number of magnet cleaning pig runs and the choice of the magnet cleaning pig for each cleaning run as suitable for the purpose to obtain internal condition adequately clean.

However, the ferrous debris permitted with magnetic cleaning pig shall not exceed 5 Kg/100KM. In case debris received is more than this amount, the Contractor shall be required to make subsequent run(s) until at least the above limit is achieved.

The cleaning pigs for successive cleaning pig runs shall be selected by the Contractor in such a manner that effective cleaning i.e. 3kg/100km ferrous debris is achieved.

The best accuracy offered and guaranteed by the Contractor shall be clearly spelt out. However, the tool should have minimum capabilities as under.

Type of pig: Uni-directional

Magnet power: Min 800 gauss

Nos. of magnets: 8/6 nos.

Min. bend radius pig can negotiate: 6D

Min dia pig can negotiate: 90% standard wall thickness ID

8.7 GAUGING

After cleaning the pipeline by using air and acceptance by Company, gauging shall be carried out by using gauging pig. The gauge plate diameter shall be equal to 95% of inside diameter of the heaviest wall pipe in the test section. While computing the Inside Diameter (ID) of heaviest wall pipe, pipe manufacturing tolerances shall not be considered. A 10 mm thick aluminum plate shall be used for making gauge plate. The gauging plates shall have 8 radial incisions at 45

degree interval. Compressed air shall be used to run Gauging pig.

After receipt of gauging pig at the other end, the gauge plate shall be inspected in the presence of Company representative. A deformed, bent or severally nicked plate or damaged pig shall be evidence of gauging pig run failure and the same shall not be acceptable to COMPANY. In such cases, the Contractor shall locate any obstruction and/ or faults such as dents, buckles, flat spots, etc. and rectify the same to the satisfaction of the Company. A written approval shall be obtained from Company regarding successful completion of gauging pig run. Photographs of the Gauge Plate before and after the gauging run shall be taken and included in the inspection report.

After acceptance of gauging operation, air header shall be cut and removed. Pre-tested test headers loaded with three numbers of four cup batching pigs shall be welded to test section.

The drawing of the test headers shall be submitted along with hydrotest procedure for approval. All fittings and flanges to be used in the test header fabrication shall be at least one ANSI rating higher than the line rating. The headers shall be pretested at line hydrotest pressure for duration of minimum 24 hours. The record shall be kept and shall be part of the final hydro test report.

8.8 WATER FILLING

After acceptance of gauging run, water filling of the testing section shall commence. For this purpose, pretested test headers loaded with three numbers of four cup batching / Bi -Directional pigs shall be welded to the test section. Weld joints between test header and pipeline shall be radiographed and accepted before filling operation starts.

Un-inhibited water equal to 10% of the volume of test section shall be filled ahead of the first pig. The first batching pig shall be launched using minimum un-inhibited water equivalent to 1.5 Km of test section for longer sections and 0.5 Km for short sections below 10 Km. Then the second pig shall be launched using inhibited water till the second pig is received at the other end. The Contractor shall continuously monitor the volume and pressure, the temperature of the fill water during the filling operation. When it has been confirmed that the filling pigs have arrived in the receiving test header, the thermal stabilization and pressurization operations can commence subsequently.

The temperature of the fill water should be recorded as it is introduced into the pipeline. This will aid in the determination of line temperature stability. Additionally, the flow rates and pressures should also be recorded or monitored to protect the pipeline from an over pressure situation.

8.9 THERMAL STABILIZATION

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

Thermal equilibrium between the pipeline and environment shall be checked through the Thermocouples installed on the pipeline and in the soil.

Temperature readings shall be made at 2 hours-intervals. Thermal stabilization shall be considered to have been achieved when a difference not higher than 1 °C is attained between the average values of the last two readings.

Thermal stabilization completion shall be approved by Company.

8.10 PRESSURIZATION

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

- Each 5 bar increments up to 80% of test pressure as recorded by the dead weight tester
- Each 2 bar increments between 80% to 100% of test pressure as recorded by the dead weight tester
- It is preferable for a pressure-volume plot to be initiated at the start of the pressurization process and continued until the test pressure is reached. The lower end of the pressure-volume plot can be used to determine the total amount of residual air in the test section. The upper end of the pressure volume plot can be used to determine if any pipe in the test segment may have reached its elastic limit.

8.10.2 The pressurization shall be cycled according to the following sequence:

- Pressurize to 50% of test pressure, hold pressure for 1 hour,
- Drop pressure to 10% of test pressure of test section at test head,
- Pressurize to 75% of test pressure, hold pressure for 1 hour
- Drop pressure to 10% of test pressure of test section at the test head
- Pressurize to test pressure.

During the pressurization to each test pressure (50% & 75%), two tests shall be carried out for the calculation of air volume in the pipeline under test.

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

8.11 AIR VOLUME CALCULATION.

Two separate consecutive pressures lowering of 0.5 bar shall be carried out after pressurizing to test pressure in order to check the presence of air in the pipeline.

For calculation of air in the pipeline the second pressure lowering shall be used, and the relevant drained water shall be accurately measured (V_1). This amount measured shall be compared to the theoretical amount (V_p) corresponding to the pressure lowering that has been carried out, by using the procedure outlined in clause 9.1 of this specification.

If no air is present in the length under test, then $\frac{V_I}{V_D} = 1$

In order that the above ratio is acceptable, it shall not differ by more than 6% (i.e. 1.06). If the air found in the pipeline is within the above established tolerance, then the pressurizing can continue. If the ratio V_I / V_D exceeds 1.06, the hydrostatic testing cannot go on and additional pig passages shall be performed to remove the air pockets.

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

8.12 TESTING

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

During the testing period the following measurements shall be recorded

- Pressure measurements from dead weight tester: Every hour
- Soil temperature and the pipe temperature at the thermocouples: Every two hours

All data shall be recorded on appropriate forms attached to the hydrostatic test procedure manual. Care shall be taken that the maximum test pressures are not exceeded. Bleed-off water shall be accurately measured and recorded.

8.13 MEASUREMENTS

8.13.1 WATER AMOUNT MEASUREMENT

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

The quantity of water added during pressurization shall be measured during the pressurization stages.

8.13.2 PRESSURE MEASUREMENT

Pressure shall be measured with a dead weight tester that shall permit readings with least count of 0.05 bar. The pressure shall also be recorded by means of a recording pressure gauge. The recording pressure gauge shall be checked by means of a dead weight tester at the beginning, during and at the end of the hydrostatic test.

Accuracy : $\pm 0.1\%$ of the full-scale value

Recording : Continuous on tape or disk, graph width 100mm

Feed : 20mm/h for tape diagrams, 15°/h for disk diagrams

Recording range : To be such as to record pressure between 50% and 90% of the diagram width.

8.13.3 TEMPERATURE MEASUREMENT

- Water temperature shall be taken at every 2 hours through the thermocouples that have been installed on the pipe wall along the section.

In addition, the temperature measurement shall be taken during filling operation, thermal stabilization stage and during the pressure hold period.

The thermocouples' sensitivity shall enable temperature readings with the accuracy of $\pm 0.1^\circ\text{C}$.

- Water temperature shall also be measured at the pump delivery through a recording thermometer throughout the filling stage.

The recording thermometer shall feature the following characteristics:

Accuracy : $\pm 1\%$ of the scale range

Scale : -10° to $+40^\circ\text{C}$

Recording : Continuous on tape or disk, diagram width 100mm

Feed : 20mm/h for tape diagrams, 15°/h for disk diagram

- Ground temperature shall be taken by measuring soil temperature at the thermocouples prior to starting the filling operation.
- Ambient temperatures shall be recorded from the beginning of pressurization to the end of the test by means of a recording thermometer.

Accuracy : $\pm 1\%$ of the scale range

Scale : 0° to $+60^\circ\text{C}$

Recording : Continuous on tape or disk, diagram width 100mm

Feed : 20mm/h for tape diagrams, 15°/h for disk diagrams.

9.0 CALCULATIONS

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

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

$$V_p = \left(0.884 \frac{r_i^2}{t} + A \right) \times 10^{-6} \times (V_t) \times (\Delta P) \times K$$

Where:

V_p = computed water amount required to raise by P the pressure in the section to be tested (m^3)

- V_t = geometrical volume of the section (m^3)
- ΔP = pressure rise (bar)
- r_i = nominal inner radius of the pipe (mm)
- t = nominal pipe thickness (mm)
- A = Isothermal compressibility value for water at the pressurization temperature in the P range (bar^{-1}) $\times 10^6$ (Refer water compressibility factor v/s pressure and temperature charts. For temperature above 30°C the values may be extrapolated.)
- K = A dimensionless coefficient that is equal to a value of 1.02 for longitudinally welded pipe.

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

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

Where:

- ΔP = Pressure change resulting from a temperature change (bar)
- ΔT = Algebraic difference between water temperature at the beginning of the test and water temperature as measured at the end of the test (°C).
- B = Value of the difference between the thermal expansion of water at the pressure and temperature as measured at the end of the test and that of steel ($^{\circ}C^{-1} \times 10^6$) (Refer Table1)
- A = Isothermal compressibility value of water as estimated at the pressure and temperature values obtained at the end of test (Refer Figure 1)
- K = A dimensionless coefficient that is equal to a value of 1.02 for longitudinally welded pipe.
- r_i = nominal inner radius of the pipe (mm)
(In case of the test section having multiple wall thicknesses, "ri" shall correspond to the wall thicknesses, having the maximum total length in the given test section.)
- t = nominal pipe thickness (mm)

10.0 ACCEPTANCE

10.1 The hydrostatic test shall be considered as positive if pressure has kept a constant value throughout the test duration, except for change due to temperature effects. Such changes shall be evaluated as described under clause 9.2 of this

specification.

The pressure change value as a function of temperature change shall be algebraically added to the pressure value as read on the meters. The pressure value thus adjusted shall be compared with the initial value and the test shall be considered as acceptable if the difference is less than or equal to 0.3 bar. In case of doubt the testing, period shall be extended by 24 hours.

- 10.2** If test section fails to maintain the specified test pressure after isolation, Contractor shall determine the location of leakage or failure by suitable means. All leaks and failures within the pipe wall or weld seams shall be repaired by replacement of entire joint or joints in which leakage or failure occurs. In those cases where leaks occur in circumferential welds, the method of repair shall be determined by the Company. Contractor shall comply with instructions of the Company whether to replace a section of the line pipe that includes the line leak or whether to repair the circumferential weld. This repair should, however, meet the requirements of applicable welding specification enclosed with the Contract. Where failures occur in pipeline field bends, bends shall be replaced with same degree of bends. After completion of repairs, the hydrostatic test shall be repeated in full, as per this specification.
- 10.3** The cost of repairs or replacements, followed by refilling and depressurizing the line, due to poor workmanship, shall be borne by the Contractor. In the event of leaks or failures resulting from faulty Company furnished materials, Contractor shall be reimbursed as per the provisions of Contract. All work of reinstalling line pipe, to replace failures, shall be done in accordance with the relevant specifications included in the CONTRACT.
- 10.4** Contractor shall haul and stockpile all damaged and defective pipes to storage location designated by the Company. All cracks and splits resulting from failure shall be coated with an application of grease to preserve the characteristics of failures from corrosion. Joint of failed pipes shall be marked with paint, with a tag indicating failure details, date and location of failure and pressure at which failure occurred. Failed pipes shall have pipe number and heat number clearly marked on the outside surface along with warning sign to prevent re-usage.

11.0 TERMINATION

After the positive result of testing and all the data have been gathered, the test shall be terminated upon written approval given by the Company. The pipeline shall be slowly depressurized at a moderate and constant rate as instructed by Company. Subsequent operations such as installation of sectionalizing valves, caliper pigging, swabbing, pre-commissioning checks, purging/ inertising and commissioning shall be carried out as per the relevant specifications.

- 11.1** All thermocouples installed in the pipeline shall be removed and damaged coating shall be repaired using Company approved materials and procedure.
- 11.2** Contractor shall dewater the tested line as per the following requirement after test acceptance.

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

- 11.3** During dewatering, care shall be taken to properly dispose the discharging water in order to avoid pollution, damages to fields under cultivation and/ or existing structures and interference with the traffic. Before the start of dewatering and disposal of hydro test water, a procedure for treatment of inhibited water to prevent pollution shall be submitted by Contractor to Company for review and approval.
- 11.4** Upon completion of the testing and dewatering operation, any provisional traps/ headers for pigs and all other temporary installation relating to the test shall be removed. Subsequently, the individual sections of the line already tested shall be joined in accordance with the requirements of relevant specifications issued for the purpose.

12.0 TEST REPORT

A complete report signed by Contractor and the Company shall be submitted upon completion of the hydrostatic test for each test section.

This report shall contain as a minimum:

- Pressure at high and low elevations;
- Elevation & Pressure at test point;
- Water test certificate;
- Inhibitor test certificate;
- The cleaning, gauging, flushing, filling and testing procedures used;
- Schematic layout of cleaning, filling and testing facilities;
- Section Elevation Plot;
- Equipment's and Instruments calibration certificate;
- A profile of the pipeline that shows the test sites, all instrument and injection connections;
- Pipe filling logs and records;
- Additive specification, required concentration and additive injection records;
- Pig specifications;
- Pig inspection records including photographs of the damages; records of gauging pig survey and photographs;
- Pressurization and stabilization records;
- Pressure and temperature recording charts with appropriate information

inscribed thereon;

- Temperature data along the pipeline;
- Dead weight tester logs and recordings;
- Air volume calculations;
- Pressure Vs Volume plot
- Pressure changes due to temperature change calculations;
- Environmental data;
- Depressurization logs and records;
- Dewatering procedure and schematic layout of relevant facilities; dewatering logs and records;
- Records and photographs of all leaks, if applicable.

13.0 PRESERVATION OF PIPELINE

When so stated in the CONTRACT, to preserve/ conserve the pipeline for a specified duration, Contractor shall completely fill the pipeline with water, with sufficient quantity of corrosion inhibitors depending upon quality of water and the period of conservation, at a pressure as per relevant specification/ Contract. Contractor shall obtain necessary approval from the Company of the procedure, type and quality and quantity of inhibitors used before commencement of the works.

14.0 PRECAUTIONS DURING THE TEST

In addition to all that has been expressly described in the procedures for carrying out the tests, the following additional requirements shall be complied with:

1. Provision shall be made for the installation of no-admittance signs to unauthorised personnel from the roads to the R.O.U.
2. Signs stating 'PIPE UNDER TEST-KEEP OFF' with local language translation shall be placed where the pipeline is uncovered, and particularly where the provisional traps and stations are located. Such areas shall be suitably fenced in such a way as to prevent access of unauthorised personnel. No unauthorised personnel shall be closer than 40M to the pipeline or equipment under test.
3. Provisional scraper traps shall be installed in compliance with methods and suitable location so that their rupture cannot cause any injuries to the personnel or third parties
4. The test station shall be placed in such a location as to prevent it from being affected by a catastrophic failure in the test head.
5. Once dewatering is over the sectionalising valves and other valve assemblies tested previously, shall be installed at locations shown in the drawings and in accordance with the procedures contained in the relevant specifications. All thermocouples installed in the pipeline shall be removed and damaged corrosion coating shall be repaired using Company approved materials and procedure.

15.0 DOCUMENTATION

PRIOR TO COMMENCEMENT OF HYDROSTATIC TEST

The Contractor shall furnish the Hydrostatic Test Procedure at least six weeks prior to commencement of hydrostatic test operations for the approval of the Company Representative. Hydrostatic test operations shall commence only after obtaining written approval from Company.

Prior to commencement of the testing, copies of certifications, calibrations, etc of any equipment/ instrumentation to be incorporated in the test set-up shall be submitted to the Company Representative.

ON COMPLETION OF HYDROSTATIC TEST

The Contractor shall furnish the Test Report duly signed by both the Contractor and the Company Representative, immediately upon completion of successful hydrostatic test.

**TABLE 1: DIFFERENCE BETWEEN THE WATER THERMAL EXPANSION FACTOR AND
THE STEEL THERMAL EXPANSION**

FACTOR ($^{\circ}\text{C}^{-1} \times 10^6$)

$^{\circ}\text{C}$ bar	1	2	3	4	5	6	7	8
0.981	-98.62	-79.89	-61.81	-44.34	-27.47	-11.14	4.66	19.98
10	-95.55	-76.94	-58.99	-41.65	-24.89	-8.67	7.02	22.23
20	-92.15	-73.68	-55.86	-38.64	-22.01	-5.92	9.65	24.74
30	-88.74	-70.4	-52.72	-35.63	-19.14	-3.16	12.29	27.26
40	-85.32	-67.12	-49.58	-32.62	-16.24	-0.41	14.93	29.78
50	-81.9	-63.84	-46.43	-29.6	-13.36	2.36	17.57	32.31
60	-78.47	-60.55	-43.27	-26.58	-10.46	5.15	20.23	34.85
70	-75.03	-57.25	-40.1	-23.54	-7.56	7.92	22.89	37.89
80	-71.6	-53.96	-36.94	-20.51	-4.65	10.7	25.55	39.94
90	-68.16	-50.66	-33.77	-17.47	-1.73	13.5	28.23	42.5
100	-64.72	-47.35	-30.6	-14.43	1.18	16.29	30.9	45.05
110	-61.28	-44.05	-27.43	-11.38	4.1	19.08	33.58	47.67
120	-57.84	-40.74	-24.26	-8.34	7.02	21.88	36.26	50.18
130	-54.4	-37.44	-21.08	-5.29	9.95	24.68	38.94	52.75
140	-50.96	-34.13	-17.9	-2.25	12.87	27.49	41.63	55.32
150	-47.53	-30.83	-14.73	0.8	15.79	30.29	44.31	57.89
160	-44.1	-27.53	-11.56	3.85	18.72	33.1	47	60.46
170	-40.67	-24.23	-8.4	6.89	21.64	35.9	49.69	63.04
180	-37.24	-20.94	-5.23	9.94	24.56	38.7	52.37	65.62
190	-33.83	-17.65	-2.06	12.98	27.48	41.51	55.06	68.19
200	-30.42	-14.37	1.09	16.01	30.4	44.3	57.75	70.77
210	-27.02	-11.09	4.25	19.04	33.31	47.1	60.43	73.34
220	-23.63	-7.82	7.4	22.06	36.22	49.9	63.12	75.9
230	-20.24	-4.56	10.54	25.08	39.13	52.69	65.8	78.48
240	-16.87	-1.3	13.67	28.1	42.03	55.48	68.48	81.05
250	-13.5	1.94	16.79	31.11	44.92	58.26	71.15	83.61
260	-10.14	5.17	19.9	34.12	47.81	61.04	73.81	86.81
270	-6.8	8.39	23	37.11	50.69	63.8	76.48	88.73
280	-3.48	11.6	26.11	40.09	53.56	66.57	79.14	91.29
290	-0.17	14.8	29.19	43.07	56.43	69.33	81.78	93.83
300	3.13	17.98	32.27	46.03	59.29	72.08	84.83	96.38

**TABLE 1: DIFFERENCE BETWEEN THE WATER THERMAL EXPANSION FACTOR AND
THE STEEL THERMAL EXPANSION**

FACTOR ($^{\circ}\text{C}^{-1} \times 10^6$)

$^{\circ}\text{C}$ bar	9	10	11	12	13	14	15	
0.981	34.82	49.22	63.2	76.78	89.99	102.83	115.34	
10	36.97	51.26	65.15	78.64	91.75	104.51	116.93	
20	39.36	53.55	67.33	80.71	93.72	106.39	118.71	
30	41.76	55.84	69.51	82.79	95.7	108.26	120.49	
40	44.18	58.14	71.7	84.87	97.68	110.14	122.28	
50	46.6	60.45	73.9	86.96	99.68	112.04	124.07	
60	49.02	62.76	76.1	89.07	102.67	113.93	125.88	
70	51.44	65.08	78.32	91.17	103.68	115.84	127.69	
80	53.88	67.4	80.53	93.29	105.69	117.76	129.5	
90	56.32	69.73	82.75	95.41	107.7	119.67	131.32	
100	58.77	72.07	84.98	97.53	109.73	121.59	133.15	
110	61.21	74.41	87.22	99.66	111.75	123.52	134.98	
120	63.67	76.74	89.45	101.79	113.79	125.46	136.82	
130	66.12	79.09	91.69	103.93	115.83	127.39	138.67	
140	68.58	81.45	93.93	106.07	117.87	129.34	140.51	
150	71.05	83.8	96.18	108.21	119.9	131.2	142.37	
160	73.51	86.15	98.43	110.36	121.96	133.74	144.22	
170	75.97	88.51	100.68	112.51	124.01	135.19	146.08	
180	78.44	90.87	102.94	114.66	126.06	137.15	147.94	
190	80.91	93.23	105.19	116.82	128.12	139.11	149.81	
200	83.37	95.59	107.45	118.97	130.17	141.07	151.68	
210	85.84	97.95	109.71	121.13	132.24	143.03	153.55	
220	88.3	100.31	111.97	123.29	134.29	144.99	155.42	
230	90.67	102.67	114.23	125.45	136.36	146.96	157.3	
240	93.22	105.03	116.48	127.6	138.42	148.93	159.18	
250	95.69	107.39	118.74	129.76	140.48	150.9	167.05	
260	98.14	109.74	121	131.92	142.54	152.87	162.93	
270	100.6	112.1	123.25	134.08	144.61	154.84	164.81	
280	103.05	114.44	125.5	136.24	146.67	156.84	166.69	
290	105.5	116.79	127.75	138.39	148.73	158.78	168.57	
300	107.94	119.13	130	140.54	150.79	160.75	170.45	

**TABLE 1: DIFFERENCE BETWEEN THE WATER THERMAL EXPANSION FACTOR AND
THE STEEL THERMAL EXPANSION**

FACTOR ($^{\circ}\text{C}^{-1} \times 10^6$)

$^{\circ}\text{C}$ bar	16	17	18	19	20	21	22	23
0.981	127.52	139.41	151	162.3	173.37	184.18	194.75	205.08
10	129.02	140.83	152.36	163.6	174.56	185.3	195.79	206.07
20	130.71	142.42	153.85	165	175.9	186.55	196.96	207.16
30	132.4	144.02	155.35	166.4	177.23	187.8	198.14	208.26
40	134.1	145.62	156.87	167.9	178.58	189.07	199.33	209.37
50	135.8	147.24	158.39	169.3	179.93	190.34	200.52	210.49
60	137.51	148.86	159.92	170.7	181.29	191.62	201.72	211.61
70	139.22	150.49	161.46	172.2	182.66	192.91	202.93	212.74
80	140.95	152.11	163	173.6	184.03	194.2	204.14	213.88
90	142.67	153.75	164.56	175.1	185.41	195.5	205.36	215.03
100	144.42	155.4	166.11	176.6	186.8	196.8	206.59	216.17
110	146.15	157.04	167.66	178.1	188.2	198.12	207.82	217.33
120	147.9	158.7	169.24	179.5	189.59	199.44	209.06	218.49
130	149.65	160.36	170.81	181	191	200.75	210.31	219.66
140	151.4	162.03	172.39	182.5	192.41	202.09	211.56	220.84
150	153.16	163.7	173.98	184	193.82	203.42	212.81	222.02
160	154.93	165.37	175.56	185.5	195.24	204.76	214.08	223.2
170	156.69	167.05	177.15	187	196.66	206.1	215.34	224.39
180	158.47	168.73	178.75	188.5	198.09	207.45	216.61	225.58
190	160.24	170.42	180.35	191.1	199.52	208.8	217.89	226.79
200	162.01	172.1	181.95	191.6	200.97	210.16	219.17	227.99
210	163.8	173.8	183.55	193.1	202.4	211.53	220.46	229.2
220	165.58	175.49	185.16	194.6	203.85	212.89	221.74	230.41
230	167.36	177.19	186.78	196.1	205.3	214.26	223.04	231.63
240	169.16	178.89	188.39	197.7	206.75	215.63	224.32	232.85
250	170.94	180.59	190.01	199.2	208.2	217	225.63	234.08
260	172.73	182.3	191.63	200.8	209.66	218.4	226.93	235.31
270	174.53	184	193.25	202.3	211.12	219.77	228.24	236.54
280	176.32	185.7	194.88	203.8	212.59	221.16	229.55	237.77
290	178.11	187.42	196.5	205.4	214.05	222.54	230.86	239.01
300	179.9	189.13	198.13	206.9	215.51	223.93	232.18	240.26

**TABLE 1: DIFFERENCE BETWEEN THE WATER THERMAL EXPANSION FACTOR AND
THE STEEL THERMAL EXPANSION**

FACTOR ($^{\circ}\text{C}^{-1} \times 10^6$)

$^{\circ}\text{C}$ bar	24	25	26	27	28	29	30	
0.981	215.2	215.14	234.88	244.41	253.79	263	272.03	
10	216.1	225.99	235.66	245.13	254.44	263.59	272.57	
20	217.2	226.94	236.53	245.94	255.18	264.27	273.18	
30	218.2	227.88	237.41	246.75	255.93	264.95	273.8	
40	219.2	228.85	238.3	247.58	256.69	265.64	274.42	
50	220.3	229.82	239.2	248.4	257.45	266.33	275.07	
60	221.3	230.79	240.11	249.24	258.22	267.04	275.7	
70	222.4	231.78	241.02	250.08	258.99	267.75	276.35	
80	223.4	232.77	241.94	250.93	259.78	268.47	277.01	
90	224.5	233.76	242.87	251.79	260.57	269.19	277.66	
100	225.6	234.76	243.79	252.66	261.36	269.92	278.33	
110	226.6	235.78	244.73	253.53	262.17	270.77	279.01	
120	227.7	236.79	245.68	254.4	262.98	271.41	279.69	
130	228.8	237.81	246.63	255.28	263.69	272.16	280.38	
140	229.9	238.84	247.59	256.18	264.62	272.92	281.08	
150	231	239.87	248.55	257.07	265.44	273.69	281.78	
160	232.1	240.91	249.52	257.97	266.28	274.46	282.49	
170	233.3	241.96	250.49	258.88	267.12	275.23	283.2	
180	234.4	243.01	251.47	259.79	267.97	276.01	283.92	
190	235.5	244.06	252.46	260.71	268.82	276.8	284.64	
200	236.6	245.12	253.45	261.63	269.67	277.59	285.37	
210	237.8	246.18	254.45	262.5	270.54	278.39	286.11	
220	238.9	247.26	255.45	263.49	271.4	279.19	286.85	
230	240.1	248.33	256.46	264.43	272.28	280	287.59	
240	241.2	249.41	257.46	265.37	273.16	280.82	288.35	
250	242.4	250.49	258.48	266.31	274.04	281.63	289.11	
260	243.5	251.58	259.49	267.27	274.92	282.46	289.86	
270	244.7	252.66	260.52	268.23	275.82	283.29	290.64	
280	245.8	253.76	261.54	269.18	276.71	284.12	291.4	
290	247	254.86	262.57	270.15	277.61	284.95	292.18	
300	248.2	255.96	263.6	271.11	278.51	285.79	292.95	

FIGURE – 1

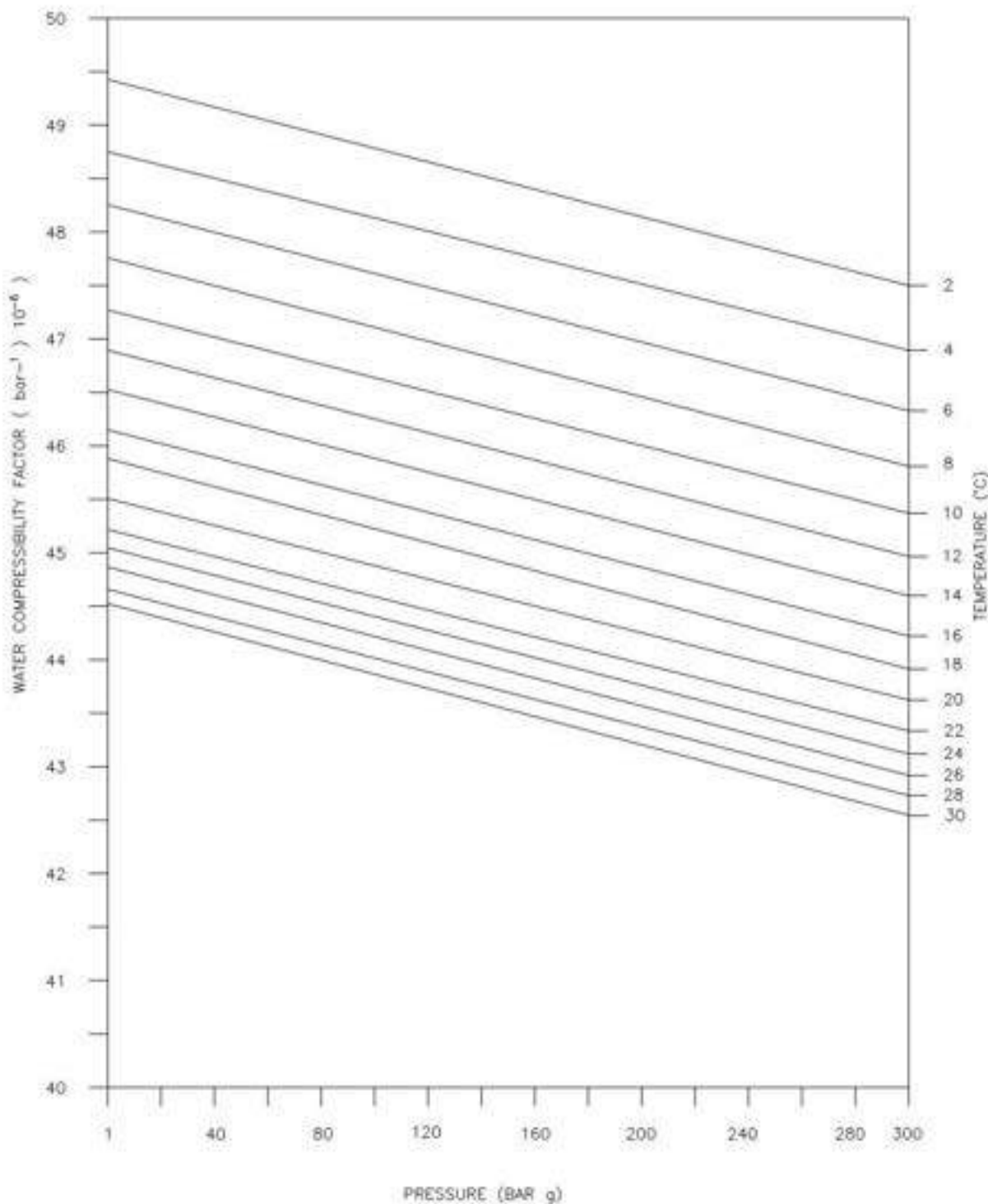


FIG. 1- WATER COMPRESSIBILITY FACTOR v/s PRESSURE AND
TEMPERATURE



VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR PAINTING

VCS SS PP - 2502

					
04	30.06.2022	RP	MC	HK	GW
03	28.01.2020	MB	AK	AD	SK
02	19.02.2018	ADE	RNR	AD	SK
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Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

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1.0 **GENERAL**

- 1.1 This technical specification shall be applicable for the work covered by the contract, and without prejudice to the provisions of various codes of practice, standard specifications etc. It is understood that contractor shall carry out the work in all respects with the best quality of materials and workmanship and in accordance with the best engineering practice and instructions of Engineer-In-Charge.

Wherever it is stated in the specification that a specific material is to be supplied or a specific work is to be done, it shall be deemed that the same shall be supplied or carried out by the contractor. Any deviation from this standard without written deviation permit from appropriate authority will result in rejection of job.

1.2 SCOPE

- 1.2.1 Scope of work covered in the specification shall include, without being limited to the following.

- 1.2.2 This specification defines the requirements for surface preparation, selection and application of primers and paints on external surfaces of equipment, vessels, machinery, piping, ducts, steel structures, external & internal protection of storage tanks for all services, MS Chimney without Refractory lining and Flare lines etc. The items listed in the heading of tables of paint systems is indicative only, however, the contractor is fully responsible for carrying out all the necessary painting, coating and lining on external and internal surfaces as per the tender requirement.

1.2.3 Extent of Work

- 1.2.3.1 The following surfaces and materials shall require shop, pre-erection and field painting:

- a. All un-insulated C.S. & A.S. equipment like columns, vessels, drums, storage tanks (both external & internal surfaces), heat exchangers, pumps, compressors, electrical panels and motors etc.
- b. All un-insulated carbon and low alloy piping, fittings and valves (including painting of identification marks), furnace ducts and stacks.
- c. All items contained in a package unit as necessary.
- d. All structural steel work, pipe, structural steel supports, walkways, handrails, ladders, platforms etc.
- e. Flare lines, external surfaces of MS chimney with or without refractory lining and internal surfaces of MS chimney without refractory lining.

- f. Identification colour bands on all piping as required including insulated aluminium clad, galvanised, SS and nonferrous piping.
- g. Identification lettering/numbering on all painted surfaces of equipment/piping insulated aluminium clad, galvanized, SS and non-ferrous piping.
- h. Marking / identification signs on painted surfaces of equipment/piping including hazardous service.
- i. Supply of all primers, paints and all other materials required for painting (other than Owner supplied materials)
- j. Over insulation surface of equipments and pipes wherever required.
- k. Painting under insulation for carbon steel, alloy steel and stainless steel as specified.
- l. Painting of pre-erection/fabrication and Shop primer.
- m. Repair work of damaged pre-erection/fabrication and shop primer and weld joints in the field/site before and after erection as required.
- n. All CS Piping, equipments, storage tanks and internal surfaces of RCC tanks in ETP plant.

1.2.3.2 The following surfaces and materials shall not require painting in general. However, if there is any specific requirement by the owner, the same shall be painted as per the relevant specifications:

- a. Un-insulated austenitic stainless steel.
- b. Plastic and/or plastic coated materials
- c. Non-ferrous materials like aluminum.

1.2.4 Documents

1.2.4.1 The contractor shall perform the work in accordance with the following documents issued to him for execution of work.

- a. Bill of quantities for piping, equipment, machinery and structures etc.
- b. Piping Line List.
- e. Painting specifications including special civil defence requirements.

1.2.5 Unless otherwise instructed, final painting on pre-erection/ shop primed pipes and equipments shall be painted in the field, only after the mechanical completion, testing on systems are completed as well as after completion of steam purging wherever required.

- 1.2.6 Changes and deviations required for any specific job due to clients requirement or otherwise shall be referred to VCS for deviation permit.

2.0 CODES & STANDARDS

Without prejudice to the specifications of the contract, the following codes and standards shall be followed for the work covered by this contract.

IS: 5 Colors for ready mixed paints and enamels.

RAL DUTCH International Standard for colour shade (Dutch Standard)

IS: 101 Methods of test for ready mixed paints and enamels,

IS: 161 Heat resistant paints.

IS: 2074 Specifications for ready mixed paint, red oxide zinc chrome priming.

IS: 2379 Color code for identification of pipelines.

IS: 2932 Specification for enamel, synthetic, exterior (a) undercoating. (b) Finishing.

3.0 CONDITIONS OF DELIVERY

Packaging

Every recipient will be fitted with a hermetically-sealed lid with an opening that is sufficiently large to allow the contents to be stirred: the outside and inside are protected against oxidation, and, the lid, are marked with a strip of color identical to the contents.

4.0 COMPOSITION OF THE PAINT PRODUCTS USED

a) Quality

The composition and quality of the products may not differ from batch to batch. A batch is all of the products of a specified manufacture. If the analyses of products bring to light that the composition does not conform to the specifications of the paint manufacturer, the OWNER may refuse to use this batch of products. The paint products must comply with the following conditions

- They must have the viscosity necessary for the described use and the established condition: use of the brush - paint roller (spray gun only for special cases and in the workshop)

b) Quality control - Sampling

While the works are in progress on the construction site, the OWNER may carry out sampling on the paint being used for the purpose of checking conformity. The paint products must be made available free of charge to the laboratory or the approved supervisory body in sufficient quantities so that all the tests can be carried out on the same batch.

If analyses reveal a non-conformity in the composition of the products used (tolerance of ± 3 % of the dosage of every component), the OWNER may refuse application of the product under consideration, halt the work and have the nonconforming product already applied removed.

Before proceeding the work, a product that does conform will be required. The only Purpose of the analysis is to reveal any nonconformity of the composition of the products. Their purpose is therefore not to assess the quality of the different components. The analyses concerned are not acceptance tests of the products supplied and in no way affect the obligations of the contractor specified in the contract towards the OWNER.

5.0 **IDENTIFICATION**

Every recipient will bear the following information:

- Name of the manufacturer
- Date and number of manufactures
- Name of the product type
- Batch no
- Net weight of the produced or the contents of the recipient
- Date of the expiry.

At the time of delivery, this packaging must bear labels in conformity with the legal stipulations in force.

Leaving the site after work

After completion of a job a general clean-up shall be carried out by the Contractor to remove all debris, materials or irregularities that his work has brought to the site so that it is left tidy:

The restoration work includes among other things:

- The removal of abrasives.
- The removal of the different protective coverings.

- The Contractor will make the required repairs to any damage after refitting the supports.
- The removal of paint and cleaning of the stains on the floor.

6.0 SURFACE PREPARATION STANDARDS

Following latest edition of standards shall be followed for surface preparations:

1. Swedish Standard Institution- SIS-05 5900-1967/ISO 8501-1
2. Steel Structures Painting Council, U.S.A. (Surface Preparation Specifications (SSPC-SP)
3. British Standards Institution (Surface Finish of Blast-cleaned for Painting) BS-4232.
4. National Association of Corrosion Engineers. U.S.A. (NACE).
5. IS-1477-1971 (Part-1) - Code of Practice for Painting of Ferrous metals in Buildings. (Part 1, Pre-treatment)
 - a) The contractor shall arrange, at his own cost to keep a set of latest edition of above standards and codes at site.
 - b) The paint manufacturer's instruction shall be followed as far as practicable at all times. Particular attention shall be paid to the following:
 - Proper storage to avoid exposure as well as extremes of temperature.
 - Surface preparation prior to painting.
 - Mixing and thinning.
 - Application of paints and the recommended limit on time intervals between coats.
 - c) Any painting work (including surface preparation) on piping or equipment shall be commenced only after the system tests have been completed and clearance for taking up painting work is given by the OWNER, who may, however, at his discretion authorize in writing, the taking up of surface preparation or painting work in any specific location, even prior to completion of system test.

7.0 PREPARATION OF THE SURFACES

7.1 General Specifications

The cases that occur in practice on building sites, with regard to painted surfaces, can be broken down as follows:

- Material of which the oxide content disappears by natural oxidation.
- Material that has already been covered with a layer of paint in the workshop.
- Material that is covered with old paint layers that show different degrees of weathering.

Good preparation of surface is the best guarantee for good anti-corrosion protection.

Paintwork may never begin until the surface to be treated is dry and is independent of the base coat and cleared of dirt, dust, rust, scale, grease, salt attack, cement powder, cement mud-scale, sand, oil, etc.

Based on the environmental conditions of coastal and saline nature, the Painting specification for station pipes defines the complete requirements like:

- Surface preparation standards like NACE etc.
- Sand blasting process
- Color Codes for piping
- Paint materials types and their DFT measurement.
- Selection and application of paints on external surfaces.

The pipeline passes through the coastal and marine environment, the **Table-4** of this specification to be followed for the painting works.

The method of preparation of the surface will be implemented in accordance with the preparation methods described below:

- Bright blast-cleaning
- Mechanical or Power tool cleaning
- Manual or hand tool cleaning

The Contractor should have the required material at his disposal to clean the surfaces to be coated thoroughly in accordance with the preparation methods regardless of the form or the condition of such surfaces. The cleaning devices that might be damaged during the surface preparation shall be screened off by the Contractor.

7.2 Air blast cleaning with abrasive

Before beginning cleaning by blasting, the person carrying out the work will take the following measures:

- Clear the steel surface of oil and/or grease;
- Ensure that each flange collar (section where the sealing is applied) is properly screened off against the blasting and the subsequent works;
- Check that no blasting grains can act into the pipes during this process. Any openings not sealed off must be screened off;

- Where there are valves, regulators and other devices, the manufacturer's identification plate will be dismantled so that all surfaces can be treated. The plate will then be put back again.
- Screen off all non-metal structures such as rubber where there is a filter;
- With valves, operators and other devices, care should be taken to ensure that no metal filings or paint get into the apparatus:
- The OWNER reserves the right to carry out part or all of these works himself.

To prevent rust forming quickly as the result of humidity on the blasted surface, cleaning by blasting may only be carried out when the temperature of the steel surface is at least 3°C higher than the dew-point of the ambient air.

Blasting may not be carried out if the relative degree of humidity exceeds 80%. The choice of the type of blasting medium used depends on local circumstances such as the possible presence of gas and the material to be blasted.

The abrasive to be used must conform to the local law i.e. it may contain no carbon and less than 1% free silicon dioxide. The Sa 3 will always be requested and must at least reach Sa 2½ during the initial stage of the paintwork. For blasting followed by metallization, the surface preparation degree to be achieved is always Sa 3. The degree of cleanliness to be obtained will be inspected in accordance with the Swedish standard SVENSK STANDARD ISO 8501-1-1988 SIS 05.5900.

- Sa 3: surface blasted down to the bare metal; when the surface is inspected with a magnifying glass, scale, rust and foreign bodies must be completely removed and it should be possible to raise a metallic -shine on the treated surface.
- Sa 2 1/2: blasted very carefully. Scale, rust and foreign bodies must be removed in such a way that anything left behind will only be visible as nuances (shading) or strips.

The blast-cleaning will be carried out by means of compressed air free of water and oil.

After the blasting and before painting, the surface should be completely cleaned of blasting material and so forth with a soft brush, a dry cloth or dry compressed air.

7.3 Mechanical or Power tool cleaning

If sandblasting is not permitted or if the metal structures are not easily accessible for blasting or blasting for one reason or other is technically unfeasible, mechanical de rusting can be used instead. With mechanical cleaning by means of chipping, rotating steel brushes and sanding discs, a degree of cleanliness St. 3 should be reached.

St 3 : removal of the old paint layers of which the adhesion leaves something to be desired and/or of which the paint layer no longer fulfills the requirements.

If parts are present that are so corroded that St 3 is difficult to achieve, this should be notified to the OWNER representative prior to the start of the works.

N.B:

St. 3 : means removal of every old paint layer. Retouching means local polishing with St. 3 or Sa 3 followed by application of the desired painting system.

After mechanical cleaning, the surface should be made dust-free with a cloth or a soft brush, washed with an organic solvent and thoroughly dried off with a dry cloth (e.g. with 1.1.1. Trichloroethane such as Solvethane, Chloroethene).

7.4 Manual or Hand tool cleaning

Manual derusting with the aid of scrapers, steel brushes, sandpaper etc. shall only be permitted in exceptional cases for local repairs. Any deviation there from must be requested from the OWNER/ OWNER 's Representative.

With manual derusting, a surface preparation degree St 3 must be obtained. The length of the handles of the equipment used may not exceed 50 cm.

7.5 Preparation of a surface covered with a layer of paint in the workshop.

This layer is in general applied by the manufacturer, for example, on valves, regulators etc. Layers of this kind will be checked for their proper adhesion in accordance with ASTM D 3359, method A (Standard Test Method for measuring adhesion by tape test). The adhesion should be at least.

If the paint layer shows less adhesion or is incompatible with the rest of the system it should be completely removed. If the paint layer is not removed, the Contractor accepts it in the state in which the coating is found and the guarantee remains in force. The adhesion does not have to be examined if system 63 has already been applied in the workshop on behalf of the OWNER.

The Contractor, who must provide for the protection on the construction site, must therefore obtain the information regarding the treatment of the surface and the quality of the paint that was used and must, moreover, examine the adhesion of the layer on the construction site, the percentage of damage and weathering as well as the value of the preparation of the surface in the workshop together with the thickness thereof that must be supplemented if necessary.

a) Galvanized surface

Galvanized surfaces, both old and new will be carefully roughened up. Every foreign body (concrete splatters, chalk marks, grease and oil stains, etc.) will be removed. Thereafter, rub the surfaces with abundant water and, if necessary, with cleaning products.

To this end, nylon brushes will be used for every kind of dirt as well as for removing zinc salt residue. Thereafter, the surfaces will be treated in accordance with system 21. Where the zinc layer is lacking, it will be derusted manually to a degree of cleanliness St 3, after which a primer coat will be applied in accordance with system 22.

b) Metallized surfaces treated with an impregnation layer

- Degrease with the desired degreasing product:
- Clean under high pressure or with a product prescribed by the paint supplier.

If the paint layer adheres well and is applied on a clean base, the painting system described may be continued. If the percentage of damage and weathering does not exceed 5 % m. retouching may be considered. These partial repairs will be carried out.

If on the other hand, the percentage of damage does exceed 5 %/m or if the layer applied in the workshop comes loose the Contractor must draw the attention of the OWNER to this and carry out the complete application system.

7.6 Preparation of surfaces covered with earlier paint layers that show different degrees of weathering.

If the surfaces do not show deep weathering limited to the spread of rust by small pitted areas or non-penetrative rust in spots, it will very often be sufficient to clean the surfaces with abrasives or with an abrasive disc, then to rub them down with steel wool, remove the dust and wash off. If thick rust appears, in spots, scale rust and active rust canker, this should be removed with needle hammers or stripped away directly by blasting, removing the dust and washing off.

7.7 Preparation of concrete or cement plaster surfaces

Remove unsound paint layers and loose components with scrapers, blades or rotating steel brushes. Thoroughly clean the entire surface with water containing ammonia. Thoroughly remove moss, algae and fungal growths. Where these growths have been removed, treat the area with a fungicide in accordance with the instructions for use.

Once the entire area is completely dry, brush off the dead residue of moss, algae and fungus with a hard brush. In the case of reinforcement steel that has been laid bare, remove as rust, dust and grease as possible and treat with a primer coat. When painting concrete surfaces, they must first be checked for cracks. Cracks larger than 0.3 mm must be repaired with an appropriate system in accordance with the type and extent of the repairs (e.g. injection with epoxy mortar). Repair damage such as cracks and bursts to concrete parts with a two-component mortar or preferably with micro-mortars. Finally check the alkalinity of the surface with the aid of litmus paper and neutralize it if necessary.

7.8 Use of solvents

It is sometimes necessary to use solvents when the surfaces to be painted are streaked with grease or oil. In this case a suitable organic solvent should be applied. The operation should be carried out with the aid of clean brushes or rags and clean solvent.

All the legal specifications in connection with solvents etc. must be adhered to. The OWNER/OWNER's Representative will be informed in advance of any toxicity or flammability. All measures must be taken to prevent any risk of fire and to nick out any possibility of poisoning (ventilation). The Contractor will provide drip collectors to keep the environment free of pollution.

7.9 Condition of the metal after stripping

The Contractor must call in a representative of the OWNER/OWNER's representative or of the Approved supervisory Body responsible for checking the condition of the metal during stripping and informing the OWNER/OWNER's representative immediately of any damage that he might have noticed.

- Deep corrosion of the plates - rivets - bolts
- Faulty welding
- Fittings that appear to be dangerous because of their age.

7.10 Removing coating from surface pipelines

The Contractor must have the equipment necessary for the removal of asphalt from the pipe without damaging the latter (scratching, impact, etc.). The Contractor undertakes to carry out the work in accordance with an approved procedure.

TABLE-1 (FOR CLAUSE 7.0)
SURFACE PREPARATION STANDARDS

SL. NO.	DESCRIPTION	VARIOUS INTERNATIONAL STANDARDS (EQUIVALENT)			REMARKS
		ISO 8501-1/ SIS-05 59 00	SSPC-SP, USA	NACE, USA	
1	Manual or hand tool cleaning Removal of loose rust, loose mill scale and loose paint, chipping, scrapping, standing and wire brushing. Surface should have a faint metallic sheen	ST.2	SSPC-SP-2	-	This method is applied when the surface is exposed to normal atmospheric conditions when other methods cannot be adopted and also for spot cleaning during maintenance painting.
2	Mechanical or power tool cleaning Removal of loose rust loose mill scale and loose paint to degree specified by power tool chipping, de-scaling, sanding, wire brushing and grinding, after removal of dust, surface should have a pronounced metallic sheen.	ST.3	SSPC-SP-3	-	
3	Dry abrasive Blast cleaning There are four common grades of blast cleaning				

3.1	White metal Blast cleaning to white metal cleanliness. Removal of all visible rust. Mill scale, paint & foreign matter 100% cleanliness with desired surface profile.	SA 3	SSPC-SP-5	NACE#1	Where extremely clean surface can be expected for prolong life of paint system.
3.2	Near white metal Blast cleaning to near white metal cleanliness, until at least 95% of each element of surface area is free of all visible residues with desired surface profile.	SA 2½	SSPC-SP-10	NACE#2	The minimum requirement for chemically resistant paint systems such as epoxy, vinyl, polyurethane based and inorganic zinc silicate paints, also for conventional paint systems used under fairly corrosive conditions to obtain desired life of paint system.
3.3	Commercial Blast Blast cleaning until at least two-third of each element of surface area is free of all visible residues with desired surface profile.	SA 2	SSPC-SP-6	NO.3	For steel required to be painted with conventional paints for exposure to mildly corrosive atmosphere for longer life of the paint systems.
3.4	Brush-off Blast Blast cleaning to white metal cleanliness, removal of all visible rust, mill scale, paint & foreign matter. Surface profile is not so important.	SA 1	SSPC-SP-7	NO.4	

8.0 **METALLISATION**

8.1 Applying the metallization

Metallization must be carried out in accordance with ISO 2063,

Metallization is carried out as rapidly as possible after blasting in order to limit corrosion of the pipes (max. 3 hours later). With metallization, a surface preparation degree Sa 3 is compulsory. The roughness of the blasted surfaces should be from 25 to 50µ R_{Max}.

- The metallizing is always carried out on dry parts in good weather conditions (maximum relative humidity 80 %);
- For metallization, a wire composed of 85 % zinc and 15 % aluminum with a minimum guaranteed degree of purity of 99.5 % is used (subject to other specifications). The application thereof is always carried out in accordance with the conditions of the manufacturer and may at all times be submitted to the OWNER s representative.
- The sealant should be applied maximum 3 hours alter metallization.
- The sealant must be thinned and applied as per the present specifications. A visual inspection whereby the sealant completely covers the metallization will suffice here.
- When evaluating the metallization, a negative deviation from the minimum coating thickness, to 80 µ for 20% of the measurements will be permitted.

9.0 **COATING PROCEDURE AND APPLICATION**

9.1 Conditions for carrying out paintwork

Painting may not be carried out in unsuitable conditions.

All preparatory work and painting may only he carried out in dry weather and at a minimum temperature of 10 C, except for special eases requested by the OWNER's Representative.

Unless otherwise stipulated in the specifications of the paint supplier, application of the paint is forbidden if it is forecast that the temperature will fall to below 0 C before the paint is dry. The temperature of-the surface to be painted must be at least 3°C higher than the dew point of the ambient air. Application of the paint is also not permitted if there is a danger that the coat of paint will not be dry before dew or condensation sets in.

The work must be stopped:

- If the temperature of the surface to be painted is higher than that described by the supplier.
- In rain, snow, mist or fog or when the relative humidity is higher than 80 %.

Coats that have not yet dried and have been exposed to frost, mist, snow or rain and might thereby be damaged must be removed after drying and the surfaces must be repainted at the expense of the Contractor.

Working in direct sunlight or in hot weather must be avoided,

The first coat of paint must be applied maximum 3 hours after the preparation of the surface of the relative humidity of the air is between 50% and 80%. This time span may be increased to 6 hours if the relative humidity is less than 50%. In all cases, the preparation of the surface must exhibit degree Sa 3 and at the very least the appearance of degree Sa 2 ½ at the time of painting.

The coats of paint may only be applied on carefully cleaned surfaces that must be dry and free of grease and dust.

9.2 Special conditions

Painting may be carried out when the Contractor can be sure that the instructions of the paint supplier have been scrupulously followed with regard to the parameters in the following (non-exhaustive) list:

- Ambient temperature.
- Surface temperature.
- Relative humidity.
- Dew point.
- Drying times.

The Contractor must in this respect be able to produce the instructions for the paint on the site. The OWNER/CONSULTANT will guarantee 100% supervision in this regard during the execution of the work.

In addition, the paintwork may only be carried out to a minimum ambient temperature of 5°C and/or to a maximum relative degree of humidity of 85 %. Application of the paint is also not permitted if there is a danger that the coat of paint will not be dry before dew or condensation sets in.

10.0 PAINT MATERIAL

Manufacturers shall furnish the characteristics of all paints indicating the suitability for the required service conditions. Primer and finish coats shall be of class-I quality and shall conform to the following:

a) Primer (P-1)

Red oxide Zinc Chromate Primer

Type and Composition	Single pack, Modified phenolic alkyd medium pigmented with red oxide and zinc chromate.
Volume solids	30 - 35% (min)
DFT	25 microns/coat (min)
Covering capacity	12 - 13 M ² /Lit/coat

b) Primer (P-2)

High build chlorinated rubber zinc phosphate primer

Type and Composition	Single pack, Air Drying Chlorinated rubber medium Plasticized with unsaponifiable plasticiser pigmented with zinc phosphate
Volume solids	35 - 40% (min)
DFT	30 - 40 microns/coat (min)
Covering capacity	7 - 8 M ² /Lit/Coat

c) Primer (P-3)

High build zinc phosphate primer

Type and Composition	Single Pack, Synthetic medium, pigmented with zinc phosphate.
Volume solids	40 - 45% (min)
DFT	35 - 50 microns/coat (min)
Covering capacity	10 - 12 M ² /Lit/coat
Heat resistance	Upto 80 °C (dry)

d) Primer (P-4)

Etch Primer / Wash Primer

	Type and Composition	Two pack Poly vinyl butyral resin medium cured with phosphoric acid solution pigmented with zinc tetroxy chromate.
	Volume solids	7 - 8% (min)
	DFT	8 - 10 microns/coat (min)
	Covering capacity	7 - 8 M ² /lit/coat
e)	Primer (P-5)	
	Epoxy Zinc Chromate Primer	
	Type and Composition	Two packs, Polyamide cured epoxy resin medium pigmented with zinc chromate.
	Volume solids	40 % (min)
	DFT	35 microns/coat (min)
	Covering capacity	11 - 12 M ² /lit/Coat
f)	Primer (P-6)	
	Epoxy Zinc Phosphate Primer	
	Type and Composition	Two packs, Polyamide cured Epoxy resin medium pigmented with zinc phosphate.
	Volume solids	40% (min)
	DFT	35 - 50 microns/coat (min)
	Covering capacity	11 - 12 M ² /lit/coat
g)	Primer (P-7)	
	Epoxy high build M10 Paint (Intermediate Coat)	
	Type and composition	two pack Poly Polyamide cured epoxy resin medium pigmented with micaceous iron oxide. Volume solids 7- 8%
	Volume Solids	50% (min)
	DFT	100 microns/coat (min)
	Covering capacity	5.0 M ² /lit/coat
h)	Primer (P-8)	
	Epoxy Red Oxide zinc phosphate primer	

	Type and Composition	two pack. Polyamine cured epoxy resin pigmented with Red oxide and Zinc phosphate.
	Volume solids	42% (min)
	DFT	30 microns/coat (min)
	Covering capacity	13 - 14 M ² /lit/coat
i)	Primer (P-9)	
	Epoxy based tie coat (suitable for conventional alkyd based coating prior to application of acrylic polyurethane epoxy finishing coat)	
	Type and Composition	Two packs, Polyamide cured epoxy resin medium suitably pigmented.
	Volume solids	50 - 60% (min)
	DFT	50 microns/coat (min)
	Covering capacity	10 - 12 M ² /Lit/Coat
j)	Finish Coats (F-1)	
	Synthetic Enamel	
	Type and Composition	Single pack, Alkyd medium pigmented with superior quality water and weather resistant pigments
	Volume solids	30 - 40% (min)
	DFT	20 - 25 microns/coat
	Covering capacity	16 - 18 M ² /lit/Coat
k)	Finish coat (F-2)	
	Acrylic Polyurethane paint	
	Type and Composition	Two pack, Acrylic resin and iso-cyanate hardener suitably pigmented.
	Volume Solids	40% (min)
	DFT	30 - 40 microns / coat
	Covering Capacity	10 - 12 M ² /lit/ coat
l)	Finish Coat (F-3)	
	Chlorinated Rubber Paint	

	Type and Composition	Single pack, Plasticised chlorinated rubber medium with chemical & weather resistant pigments.
	Volume solids	40% (min)
	DFT	30 - 40 microns/coat (min)
	Covering capacity	8 - 10 M ² /lit /coat
m)	Finish Coat (F-4)	
	High build chlorinated rubber M10 paint.	
	Type and Composition	Single pack Chlorinated rubber based high build pigmented with micaceous iron oxide.
	Volume solids	40 - 50% (min)
	DFT	65 - 75 microns/coat
	Covering capacity	6.0 - 7.0 M ² /lit/coat
n)	Finish coat (F-5)	
	Chemical Resistant Phenolic based Enamel	
	Type and Composition	Single pack phenolic medium suitably pigmented.
	Volume solids	35 - 40% (min)
	DFT	25 microns/ coat
	Covering capacity	15.0 M ² /lit/coat
o)	Finish Coat (F-6)	
	Epoxy High Building Coating	
	Type and Composition	Two pack. Polyamide-amine cured epoxy resin medium suitably pigmented.
	Volume solids	60 - 65% (min)
	DFT	100 microns/coat (min)
	Covering capacity	6.0 - 6.5 M ² /lit/coat
p)	Finish Coat (F-7)	
	High build Coal Tar Epoxy	

	Type and Composition	Two pack, Polyamine cured epoxy resin blended with Coal Tar.
	Volume solids	65% (min)
	DFT	100 - 125 microns/coat
	Covering capacity	6.0 - 6.5 M ² /lit/coat
q)	Finish Coat (F-8)	
	Self-priming epoxy high build coating (complete rust control coating)	
	Type and Composition	Two packs. Polyamide-amine cured epoxy resin suitably pigmented. Capable of adhering to manually prepared surface and old coatings.
	Volume solids	65 - 80% (min)
	DFT	125 - 150 microns/coat
	Covering capacity	4 - 5 M ² /lit/coat
r)	Finish Coat (F-9)	
	Inorganic Zinc Silicate coating	
	Type and Composition	Two packs, self-cured solvent based inorganic zinc silicate coating.
	Volume solids	60% (min)
	DFT	65 - 75 microns/coat
	Covering capacity	8 - 9 M ² /lit/coat
s)	Finish coat (F-10)	
	High build Black	
	Type and Composition	Single pack. Reinforced bituminous composition phenol based resin.
	Volume solids	55 - 60% (min)
	DFT	100 microns/coat (min)
	Covering capacity	5.5 - 6.0 M ² /lit/coat
t)	Finish Coat (F-11)	
	Heat Resistant Aluminium Paint Suitable up to 250°C.	

	Type and Composition	Duel container (paste & medium). Heat resistant spec varnish medium combined with aluminium flakes.
	Volume solids	20 - 25% (min)
	DFT	20 microns/coat (min)
	Covering capacity	10 - 12 M ² /lit/coat
u)	Finish Coat (F-12)	
	Heat Resistant Silicon Paint suitable up to 400° C.	
	Type and Composition	Single pack Silicone resin based with aluminium flakes.
	Volume solids	20 - 25% (min)
	DFT	20 microns/coat (min)
	Covering capacity	10 - 12 M ² /lit/coat
v)	Finish Coat (F-13)	
	Synthetic Rubber Based Aluminium Paint Suitable up to 150 C.	
	Type and Composition	Single Pack, Synthetic medium rubber medium combined with leafing Aluminium,
	DFT	25 microns/coat (min)
	Covering capacity	9.5 M ² /lit/coat

Notes:

1. Covering capacity and DFT depends on method of application Covering capacity specified above is theoretical. Allowing the losses during application, min specified DFT should be maintained.
2. All paints shall be applied in accordance with manufacturer's instructions for surface preparation, intervals, curing and application. The surface preparation quality and workmanship should be ensured.
3. Selected chlorinated rubber paint should have resistance to corrosive atmosphere and suitable for marine environment,
4. All primers and finish coats should be cold cured and air-drying unless otherwise specified.

5. Technical data sheets for all paints shall be supplied at the time of submission of quotations.
6. In case of use of epoxy tie coat, manufacturer should demonstrate satisfactory test for inter coat adhesion. In case of limited availability of epoxy tie coat (P-9) alternate system may be used taking into the service requirement of the system.
7. In case of F-6, F-9, F-1 1 & F-1 2 Finish Coats, No Primer are required.

MANUFACTURERS

The paints shall conform to the specifications given above and Class-I quality in their products range of any of the-following manufacturer or other approved vendors:

- i) Asian Paints (India) Ltd.
- ii) Bombay Paints
- iii) Berger Paints India Ltd.
- iv) Akzo Nobel
- v) Jenson & Nicholson
- vi) Shalimar Paints

STORAGE

All paints and painting material shall be stored only in rooms to be provided by contractor and approved by OWNER/ OWNER 's Representative for the purpose. All necessary precautions shall be taken to prevent fire. The storage building shall preferably be separate from adjacent, building.

A signboard bearing the words given below shall be clearly displayed outside:
PAINT STORAGE No NAKED LIGHT highly -inflammable

12.0 COLOR CODE FOR PIPING:

- i) For identification of pipelines, the color code as per Table -1 shall be used.
- ii) The color code scheme is intended for identification of the individual group of the pipeline. The system of color coding consists of a ground color and color bands superimposed on it.
- iii) Colors (Ground) as given in Table-2 shall be applied throughout the entire length of un insulated pipes, on the metal cladding & on surfaces. Ground color coating of minimum 2m length or of adequate length not to be mistaken as color band shall be applied at places requiring color bands. Color bands shall be applied as per approved procedure.
- iv) Line coating shall meet DIN 30670 standard for external coating and API 5L RP 2 for internal coating.

- v) The thickness for the epoxy should be 180 microns, adhesive 200 microns and balance should be PE .
- vi) The minimum coating thickness on weld seam shall be 3.2 mm and minimum coating thickness on body should be 3.2.
- vii) Minimum thickness for liquid epoxy for internal coating should be 100 ± 20 microns. Max design temperature for coating should be considered $+80^{\circ}\text{C}$.

COLOR CODE:

- A) Ball Valve (Above Ground) : Off White
- B) Globe Valve (Above Ground) : Oxford Blue-RAL 5005, IS-519941005
- C) Check Valve(Above Ground) : Oxford Blue-RAL 5005, IS-519941005
- D) Launcher / Receiver : Yellow Golden
- E) Jib Crane / Trolley : Yellow Golden
- F) All underground valves shall have epoxy base coating after surface finish of SA 2:5
- G) Valves and above ground pipes need to be properly blasted to achieve surface finish of Sa 2:5 before the application of paints.

Table 12.1 Colour Coding Scheme for Pipes and Equipment

SI. No	Description	Ground Color	First Color Band	Second Color Band
1	COMPRESSED AIR			
a)	Plant Air	Sky Blue	Silver Grey	-
b)	Instrument Air	Sea Green	Black	-
2	GASES			
a)	Charge Gas	Canary Yellow	Signal Red	Smoke Grey
b)	Regeneration Gas	Canary Yellow	White	Dark Violet
c)	Residue Gas	Canary Yellow	White	French Blue
d)	LPG	Canary Yellow	Brilliant Green	White
e)	Acetylene	Canary Yellow	Dark violet	-
	Flare Lines	Heat resistant aluminium		
f)	Fire water and Foam & Extinguisher	Post office red		
3	ALL EQUIPMENT			
a)	Vessels. Columns, exchangers, etc. containing non- hazardous fluids.	Light Grey		
b)	Base Frame/Structure	Black		
b)	All equipment containing hazardous fluids	Canary Yellow		

c)	Pipe carrying hazardous fluids	Bar is to be replaced by Hazardous Marking as per IS:2379 Clause 7.1C		

IDENTIFICATION SIGN

- i) Colors of arrows shall be black or white and in contrast to the color on which they are superimposed.
- ii) Product names shall be marked at pump inlet, outlet and battery limit in a suitable size as approved by OWNER.
- iii) Size of arrow shall be either of the following:

- a) Color Bands

Minimum width of color band shall be as per approved procedure.

- b) Whenever it is required by the OWNER to indicate that a pipeline carries a hazardous material, a hazard marking of diagonal stripes of black and golden, yellow as per IS:2379 shall be painted on the ground color.

IDENTIFICATION OF EQUIPMENT

All equipment shall be stenciled in black or white on each vessels, column, equipment, and painting as per approved procedure.

INSPECTION AND TESTING

1. All painting materials including primers and thinners brought to site by contractor for application shall be procured directly from manufactures as per specifications and shall be accompanied by manufacturer's test certificates Paint formulations without certificates are not acceptable.
2. The painting work shall be subject to inspection by OWNER/ OWNER's Representative at all times. In particular, following stage wise inspection will be performed and contractor shall offer the work for inspection and approval at every stage before proceeding with the next stage.

In addition to above. record should include type of shop primer already applied on equipment e.g. Red oxide zinc chromate or zinc chromate or Red lead primer etc.

Any defect noticed during the various stages of inspection shall be rectified by the contractor to the entire satisfaction of OWNER/ OWNER's Representative before proceeding further. Irrespective of the inspection, repair and approval at intermediate stages of work. Contractor shall be responsible for making good any defects found during final inspection/guarantee period/defect liability period as defined in general condition of contract. Dry film thickness (DFT) shall be checked and recorded after application of each coat and extra coat of paint should be applied to make-up the DFT specified without any extra cost to OWNER.

PRIMER APPLICATION

- i. The contractor shall provide standard thickness measurement instrument with appropriate range(s) for measuring.

Dry film thickness of each coat, surface profile gauge for checking of surface profile in case of sand blasting. Holiday detectors and pinhole detector and protector whenever required for checking in case of immerse conditions.

- ii. At the discretion of OWNER/ OWNER's Representative, contractor has to provide the paint manufacturers expert technical service at site as and when required. For this service, there should not be any extra cost to the OWNER.
- iii. Final Inspection shall include measurement of paint dry film thickness, check of finish and workmanship. The thickness should be measured at as many points/ locations as decided by OWNER/ OWNER's Representative and shall be within +10% of the dry film thickness.
- iv. The contractor shall produce test reports from manufacturer regarding the quality of the particular batch of paint supplied. The OWNER shall have the right to test wet samples of paint at random for quality of same. Batch test reports of the manufacturer's for each batch of paints supplied shall be made available by the contractor.

18.0 PAINT SYSTEMS

The paint system should vary, with type of environment envisaged in and around the plants. The types of environment as given below are considered for selection of paint system. The paint system is also given for specific requirements.

- a) Normal Industrial Environment, Table 18.2.
- b) Corrosive industrial Environment, Table 18.3
- c) Coastal & Marine Environment, Table 18.4

Notes 1. Primers and finish coats for any particular paint systems shall be from same manufacturer in order to ensure compatibility.

TABLE 18.1: LIST OF PRIMERS & FINISH PAINTS

<u>PRIMERS</u>	
P-1	Red oxide Zinc chromate Primer
P-2	Chlorinated rubber zinc Phosphate Primer
P-3	High build Zinc phosphate Primer
P-4	Etch Primer/Wash Primer
P-5	Epoxy Zinc Chromate Primer
P-6	Two component Epoxy Zinc Phosphate Primer cured with polyamine hardener
P-8	Epoxy red oxide zinc phosphate primer
<u>FINISH COATS / PAINTS</u>	
F-1	Synthetic Enamel
F-2	Two component Acrylic Polyurethane finish paint
F-3	Chlorinated Rubber finish paint
F-5	Chemical resistant phenolic based enamel
F-6	High Build Epoxy finish coating cured with polyamide hardener
F-7	High build Coal Tar Epoxy coating cured with polyamine hardener
F-8	Self priming surface Tolerant High Build epoxy coating. cured with polyamine hardener
F-9	Two component Inorganic Zinc Silicate coating
F-10	High build Reinforced bituminous composition phenol based resin.
F-11	Heat resistant synthetic medium based Aluminium paint suitable for 250 deg C
F-12	Two component Heat resistant Silicone Aluminium paint. suitable for 400 deg C
F-13	Synthetic based aluminium Paint suitable for 150 deg C

Table 18.2: Painting System for Normal Industrial Environment for Piping and Equipment (Above Ground)

Sl. No.	Temp. Range	Surface Preparation	Primer	Finish Coat	Total DFT	Remarks
1	-10 to 20	SSPC-SP-3	One coat P-2 50 microns / coat (min)	One coat F-4 65 microns/ coat (min) Two coats F-3, 30 Microns/coa t (min)	175	Primer and Finish coat can be applied at ambient temp.
2	21 to 60	SSPC-SP-6	Two coats P-1, 25 microns/ coat (min.)	Two coats of F-1, 20 microns/coa t (min)	90	-
3	61 to 80	SSPC-SP-6	Two coats P-3, 50 microns/ coat (min)	Two coats of F-13, 25 microns/coa t (min)	150	-
4	81 to 250	SSPC-SP-6	-	Three coats of F-11, 20 microns/ coat (min)	60	Paint application at ambient temp. curing at elevated temp. during start-up.
5	251 to 400	SSPC-SP-10	-	Three coats of F-12, 20 microns/ coat (min)	60	-do-

Table 18.3: Painting System for Corrosive Industrial Environment for Piping and Equipment (Above Ground)

SI. No.	Temp. Range	Surface preparation	Primer	Finish Coat	Total DFT	Remarks
1	-14 to 80	SSPC-SP-10	Two coats P-6, 35 microns / coat (min.)	One coats F- 6, 100 microns coat (min.) and one coats F- 2 40 microns coat (min.)	210	Paint application at ambient temp.
2	81 to 250	SSPC-SP-10	-	Three coats F- 11, 20 Microns / coat (min.)	60	Paint application at ambient temp. and curing at 250°C for 4 hours
3	81 to 400	SSPC-SP-10	-	Three coats F- 12, 20 Microns / coat (min.)	60	Paint application at ambient temp. and curing at 250°C for 4 hours

Table 18.4 :Painting System for Coastal and Marine Environment for Piping and Equipment (Above Ground)

SI. No.	Temp. Range	Surface Preparation	Primer	Finish Coat	Total DFT	Remarks
1	-14 to 80	SSPC-SP-10	Two coats P-6. 35 Microns. coat (Min.)	Two coats F- 6, 100 microns /coat (min.) and one coats F-2 40 Microns /coat (min.)	310	Primer and Finish coat application at Ambient temp.
2	81 to 400	SSPC-SP-I0	-	- Three coats F- 12, 20 Microns / coat (min.)	60	Paint application. at ambient temp, and curing at 250°C for 4 hours
3	401 to 550	SSPC-SP- 10	-	Three coats F- 12, 20 Microns / coat (min.)	60	Paint application. at ambient temp, and curing at 250°C for 4 hours

Table 18.5 : Painting System for External Side of Underground Tanks in all areas.

SI. No.	Temp. Range	Surface Preparation	Primer	Finish Coat	Total DFT	Remarks
External side of un-insulated underground storage tanks:						
1	-40 to 80	SSPC-SP-10	1 coat of F-9 @ 65-75μ DFT/ coat	3 coats of F-7 @ 100μ DFT/coat (3x100=300)	365-375	

18.2 Precautions to be taken

Neither the environment of the site nor the marking labels of devices may be covered with paint and they must be kept free of paint splashes. To this end, it is advisable to use removable masking tape.

Paint splashes, leaks, etc. on any adjacent installations such as measuring apparatus, valves, pipes. Sources of light, insulation, heat insulators, walls, concrete, etc, must immediately be wiped up and the damage repaired before the paint is dry.

Otherwise, the OWNER will be obliged to have the cleaning carried out at the expense of the Contractor. The paint recipient will only be opened at the time of use (unless otherwise specified by the manufacturer).

The product will be mixed in the recipient with the aid of suitable tools and thus homogenized.

18.3 Method of application

Normally, three methods of application will be used on the construction site for the paint products. i.e. with a brush, with a roller or with a spray gun.

- The brush method makes it possible to obtain good penetration of the paint over irregularities in the metal.
- Only this method will be used for application of the base coats, for retouching and for protrusions, welded areas, riveted joints or bolted joints:
- The roller method may be used on large flat surfaces for the intermediate and topcoats.
- The spray gun method must be used in accordance with the instructions of the manufacturer and carried out by qualified personnel.

The Contractor must guarantee that all safety measures have been taken for such work. The spray gun method may only be used on site for places that are difficult to reach with the brush. In this case, a request must be made to the OWNER/ OWNER's Representative for a deviation.

All paintwork will be carried out with good brushes or rollers that are suitable for the type of paint being used and for the form of the material to be painted and fitted with short handles. The maximum length of the brush and roller handles will be 50 cm; longer handles may only be used for places that are absolutely inaccessible. The maximum width of a brush will be 13 cm.

18.4 Application of the coating

Application of the paint will be carried out in accordance with best practice in order to obtain a homogeneous and continuous layer. The OWNER or the Approved Supervisory body demands that painting of a layer will only be started after acceptance by them of the surface preparation or of the previous layer of paint.

The layers of paint must have a uniform thickness. They must be spread in such a way that all concave parts are dried out and that the surface is completely covered and has a

glossy appearance without leaving brush marks and without exhibiting bubbles, foam, wrinkles, drips, craters, skins or gums that arise from weathered paint,

Each layer must have the color stipulated in the tables of the present specifications, which clearly differs from the previous layer, taking account of the Color of the top layer, all of which for the purpose of being able to identify the number of coats and their order of sequence. If the color of the coats is not mentioned in the tables the color difference in consecutive coats must, if possible, be at least 100 RAL. The color of the top layer is given in the table.

The coating power should be such that the underlying layer is not visible. Only 1 layer per day may be applied, unless otherwise specified by the OWNER or the Approved Supervisory Body.

The drying times prescribed by the paint manufacturer must be strictly observed in relation to the environmental conditions before proceeding with the application of the next layer.

The dry coating thickness indicated in the description of the paint systems are minimum thickness. In this connection, the Contractor is obliged to contact the paint manufacturer and conform to his guidelines. The Contractor must respect the thickness specified by the supplier.

18.5 Transporting treated items

In the case of works being carried out in a workshop, the metal structures will be surrounded by ventilated contraction film that prevents damage during transportation. This film may only be applied after complete polymerization of the paint.

19.0 GROUND-LEVEL TRANSITION POINT

19.1 Polyester protection system

The Contractor will provide system 02 over the entire length of the pipes above ground and below ground and up to a height of 20 cm and a depth of 40 cm. perpendicular to the ground level mark. In each case, he must ensure that the jointing below the asphalt is in good condition and assures' faultless adhesion. He will apply the following products over the entire surface area, prepared in accordance with is Sa 3:

- 1) The primer of system 01.
- 2) Reinforced polyester $\pm$ 20 cm above the ground level marker and $\pm$ 5 cm on the asphalt cleaned beforehand (application of reinforced polyester is carried out in accordance with the work method prescribed by the manufacturer). Moreover, in the case of PE, in contrast to asphalt, he will apply a polygon primer to PE immediately before applying the reinforced polyester.

- 3) He will then apply the other coats of system 01a to the surface section and thus cover the reinforced polyester with about 5 cm.
- 4) For new constructions, the polygon primer will be applied to PE and then subsequently processed as described under point 2.

20.0 USE OF SCAFFOLDING

Mounting, maintenance and dismantling of scaffolding for carrying out adaptation and/or paintwork to surface gas pipes or gas transport installations in use;

- The Contractor will specify the cost of scaffolding in the price list.
- The supplementary rental price for delays attributable to the Contractor will be charged to him:
- In his price quotation the Contractor should present the OWNER with diagrams of the scaffolding that he intends to install for carrying out the works of the OWNER.

21.0 QUALITY CONTROLS AND GUARANTEE

- 21.1 The Contractor is responsible for checking the weather conditions to ascertain whether the paintwork can be carried out within the technical specifications.

The Contractor should have the required calibrated monitoring apparatus for this purpose on site (with calibration certificates). The personnel who will have to use this apparatus should have the training for this purpose.

The OWNER or his representative and possibly the approved supervisory body indicated by the OWNER will maintain supervision during the works and inspect the works with random checks. A daily report will be drawn up in relation to the department that maintains supervision of these works.

The supplementary inspection and the supervision by the OWNER or the approved supervisory body do not diminish in any way the liability of the Contractor. The proper execution of the work and the materials used may be checked at any time.

21.2 Reference Surfaces

At the start of the works. The OWNER or the approved supervisory body will indicate a few surfaces that the Contractor will prepare and cover in accordance with the recognized method of operation under the inspection and to the satisfaction of all parties; the OWNER or his representative, the approved supervisory body, the contractor and possibly the paint manufacturer. These reference surfaces will serve as a point of comparison for the good adhesion of the paint on the installations as a whole. The parties will together

work out a system for the identification of these surfaces in order to be able to monitor the conditions of the coatings over time. If the paintwork on a section of the installations is in a worse condition than the reference surfaces, the Contractor may be obliged to treat these parts again.

21.3 Measures to be taken in the event of a dispute

If on delivery of the works no agreement can be reached between the Contractor and the OWNER regarding the conformity of the works to the requirements of these specifications, an Approved Supervisory Body will be called in. The Approved Supervisory Body will then carry out inspections on site whereby the following assessment criteria will be used:

- The Swedish standards ISO 8501-1 1988 SS 05.5900 concerning the degree of cleanliness of the areas derusted by blasting, by machine or by hand.
- The wet film thickness of the paint will be measured in accordance with ISO 2808 or ASTM D 1186;
- The dry layer thickness of the film will be measured electronically, will complete statistical information. in accordance with, ISO 2808 or ASTM D 1186.
- The thickness of each layer will be measured in accordance with ISO 2808. ASTM 4138 or DIN 50986.
- Adhesion tests will be carried out in accordance with ISO 2409. ASTM 3359 or DIN 53151.
- Traction tests will be carried out in conformity with ISO 4624 or ASTM D 4541.
- The rugosity will be measured electronically in accordance with DIN 4768;
- The non-porosity will be measured with a test tension depending on the type of coating, the layer thickness and after consultation with the Paint manufacturer.
- Any defects in the paint film may be inspected visually by means of a magnifying glass or microscope. If necessary a photographic report may be drawn up in accordance with ASTM Standard D 4121-82.

The final judgment of the Approved Supervisory Body is irrevocable and binding for the Contractor and the OWNER. In the event of non-conformity of the works with the criteria of these specifications, all costs arising from the inspection by the Approved Supervisory Body shall be borne by the Contractor.

21.4 Guarantee

a) General Principles

The Contractor declares that he is aware of:

- The maximum operating temperature of the surfaces to be covered.
 - The maximum permitted degree of humidity of the bearing surface.
 - The properties of the environment to which the surfaces to be covered are: subject.
- b) Summary of the Guarantee.

The contractor fully guarantees the following without reservation:

- The observance of all stipulations of the specifications for paintwork regarding, among other things:
 - The preparation of the surfaces.
 - The thickness of each layer.
 - The total thickness of the covering.
- The uniformity of the materials used.
- The repair of all defects before delivery of the works.

The Contractor will carry out the requested repair work as promptly as possible.



VCS PROJECT CONSULTANTS PVT. LTD.

STANDARD SPECIFICATION FOR FABRICATION AND ERECTION OF PIPING

VCS-SS-PP-2507

00	13.05.2017	CM	SM	AD	SK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By
UNCONTROLLED COPY : If printed					
CONTROLLED COPY : If in soft and signed					

Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	28.01.2020					
		MB	AK	AD	SK	

Abbreviations:

AS	:	Alloy Steel
ASME	:	American Society of Mechanical Engineers
CI	:	Cast Iron
CS	:	Carbon Steel
HMTD	:	Heat & Mass Transfer Division
IBR	:	Indian Boiler Regulations
LTCS	:	Low Temperature Carbon Steel
NACE	:	National Association of Corrosion Engineers
NB	:	Nominal Bore
NDT	:	Non Destructive Testing
P & ID	:	Piping and Instrumentation Diagram
PMI	:	Positive Material Identification
SS	:	Stainless Steel
SMMS	:	Specialist Material & Maintenance Services

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1.0 SCOPE

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

2.0 SCOPE OF WORK OF CONTRACTOR

Generally the scope of work of Contractor shall include the following:

2.1 Transportation of required piping materials (as described in C1.2.1.1), pipe support (material as described in C1. 2.3) and all other necessary piping materials from Owner's storage point or Contractor's storage point (in case of Contractor's scope of supply) to work site/shop including raising store requisitions for issue of materials in the prescribed format & 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. Pipes (All sizes and schedule)
- b. Flanges (All sizes, types & Pressure ratings).
- c. Fittings (All sizes, types and schedule)
- d. Valves (All sizes, types and Ratings)
- e. Gaskets (All sizes, types & Ratings)
- f. Bolts, Nuts or M/C Bolts (All types)
- g. Expansion Joint/Bellows (All types)
- h. Specialty items like online filters, ejectors, sample coolers, steam traps, strainers, air traps, springs, silencers, snubbers, steam and condensate manifolds, injection nozzles, MOVs, sight glass, spray nozzles, integrated steam traps, hoses, hose couplings, etc.
- i. Online instruments like control valve, orifice flange, rotameter, safety valves, restriction orifice, rupture disc, de-super heaters, corrosion probes, annubar, magnetic flow meter, ultrasonic flow meter, Coriolis mass flow meters, venturi PG/PT/ Flow transmitter, ejectors, static mixers, flame arrestors, thermal flow switches, pre-fabricated hook-ups etc.
- j. Shutdown Valves with and without fire box.

2.2 Shop & field fabrication and erection of piping in accordance with documents listed under C1.3.0 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, tum-buckles, supporting fixtures, bracket cantilevers, struts, tee-posts including erection of spring supports, sway braces, dummy pipes, corrosion pads/protection shields, low friction pads, clamps, special support, expansion bellows, steam and condensate manifolds supports etc. Corrosion Pads/Protection shields, stiffeners and stiffening rings, if not covered in the specifications/standards, shall be of the same material as of parent pipes.

2.4 Site fabrication of Piping items

Site fabrication of Piping items shall include but not be limited to the following

- 2.4.1 Fabrication of piping specials 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.
- 2.4.8 Fabrication of circular pipe for steam rings, fire water lines, utility lines.
- 2.4.9 Threading of all small bore piping as per piping material specifications.
- 2.4.10 Drilling on blind flange for inserting / joining small bore lines.
- 2.4.11 Fabrication and welding of reinforcement pads at branch pipe locations wherever required.
- 2.4.12 Equipment nozzle reinforcement with pads, jacket & stiffeners wherever required.
- 2.4.13 Fabrication of injection nozzles as per details provided wherever required.
- 2.4.14 Fabrication of chain operation arrangement for valves, wherever required. All material required for this modification shall be supplied by Contractor.
- 2.4.15 Fabrication and erection in position of funnels required for OWS/ SS/ Condensate blow down system as per direction of Engineer-in-charge.
- 2.4.16 Grinding & finishing of uneven surfaces/ joints after welding. Internal grinding of welds of orifice flanges to render smooth surface.
- 2.4.17 Tapping and drilling of holes in flanges, blind flanges, piping connections for jack screw, if required.
- 2.4.18 Providing bird screens at the outlet of lines open to atmosphere.
- 2.5 Modifications like providing additional cleats, extension of stem of valve, locking arrangement of valves etc. as and when required.
- 2.6 Piping isometrics for main process/utility lines shall be provided to the Contractor.

Preparation of miscellaneous small bore isometrics with bill of materials for process and utility lines (up to 1½" size) like instruments & pump flushing / cooling, sample connection, purging, pump casing vents & drains, pump base plate drains, control valve drains / vent to flare, instrument drains & vents, steam tracing (non-IBR) from steam supply stations up to condensate recovery station, and lines specified as field routed within the Unit battery limit as and when required are in Contractor's scope of work. Approval for these isometrics prepared by the Contractor shall be taken from Engineer-in-charge before erection.

Small bore piping isometrics given by Owner shall be rechecked by Contractor before erection and installation.
- 2.7 Obtaining approval for drawings prepared by Contractor from statutory authority, if required.
- 2.8 Spun concrete lining of the inside of pipes 3" NB & above including fittings and flanges as

required in accordance with specification.

- 2.9 Rubber lining inside pipes, fittings, flanges as and when required, in accordance with specification.
- 2.10 Radiography, stress relieving, dye penetration, magnetic particle test etc. as required in specification.
- 2.11 Performing PMI using alloy analyzers as per Standard Specification for Positive Material Identification at Construction Sites, VPC-SS-PP-2502.
- 2.12 Casting of concrete pedestals and Fabrication and erection of small structures/ platforms for pipe supports and valve operation / attending some instruments, spectacle blinds etc., providing brackets, modification / extension of platforms, providing additional platforms / ladders for improving / providing accessibility.
- 2.13 Providing insert plates with anchor fasteners in concrete structures / paved floors and repair of platform gratings around pipe openings and providing suitable members for support under the platform grating.
- 2.14 Making material reconciliation statement and return of Owner's supply left over materials to Owner's storage.
- 2.15 Flushing and testing of all piping systems as per standard specification for inspection, flushing and testing of piping systems (Specification No. 6-44-0013). The accessories required for blinding the line like flange, blind flange, gasket (all sizes, type and rating), stud-bolts, flexible hoses etc. are to be arranged by the Contractor. During flushing the discharged water / air shall be drained / routed as directed by the Engineer - In Charge.
- 2.16 Contractor shall prepare welding specifications for all weld joints where dissimilar welding will be performed, and obtain approval from VCS.
- 2.17 Contractor to ensure meeting all requirements for carrying out work in shutdown/running plant.
- 2.18 Pickling (as and when applicable) as per Job specification(s) for chemical cleaning of CS suction piping of compressors, SS Piping, Weldment etc., as applicable.
- 2.19 Chemical Cleaning/ Hydro jet cleaning as per marked-up P&IDs with supply of chemicals, consumables, DM water, equipment's, boilers, coupons, tools & tackles and other testing equipment's required for the same.

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 VCS to the Contractor - Plans and/or Isometrics.
 - 3.1.2 "Approved for Construction" drawings and sketches issued by Turn-key bidders to the Contractor - Plans and/or Isometrics.
 - 3.1.3 Approved Process Licensors standards and specifications.
 - 3.1.4 Drawings, sketches and documents prepared by Contractor duly approved by Engineer-in-Charge (such as isometrics of small bore piping and offsite piping etc.).
 - 3.1.5 VCS specifications / documents as below:

- a. Process and Instrument Diagram.
- b. Job Piping Materials Specification (****-6-44-0005). **** denotes job number.
- c. Piping support, engineering standards.
- d. Line list
- e. Piping support indices (only in offsite), if supports are not shown in plan.
- f. Job specification of Non-destructive Requirement of Piping (VPC-SS-PP-0036)
- g. Job Welding specification for fabrication of piping (VPC-SS-PP-0040).
- h. Any other VCS or OTHER specifications attached with Piping Material Specification or special condition of contract (such as standard for cement lining of pipe, standard of jacketed piping, standard for steam tracing, Dimensional Tolerances etc.)
- i. Standard specification for positive material identification (PMI) at construction sites, 6-82-0002
- j. Standard Spec for application of torque & hydraulic bolt tension for flange joints (6-76-0002) and its addendum, if any.

3.1.6 Following codes, standards and regulations

a.	ASME B 31.3	:	Process Piping
b.	ASME Sec. VIII	:	Code for unfired pressure vessel.
c.	IBR Regulations		
d.	ASME Sec. IX	:	Qualification standard for welding and brazing procedures, welders, brazers and welding and brazing operators.
e.	NACE Std.	:	Code for Sour Services material requirements MR-0175/MR0103/Job spec(NACE), as applicable

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

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 Engineer-in-Charge and the work carried out only after obtaining written approval from him 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 Owner / Contractor shall have proper identification marks as per relevant standards / VCS specifications / Licensors specification. Contractor shall provide identification marks on left over pipe lengths wherever marked up pipe lengths have been fabricated / erected. Material-

traceability is to be maintained for A.S., S.S., NACE, L TCS, material for Hydrogen service and other exotic materials by way of transferring heat number, etc. (hard punching) as per approved procedure. This shall be in addition to colour coding for all piping materials to avoid mix-up.

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.

4.2 Dimensional Tolerances

The Contractor shall be responsible for working to the dimensions shown on the drawings. However, the Contractor shall bear in mind that there may be variations between the dimensions shown in the drawing and those actually existing at site due to minor variations in the location of equipment's, inserts, structures etc. To take care of these variations "Field Welds" shall be provided during piping fabrication. An extra pipe length of 100 mm over and above the dimensions indicated in the drawing may be left on one side of the pipe at each of the field welds. During erection, the pipe end with extra length at each field weld shall be cut to obtain the actual dimension occurring at site. Isometrics, if supplied may have the field welds marked on them. However, it is the responsibility of the Contractor to provide adequate number of field welds. In any case no extra 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.

4.3 IBR Piping

- 4.3.1 Contractor shall obtain approval for the piping systems falling under purview of IBR from the statutory Indian Boiler Regulations (IBR) authority of the state where the plant is situated. The Owner shall provide documentation for the IBR System. The Contractor shall carry out the fabrications, erection and testing of this piping as per requirements of Indian Boiler Regulations and to the entire satisfaction of the local Boiler Inspector. The Contractor shall also get the approval of IBR inspector for all fabrication and testing done by him at his own cost. All certificates of approval shall be in proper IBR forms.
- 4.3.2 IBR Package for residual, field routed and site modified steam lines shall be prepared by the Contractor. IBR approval for the same shall be in Contractor's scope, at his own cost.

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. This is only applicable for non-galvanized piping without lining.

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

4.5 Butt Welded and Socket Welded Piping

End preparation, alignment and fit-up of pipe pieces to be welded, welding, pre-heating, post-heating and heat treatment shall be as described in the Job welding specification (VPC-SS-PP-0040) and NDT specification (VPC-SS-PP-0036).

4.6 Screwed Piping

In general, Galvanized piping shall have threads as per IS:554 or ANSI B2.1 NPT as required to match threads on fittings, valves etc. All other piping shall have threads as per ANSI B2.1, 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 centerlines unless different orientation is shown in the drawing.

Wherever jack screws are to be provided, drilling and tapping for the jack screws in the flange, shall be done as per VCS Standard 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.

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 like that for headers around heaters, reactors etc.

The completed bend shall have a smooth surface, free from cracks, buckles, wrinkles, bulges, flat spots and other serious defects. They shall be true to dimensions. The flattening of a bend, as measured by the difference between the maximum and minimum diameters at any

cross-section, shall not exceed 8% and 3% of the 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.

4.11 Mitre Bends and Fabricated Reducers

The specific application of welded mitre bends and fabricated reducers shall be governed by the Piping Material Specifications. Reducers shall be fabricated as per directions of Engineer-in-Charge. The radiographic requirements shall be as per Material Specifications for process and utility systems and NDT Specification for steam piping under IBR, radiographic requirements of IBR shall be complied with.

4.12 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.

4.13 Galvanized Piping

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

4.14 Jacketed Piping

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

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

4.15 Shop Fabrication / Prefabrication

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

4.16 Miscellaneous

4.16.1 Contractor shall fabricate miscellaneous elements like flash pot, seal pot, sample cooler, supporting elements like tum-buckles, extension of spindles and interlocking arrangement of valves, operating platforms as required by Engineer-in-Charge.

4.16.2 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.

4.16.3 Fabrication of pipes from plate

Pipes shall be fabricated at site as and when required as per the specifications and the actual Piping Material Specification.

5.0 ERECTION

5.1 Cleaning of Piping before Erection

Before erection all pre-fabricated 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. S.S jacketed piping requiring pickling shall be pickled to remove oxidation and discoloring due to welding.

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 / equipment's 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 Cold Pull

Wherever cold pull is specified, the Contractor shall maintain the necessary gap, as indicated in the drawing. Confirmation in writing shall be obtained by the Contractor from the Engineer-in-Charge, certifying that the gap between the pipes is as indicated in the drawing, before drawing the cold pull. Stress relieving shall be performed before removing the gadgets for cold pulling.

5.4 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.

5.5 Expansion Joints / Bellows

Installation of Expansion Joints/Bellows shall be as follows:

- 5.5.1. All Expansion joints / Bellows shall be installed in accordance with the specification and installation drawings, supplied to the Contractor.
- 5.5.2. a. Upon receipt, the Contractor shall remove the Expansion Joints / Bellows from the case(s) and check for any damage occurred during transit.

- b. 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.
 - c. Each Expansion Joint / Bellow shall be blown free of dust / foreign matter with compressed air or cleaned with a piece of cloth.
- 5.5.3. a. 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.
- b. An Expansion Joints / Bellow shall preferably be slinged from the end pipes / flanges or on the middle pipe.
- 5.5.4. a. All Expansion Joints shall be delivered to the Contractor at "Installation length", maintained by means of shipping rods, angles welded to the flanges or weld ends or by wooden or metallic stops.
- b. 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.
- 5.5.5. a. 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.
- b. The pipe ends / flanges shall be spaced at a distance specified in the drawings.
- 5.5.6. 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.
- 5.5.7. Butt-welding shall be carried out at each end of the expansion joint. For flanged Expansion Joint, the mating flanges shall be bolted.
- 5.5.8. 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.
- 5.5.9. The Expansion Joint shall not have any lateral deflection. The Contractor shall maintain parallelism of restraining rings or bellows convolutions.
- 5.5.10. Precautions
- a. For carrying out welding, earthing lead shall not be attached with the Expansion Joint.
 - b. The Expansion bellow shall be protected from arc weld spot and welding spatter.
 - c. 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 equipment's 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.

Hydraulic bolt tensioning & torque tensioning shall be performed on flange joints as per the requirements specified in "standard Specification for application of Torque & bolt Tension for flange joints,VPC-SS-PP-0041 and its addendum, if any.

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

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 this, the 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, if any, 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 points 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 control valve, orifice flange, rotameter, safety valves, restriction orifice, rupture disc, de-super heaters, corrosion probes, annubar, magnetic flow meter, ultrasonic flow meter, Coriolis mass flow meters, venturi PG/PTI Flow transmitter, ejectors, etc. and Shut Down Valves with fireboxes 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.

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 (VCS Spec.

VPC-SS-PI-0007). 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's / Items

Installation of line mounted items like filters, strainers, steam traps, air traps, de-super heaters, 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 molycoat grease mixed with graphite powder (unless otherwise specified in piping classes) 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 of pipe supports will be shown in drawings for lines 2" NB & above. For lines 1½"NB & below Contractor shall locate and design pipe supports in line with VCS Std's. In case of IBR Lines 1½"NB & below only indicative supporting shall be provided & detailing of such supports is in Contractor's scope. Contractor shall obtain approval of Engineer - in - Charge on drawings prepared by Contractor, before erection. 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 move during expansion.

Pre-set 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.



VCS QUALITY SERVICES PRIVATE LIMITED

STANDARD SPECIFICATION FOR STAINLESS STEEL – MULTI TUBES FOR CNG STATION

VCS – SS – PI - 0012

00	04.06.2019	ISSUED AS STANDARD	PNS	SM	AD
REV. No.	DATE	Purpose	Prepared By	Checked By	Approved By

ABBREVIATIONS:

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

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1.0 INTRODUCTION

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

2.0 SCOPE

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

3.0 ADVANTAGES OF BUNDLE / MULTIFLEXIABLE TUBES

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

4.0 TECHNICAL SPECIFICATION FOR PIPING COMPONENTS

a) CODES AND STANDARDS:

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

ISO 1127

DIN VED 0207 ASTM D1248

b) HYDRAULIC ANALYSIS OF SS TUBES:

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

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

Note:

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

c) TUBE SIZING IN LINE WITH HYDRAULIC ANALYSIS:

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

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

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

Notes:

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

accepted for this case of CNG application.

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

5.0 TUBING AND TUBE FITTINGS

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

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

6.0 BUNDLE TUBE / MULTI TUBES INSTALLATION PHILOSOPHY

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

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

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

7.0 STORAGE TO DISPENSER TUBING

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

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

8.0 TRAINING

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

9.0 APPROVALS

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



10.0 ADDITIONAL CERTIFICATES OF TUBE BUNDLES

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



VCS QUALITY SERVICES PRIVATE LIMITED

STANDARD SPECIFICATION FOR STAINLESS STEEL TUBE LAYING AND TESTING

VCS – SS – PI - 0015

00	10.07.2019	ISSUED AS STANDARD	AK	DG	AD
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1.0 SCOPE OF WORK AND TECHNICAL SPECIFICATION

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

1.1 Laying of SS Tube

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

Contractor shall engage approved subcontractor for this specialized work.

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

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

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

2.0 INSTALLATION PROCEDURE

2.1 TUBE END PREPARATION

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



2.2 ASSEMBLY

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

3.0 REMAKE OF FITTINGS

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

4.0 REFERENCE SPECIFICATION, CODES AND STANDARDS

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

5.0 SCOPE OF SUPPLY

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

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

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

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

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



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

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



VCS QUALITY SERVICES PRIVATE LIMITED

STANDARD SPECIFICATION FOR SS VALVES

VCS – SS – PI – 0016

00	10.07.2019	ISSUED AS STANDARD	AK	DG	AD
REV. No	DATE	Purpose	Prepared By	Checked By	Approved By



1. SCOPE

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

2. CODES & STANDARDS

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

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

3. PRECEDENCE CONFLICT RESOLUTION

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

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

4. DEVIATIONS

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

5. SPECIFICATIONS OF 2 WAY SS BALL VALVES

- a) Valves should be manufactured from following materials
 - i. The valve body will be made out of material conforming to ASTM A 479 Gr. SS 316/ASTM A351 CF3M.
 - ii. Material of construction of ball shall conform to ASTM A 276 Gr. SS 316.
- b) All ball valves shall be designed in conformance with the requirements of ASME B31.3, MSS SP-99 and other applicable standards. Area classification applicable for all items shall be Class 1, Division 1, Group D as per NEC or Zone-1, Group IIA/IIB as per IS/IEC specification or equivalent specification. All parts components shall meet the requirements for the specified area classification.
- c) Valves shall be rated for a maximum pressure rating of 6000 psig and shall be capable of operation between Design Temperature range of -400F to +2500F.
- d) Valves shall have spring loaded PEEK seats allowing seal-ability over the full pressure range at any port and low operating torque over the full range of pressure and temperatures.



- e) Valve shall have Nylon handle. Handle shall indicate the direction of flow.
- f) All valves should be full bore to ensure no pressure drop.

6. DOCUMENTATION

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

7. OTHER REQUIREMENT

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

8. MARKINGS, PACKING AND SHIPMENT

- a) Heat code shall be marked on valve body to facilitate traceability.
- b) All items shall be suitably wrapped and packaged to withstand rough handling during ocean shipment and inland journey.
- c) Each item shall be properly tagged and packaged separately to facilitate easy identification.
- d) All items shall be wrapped and packaged in such a way that they can be preserved in their original, as new condition.



VCS QUALITY SERVICES PRIVATE LIMITED

STANDARD SPECIFICATION

FOR SS FITTINGS

VCS – SS – PI – 0014

00	10.07.2019	ISSUED AS STANDARD	AK	DG	AD
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1.0 SCOPE OF SUPPLY

The scope of this specification covers the requirement of design, manufacture, inspection, testing at works/ marking/ packaging/ and supply of high-pressure SS Ferrule Fittings.

All codes & Standards for manufacturing, testing, inspection etc. shall be of latest edition.

2.0 CODES & STANDARDS

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

Bar Stock : ASME SA-479-316 or DIN 4401 or BS:970-316-S31

Forging : ASME SA-182-316 or DIN 4401 or BS:970- 316-S31

Thread : NPT ANSI B 1.20.1

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

- Job Specification
- International Standards/ Codes Applicable.

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

3.0 TECHNICAL SPECIFICATION

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

Testing shall be as per ASTM F 1387

4.1 Materials

4.1.1 Fittings shall be manufactured from the following materials:

3.1 Bar stock shall be as per BS: 970-316-S31, EIN 1.4401 or ASME 479-316.

3.2 Forgings shall be as per BS: 970-316-S31, EIN 1.4401 or ASME SA- 182-316

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

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

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

4.2 Design & Manufacture

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

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



- 4.2.3** Fittings shall be rated for at least the design pressure as stipulated in the material requisition. The design of fittings shall ensure that they shall be capable of holding full tube burst pressure after only one and a quarter turn pulls up of the nut
- 4.2.4** The threaded ends of fittings shall be NPT as per ANSI B1.20.1. Especially male threads are to be made by
Cold rolling method & shall be protected by plastic end caps.
- 4.2.5** The fittings shall hold the tube with collecting action producing a firm grip on the tube without substantially
reducing the tube wall thickness.
- 4.2.6** Fittings shall not torque the tubing during original or subsequent make-up of the connection and should use
geometry for inspection before and after make up the fittings shall not require disassembly for inspection
before or after makeup.
- 4.2.7** All tube fittings shall be guageable for sufficient pull up after one and a quarter turn. All tube fittings shall have a guageable shoulder and there will be no radius at the point where the shoulder meets the neck of the fitting body.
- 4.2.8** The gap inspection gauge shall be easily insertable at finger tight position of nut. The gap inspection gauge shall not be insertable between the nut and shoulder of the fitting after completing only one and a quarter turn pull up of the nut.
- 4.2.9** The tube seat counter bore in the body shall be faced flat 90° to the axis of the tubing to minimize tube expansion and subsequent galling.
- 4.2.10** The sealing and gripping power of the fitting shall be controlled such that the action between ferrules will overcome commercial variations in tubing wall thickness, hardness, diameter and installer skill.
- 4.2.11** The seal contact areas of the fittings body shall have a machined finish of 32 Ra or better.
- 4.2.12** The fittings body shall have no machined stop or shoulder to preclude additional tightening in subsequent make-up.
- 4.2.13** Front Ferrule
- i) The front ferrule shall affect a long, smooth repeatable seal by contact with body and a grip hold
on the tube surface
 - ii) The front ferrule shall always remain in a sprung condition to compensate for thermal stresses and to
accomplish repeated make and break
 - iii) Front ferrule which is wetted part shall not be hardened by HT.
 - iv) The sealing cone of body where front ferrule sits shall be finished to remove tool marks & to give extra
smooth surface for proper seating.
- 4.2.14** Rear Ferrule



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

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

tightening torque.

4.0 INSPECTION AND TESTING

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

samples of two ferrule fittings

- i) Hydraulic burst pressure test
- ii) Helium leak test under 0.0002 PSIA negative pressure, leaks into assembly greater than 4.0×10^{-9} atm-cc/sec being unacceptable
- iii) Gas pressure test for 25 Remakes at 5000 Psig. No leakage should be detectable even after 25 remakes.
- iv) Impulse & vibration testing as per ASTM F1387.

5.0 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

6.0 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 withstand rough handling during ocean shipment and inland journey.
- 7.4** Item shall be properly tagged and packaged 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.

7.0 DOCUMENTATION

Following test certificates shall be furnished along with shipment

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



VCS QUALITY SERVICES PRIVATE LIMITED

TECHNICAL SPECIFICATION FOR ASSORTED PIPES

VCS – SS – PI - 0001

00	13.05.2017	ISSUED AS STANDARD	AS	SM	AD
REV. No	DATE	Purpose	Prepared By	Checked By	Approved By



ABBREVIATIONS:

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

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GENERAL:

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

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

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

1.0 SCOPE

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

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

2.0 REFERENCED DOCUMENTS

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

B36.10 Welded and Seamless Wrought Steel Pipe

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

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

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

3.0 PRODUCT ANALYSIS

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

4.0 BENDING REQUIREMENTS

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



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

5.0 NON DESTRUCTIVE ELECTRIC TEST

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

6.0 WORKMANSHIP, FINISH AND APPEARANCE

Weld repair is not permitted.

7.0 CERTIFICATION

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

8.0 PRODUCT MARKING

8.1 GENERAL

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

8.2 LOCATION OF MARKINGS

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

8.3 SPECIFIED DIMENSIONS

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

8.4 GRADES AND CLASS

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

8.5 DIE STAMPING

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

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

1.0 SCOPE

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



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

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

2.0 REFERENCED DOCUMENTS

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

B36.10 Welded and Seamless Wrought Steel Pipe

B36.19 Stainless Steel Pipe

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

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

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

3.0 MATERIALS AND MANUFACTURE

The pipe shall be manufactured by the seamless process.

4.0 PRODUCT ANALYSIS

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

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

5.0 LENGTHS

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

6.0 WORKMANSHIP, FINISH AND APPEARANCE (NEW)

Repair by welding is not permitted.

7.0 MARKING

7.1 GENERAL

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



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

7.2 LOCATION OF MARKINGS

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

7.3 SPECIFIED DIMENSIONS

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

7.4 GRADES AND CLASS

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

7.5 DIE STAMPING

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

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

1.0 SCOPE

1.1 PURPOSE AND COVERAGE

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

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

1.2 SUPPLEMENTARY REQUIREMENT S1

Supplementary Requirement S1 applies.

1.3 UNITS OF MEASUREMENT

SI (metric) units shall apply.

1.4 DIMENSIONS

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

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

2.0 REFERENCED DOCUMENTS

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

B36.10 Welded and Seamless Wrought Steel Pipe

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

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

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

3.0 MATERIALS AND MANUFACTURE

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

4.0 PRODUCT ANALYSIS

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

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

5.0 LENGTHS AND PIPE ENDS

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

6.0 WORKMANSHIP, FINISH AND APPEARANCE

Repair welding is not permitted.

7.0 HYDROSTATIC AND ULTRASONIC TESTING

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

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

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

8.0 PRODUCT MARKING

8.1 GENERAL

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

8.2 LOCATION OF MARKINGS

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

8.3 SPECIFIED DIMENSIONS

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

8.4 GRADES AND CLASS

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



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

8.5 DIE STAMPING

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



PART IV - ADDITIONAL REQUIREMENTS

1.0 COATING AND PROTECTION

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

2.0 DOCUMENTS

2.1 RETENTION OF RECORDS

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

2.2 LINES-PIPE DATA

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

3.0 PIPE LOADING

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

4.0 INSPECTION OF FIELD TEST AND WARRANTY

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

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



VCS PROJECT CONSULTANTS PVT. LTD.

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

VPC – SS – PP - 2024

00	28.01.2020	MB	MC	AD	SK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY	:	If printed
CONTROLLED COPY	:	If in soft and signed

REVISION RECORD

Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	28.01.2020					
		MB	MC	AD	SK	

ABBREVIATIONS:

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

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1.0 SCOPE

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

2.0 REFERENCE DOCUMENTS

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

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

MANUFACTURERS STANDARDIZATION SOCIETY (MSS)

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

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

3.0 MATERIALS

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

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

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

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

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

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

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

- 3.4** For flanges and fittings specified to be used for Gas service or LPG service, Hardness test shall be carried out as per ASTM A 370 for each heat of steel used. A full thickness cross section shall be taken for this purpose and the maximum hardness of base metal, Weld metal and heat affected zone shall not exceed 248 HV₁₀.
- 3.5** In case of RTJ (Ring Type Joint) flanges, the groove hardness shall be minimum 140 BHN. Ring Joint flanges shall have octagonal section of Ring joint.

4.0 DESIGN AND MANUFACTURE

- 4.1** Flanges such as weld neck flanges and blind flanges shall conform to the requirements of ASME B 16.5.
- 4.2** Spectacle blind and spacer & blind shall conform to the requirements of ASME B 16.48.
- 4.3** Fittings such as tees, elbows, reducers, etc. shall be seamless type and shall conform to ASME B 16.9 for sizes DN 50mm (2") to DN 400mm (16") (both sizes included) and ASME B 16.11 for sizes DN 15mm(1½") & below.
- 4.4** Fittings such as weldolets, sockolets, nippolets, etc. shall be manufactured in accordance with MSS-SP-97.
- 4.5** Repair by Welding on flanges and fitting is not permitted.
- 4.6** All butt weld ends shall be beveled as per ASME B 16.5/ASME B 16.9/MSS-SP-97 as applicable
- 4.7** Type, face and finish of flanges shall be as specified in purchase requisition. The interpretation of range of face finish shall be as follows:

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

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

5.0 INSPECTION AND TESTS

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

5.1 TESTING OF MATERIALS

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

5.2 VISUAL INSPECTION AND DIMENSIONAL CHECK

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

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

5.3 NON-DESTRUCTIVE EXAMINATION

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

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

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

6.0 PAINTING

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

7.0 MARKING

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

- PO Number.
- Item Code.

8.0 TEST CERTIFICATES

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

Manufacturer shall furnish the following certificates:

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

9.0 PACKING & SHIPPING

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

10.0 DOCUMENTATION

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



VCS QUALITY SERVICES PVT.LTD.

STANDARD SPECIFICATION FOR PIPELINE BALL VALVES

VPC-SS-PP-2004

03	03.01.2022	SR	MC	HK	HK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

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CONTROLLED COPY	:	If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	23.06.2017					Issued as Standard
		AS	SM	AD	SK	
01	22.05.2019					Revised based on API 6D 24 TH Edition.
		BS	MC	AD	SK	
02	28.01.2020					Documents Formatting, numbering updated from SS-PL-004 to VPC-SS-PP-2004, vent drain Diagram updated, other Detail updated as marked
		MB	MC	AD	SK	
03	07.01.2022					Revised as Marked
		SR	MC	HK	HK	

ABBREVIATIONS:

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

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1 SCOPE

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

2 REFERENCE DOCUMENTS

All valves shall be manufactured and supplied in accordance with the American Petroleum Institute (API) Specification 6D, latest edition (edition in force at the time of issue of enquiry), Specification for Pipeline and Piping Valves, with additions and modifications as indicated in the following sections of this specification.

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

2.1 American Society of Mechanical Engineers (ASME)

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

2.2 American Petroleum Institute (API)

1104	:	Specification for Welding of Pipelines and Related Facilities.

2.3 American Society for Testing and Materials (ASTM)

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

2.4 Manufacturers Standardization Society (MSS)

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

2.5 Steel Structures Painting Council (SSPC)

- SSPC-VIS-I : Steel Structures Painting Council Visual Standard-Guide and Reference Photographs for Steel Surfaces prepared by Dry Abrasive Blast Cleaning.

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

3 MATERIALS

- 3.1 The material of major components of the ball valves shall be as indicated in Valve Data Sheet. Remaining components shall be as per Manufacturer's standard (suitable for the service indicated in the data Sheet) and shall be subjected to approval by Company. In addition, the material shall also meet the requirement specified hereinafter.

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

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

- 3.2 Carbon steel used for the manufacture of valves shall be fully killed.
- 3.3 The carbon equivalent ($CE_{I\!W}$) of valve end connections which are subject to further field welding by Company shall not exceed 0.43 on check analysis for each heat of steel used, as calculated by the following formula:

$$CE_{I\!W} = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Cu + Ni}{15}$$

3.4 Charpy V-Notch Test Requirements

Charpy V-notch test on each heat of base material shall be conducted for all pressure containing parts such as Body, End Flanges, Stem and Welding Ends as well as Bolting materials for pressure containing parts.

Test procedure for Charpy V-Notch Test shall conform to ASTM A370.

For Carbon Steel, alloy steel & Stainless Steel (except Austenitic Grades) Materials, The impact test temperature shall be 0 °C or minimum design temperature indicated in valve

data sheet / MR, whichever is lower. The average absorbed energy value of three full sized specimens shall be 27 J (for materials with Specified Minimum Tensile Strength 100,000 psi)/ 34 J (for materials with Specified Minimum Tensile Strength >100,000 psi). The minimum impact energy value of any one specimen of the three specimens analysed as above, shall not be less than 22 J (for materials with Specified Minimum Tensile Strength 100,000 psi)/ 26 J (for materials with Specified Minimum Tensile Strength >100,000 psi).

For Low Temperature Carbon Steel Materials, the impact test temperature shall be as per requirement of Material Standard or minimum design temperature indicated in valve data sheet/MR, whichever is lower. The average absorbed energy value of three full sized specimens shall be 27 J (for materials with Specified Minimum Tensile Strength 100,000 psi)/ 34 J (for materials with Specified Minimum Tensile Strength >100,000 psi). The minimum impact energy value of any one specimen of the three specimens analysed as above, shall not be less than 22 J (for materials with Specified Minimum Tensile Strength 100,000 psi)/ 26 J (for materials with Specified Minimum Tensile Strength >100,000 psi).

Where the material specification requires impact values to be higher than specified in the above paragraphs, the higher values shall apply.

For duplex & super duplex stainless steel the Charpy V-Notch test values and test temperature shall be as per API 6D.

3.5 Hardness Test Requirements

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

3.6 Electroless Nickel Plating Requirements

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

- SC2, Type II, Class 2.

The hardness of plating shall be minimum 50 RC.

4 DESIGN AND CONSTRUCTION REQUIREMENTS

4.1 General

Valve design shall meet the requirements of API Specification 6D and shall be suitable for the service conditions indicated in the Valve Data Sheet. The ASME Boiler & Pressure Vessel Code, Section VIII, Div 1 shall be used to design the valve body. Allowable stress requirements shall comply the provisions of above code. Also, corrosion allowance indicated in Valve Data Sheet shall be considered in valve design; however, the minimum wall thickness shall not be less than the minimum requirement of ASME B16.34. The

manufacturer shall have valid license to use API monogram on valves manufactured as per API 6D.

4.2 Valve Installation

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

4.3 Valve Body

4.3.1 For above ground valve, valve body design shall be either fully welded or bolted type. For buried valves, valve body design shall be fully welded type only. Valve body joints with threads are not permitted.

4.3.2 Ball mounting shall be trunnion or pivot type only. Valve design shall minimize the possibility of debris ingress into the trunnion as far as practicable

4.4 Ball

Ball shall be of single piece, solid type construction.

4.5 Valve Bore Configuration

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

Full Opening Valve

Full bore valves shall be suitable for the passage of all types of pipeline pigs including instrumented intelligent pigs and regular cleaning, batching and scraper pigs on regular basis without causing damage to either the valve component or the pig. The full bore, valve shall provide an unobstructed profile for pigging operations in either direction. Full bore valves shall be designed to minimize accumulation of debris in the seat ring region to ensure that valve movement is not impeded. The bore of full bore butt-welded & flanged valves shall be in line with Connecting pipe as stated in valve data sheet or Valve MR, however in any case it shall not be less than the minimum required shown in Client Ball Valve specification & API 6D.

Reduced Opening Valve

The bore size of reduced bore valve shall correspond to that of a full-bore valve of smaller nominal diameter as indicated in Table- 4.5 below. For sizes of a particular rating not covered in API 6D, the bore size of the reduced bore valve shall be as per manufacturer`s Standard.

TABLE 4.5			
Nominal Valve Size	Nominal Valve Size for Reduced Bore	Nominal Valve Size	Nominal Valve Size for Reduced Bore
DN mm (NPS inches)	DN mm (NPS inches)	DNmm (NPSinches)	DNmm (NPS inches)
50 (2)	40 (1.5)	600 (24)	500 (20)

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

4.6 Seat Design

The valves shall either be a soft seated valve or metal seated valve or with primary metal-to metal contact and secondary soft seats or seat design shall be as indicated in valve data sheet.

For soft seated valves, Metal seat rings may be provided with soft insert. The same shall be positively locked in position in Metal seat rings.

For valves with primary metal to metal contact and secondary soft seats, O-rings or other seals if used for drip tight sealing shall be encased in a suitable groove in such a manner that it cannot be removed from seat ring and there is no extrusion during opening or closing operation of valve at maximum differential pressure corresponding to valve class rating. The seat rings shall be so designed as to ensure sealing at low as well as high differential pressures.

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

4.8 Double Block & Bleed Design

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

4.9 Sealant Injection

Full bore valves of nominal valve size DN 200 mm (8") & above and Reduced Bore valves of nominal valve size DN 250 mm (10") & above, shall have provision for secondary sealant injection under full line pressure for seat and stem seals. All sealant injection connections shall be provided with block valve and an internal non-return valve. Valve design shall have a provision to replace the sealant injection fitting under full line pressure. Location and arrangement of sealant points shall be as per Fig 4.9.

4.10 Vent & Drain

Valves shall be provided with vent and drain connections. Location and arrangement of

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

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

4.11 Support Foot

Full bore valves of nominal valve size DN 200 mm (8") & above and Reduced bore valves of nominal valve size DN 250 mm (10") & above, shall be equipped with support foot and lifting lugs unless specified otherwise. Tapped holes and eyebolts shall not be used for lifting lugs. Height of support foot shall be kept minimum. The location and size of support foot/ lifting lugs shall ensure unrestrictive operation of vent/ drain valves. The design of support foot shall be such that it shall take minimum double the weight of the valve assembly.

4.12 Valve design shall be such as to avoid bimetallic corrosion between carbon steel and high alloy steel components. Suitable insulation shall be provided as required.

4.13 The valve body cavity over-pressure shall be prevented by self-relieving seat rings/ assemblies. Valve Cavity relief pressure when added to the valve pressure rating shall not exceed 133% of the pressure rating of the valve at its maximum specified design temperature.

4.14 Valve Ends

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

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

Butt weld end preparation shall be as per ASME B 16.25. The thickness of the pipe to which the valve has to be welded shall be as indicated in the Valve Data Sheet. In case difference exists between thickness of welding ends of valve and connecting pipe, the welding ends of valve shall have bevel preparation as per ASME B31.4 or ASME B31.8 as applicable.

In case of all Butt welded end valves (including soft seated valves or valves with primary metal to metal and secondary soft seats), actual yield strength of valve body shall not be less than 2/3rd of the specified minimum yield strength (SMYS) of the connecting pipe material.

For soft seated valves with Butt welded end, valves shall be provided with pup pieces on

either side of length 200 mm each for size up-to 8" & 250 mm for size 10" and above, with material as specified in valve data sheet. Length of pup piece shall be confirmed by manufacturer so as to avoid damage to seats during field welding or post weld heat treatment. Pup piece thickness shall be calculated for the class rating. Vendor shall provide for each type (considering size, grade and thickness of the pup pieces used for all offered valves) of pup piece, test rings (500 mm long) from pup piece material for field weld procedure qualification. Valves shall be tested along-with pup piece.

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

4.16 POSITION INDICATORS

Valve shall be provided with ball position indicator and stops of rugged construction at the fully open and fully closed positions. For actuated valves, additionally mechanical means of position indicator shall be provided.

4.17 STEM EXTENSIONS

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

- a. Valves provided with stem extension shall have water proof outer casing. Length of stem extension shall be as indicated in Valve Data Sheet. The length indicated corresponds to the distance between centerline of the valve opening and the top of mounting flange for valve operating device (gear operator/ power actuator as applicable).
- b. In case of below Ground LTCS valves, Stem extension material shall be equivalent to stem material.
- c. Vent and drain connections and sealant injection lines shall be terminated adjacent to the valve operator by means of suitable piping anchored to the valve body. The pipe used shall be API 5L Gr. B/ ASTM A 106 Gr. B, with Sch 160 for carbon steel valves and ASTM A 333 Gr 6, with Sch 160 for Low temperature carbon steel valves or the material shall be as specified in valve data sheet. The material of fittings for Carbon Steel valve shall be ASTM A105/ ASTM A234 Gr. WPB and material for the fittings for low temperature carbon steel valves shall be ASTM A 350 Gr LF2 Cl 1 or the material shall be as specified in valve data sheet. The fittings and valve end shall be Socket welded ANSI class 6000# as per ASME B 16.11 (For piping class up to 600#) and BW end (For Piping Class 900#).
- d. Stem extension and stem housing design shall be such that the complete assembly will form a rigid unit giving positive drive under all conditions with no-possibility of free movement between valve body, stem extension or its operator.
- e. Outer casing of stem extension shall have 3/8" or 1/2" NPT plugs at the top and bottom, for draining and filling with oil to prevent internal corrosion.
- f. The Stem Extension shall be self-relieving.

4.18 OPERATING DEVICES

- a. Valves shall have a power actuator or manual operator as indicated in the Valve Data Sheet. In case of manual operator, valve sizes, DN 100 mm (4) shall be wrench operated and valve sizes, DN 150 mm (6) shall be gear operated. The length of wrench shall not be longer than twice the face to face or end to end dimension of the valve. Each wrench operated valve shall be supplied with wrench. Valve design shall be such that damage due to malfunctioning of the operator or its controls will only occur in the operator gear train or power cylinder and that damaged parts can be replaced without the valve cover being removed.
- b. The power actuator shall be in accordance with the Company Specification issued for the purpose and as indicated in the Valve and Actuator Data Sheet. Operating time shall be as indicated in Valve Data Sheet. Valve operating time shall correspond to full close to full open/ full open to full close under maximum differential pressure corresponding to the valve rating. For actuated valves, the actuator's rated torque output shall be 1.25 times the break torque required to operate the ball valve under the maximum differential pressure corresponding to the Valve Class Rating.
- c. For the manual operator of all valves, the diameter of the hand wheel or the length of operating wrench shall be such that under the maximum differential pressure, the total force required to operate the valve does not exceed 350N. However, failing to meet above requirement, vendor shall offer gear operated valves. Manufacturer shall also indicate the number of turns of hand wheel in case of gear operators (along with their offer) required for Operating the valve from full open to full close position. The number of turns shall not exceed 250 for valves sizes up to 24" and 450 for valve sizes above 24" .
- d. Direction of operation of hand wheel or wrench shall be in clock-wise direction while closing the valve. Hand wheels shall not have protruding spokes.
- e. Gear operators, when provided, shall have a self-locking provision and shall be fully encased in water proof/ splash proof enclosure and shall be filled with suitable grease.

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

4.20 LOCKING DEVICES

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

4.21 WELDING

All welds shall be made by welders and welding procedures qualified in accordance with the provisions of ASME Section IX. The procedure qualification shall also include impact test and hardness test when required as per Clause 3.4 to 3.5 of this specification and shall meet the requirements as specified therein.

4.22 REPAIR WELDING

Repair by welding is not permitted for fabricated and forged body valves. However, repair

by welding as per ASME B16.34 is permitted for cast body valves. Such repairs shall be carried out at casting supplier's care only. Repair shall be carried out before any heat treatment of casting is done. Repair welding procedure qualification shall also include impact test and hardness test when required as per Clause 3.4 to 3.5 of this specification and shall meet the requirements as specified therein. Heat treatment and radiography shall be repeated after the weld repair.

- 4.23** No Casting is permitted for stem and stem extended material of all valve. Valve stem shall be capable of withstanding the maximum operating torque required to operate the valve against the maximum differential pressure corresponding to applicable class rating. The combined stress shall not exceed the maximum allowable stresses specified in ASME section VIII, Division 1. For power actuated valves, the valve stem shall be designed for maximum output torque of the selected power actuator (including gear box, if any) at valve stem.
- 4.24** Wherever specified for the part of valve in valve data sheet, minimum thickness of stelliting shall be 1.6mm
- 4.25** All Soft seated valves shall be fire safe design and qualified as per API 6FA/ API 607/ ISO 10497.
- 4.26** Soft-seated valves shall have antistatic device.

5 INSPECTION & TESTS

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

Pressure Class Rating	Valve Size	Extent of Radiography
ANSI 150 # Class	DN 600 mm (24)	Nil
	DN 650 mm (26)	100%

ANSI 300 # Class	DN 400 mm (16)	Nil
	DN 450 mm (18)	100%
ANSI 600 # Class and above	All sizes	100%

Radiography shall be performed after the final heat treatment also.

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

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

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

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

5.6 Full inspection by radiography shall be carried out on all welds of pressure containing parts. Acceptance criteria shall be as per ASME B 31.4 or ASME B31.8 as applicable and API 1104.

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

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

- a. Weld ends of all cast valves subject to welding in field shall be 100% radio graphically examined and acceptance criteria shall be as per ASME B16.34.
- b. After final machining, all bevel surfaces shall be inspected by dye penetrant or wet magnetic particle methods. All defects longer than 6.35 mm are rejected, as are the defects between 6.35 mm and 1.59 mm that are separated by a distance less than 50 times their greatest length. Rejectable defects must be removed. Weld repair of bevel surface is not permitted.

5.9 All valves shall be tested in compliance with the requirements of API 6D. During pressure testing, valves shall not have sealant lines and other cavities filled with sealant, grease or other foreign material: The drain, vent and sealant lines shall be either included in the hydrostatic shell test or tested independently. Test pressure shall be held for at least 30 minutes for both Shell & seat Test. No leakage is permissible during hydrostatic testing. The body cavity self-relieving feature meeting the requirements of clause 4.13 of this specification shall also be checked.

5.10 A supplementary air seat test as per API 6D (Annex I, Para I.9 Type II) shall be carried

out for all valves. A bubble tight seal is required without the use of any sealant. No leakage is allowed. Test pressure shall be held for at least 15 minutes.

5.11 Valves shall be subjected to Operational Torque Test as per API 6D (Annex I, Para I.6) under hydraulic pressure equal to maximum differential pressure corresponding to the applicable ANSI class rating of valve. It shall be established that the force required to operate the valve does not exceed the requirements stated in section 4.18 (C) of this specification.

5.12 Power actuated valves shall be tested after assembly of the valve and actuator, at the valve Manufacturer's works. At least five Open-Close-Open cycles without internal pressure and five Open-Close-Open cycles with maximum differential pressure corresponding to the valve rating shall be performed on the valve actuator assembly. The time for Full Open to Full Close shall be recorded during testing. If required, the actuator shall be adjusted to ensure that the opening and closing time is within the limits stated in Valve Data Sheet.

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

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

5.13 Subsequent to successful testing as specified in clause 5.11 and 5.12 above, one (1) valve out of the total ordered quantity shall be randomly selected by the Company Representative for cyclic testing as mentioned below:

- a. The valve shall be subjected to at least 100 Open-Close-Open cycles with maximum differential pressure corresponding to the valve rating.
- b. Subsequent to the above, the valve shall be subjected to hydrostatic test and supplementary air seat test in accordance with clause 5.9 and 5.10.

In case this valve fails to pass these tests, the valve shall be rejected and two more valves shall be selected randomly and subjected to testing as indicated above. If both valves pass these tests, all valves manufactured for the order (except the valve that failed) shall be deemed acceptable. If either of the two valves fails to pass these tests, all valves shall be rejected or each valve shall be tested at the option of manufacturer.

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

5.14 Checks shall be carried out to demonstrate that the dissimilar metals used in the valves are successfully insulated as per the requirement of clause 4.12 of this specification.

5.15 Anti-Static testing for soft seated valves in accordance with L.5 of API 6D.

5.16 Company reserves the right to perform stage wise inspection and witness tests as indicated in clause 5.1 above at Manufacturer's works prior to shipment. Manufacturer shall give reasonable access and facilities required for inspection to the Company's

Inspector. Company reserves the right to require additional testing at any time to confirm or further investigate a suspected fault. The cost incurred shall be to Manufacturer's account.

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

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

6 TEST CERTIFICATES

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

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

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

7 PAINTING

Valve surface shall be thoroughly cleaned, freed from rust and grease and applied with sufficient coats of corrosion resistant paint. Surface preparation shall be carried out by shot blasting to SA-2 ½ / SSPC-SP10. For Coastal area, painting shall be suitable for industrial marine environment. For the valves to be installed underground, when indicated in Valve Data Sheet, the external surfaces of buried portion of the valve shall be painted with 100% Solid high build epoxy with a minimum dry film thickness of 1000 microns or 1.5 mm thick polyurethane coating.

8 MARKING & SHIPMENT

- 8.1** All valves shall be marked as per API 6D. The units of marking shall be metric except nominal diameter, which shall be in inches.
- 8.2** Valve ends shall be suitably protected to avoid any damage during transit. All threaded and machined surfaces subject to corrosion shall be well protected by a coat of grease or other suitable material. All valves shall be provided with suitable protectors for flange faces, securely attached to the valves. Bevel ends shall be protected with metallic or high impact plastic bevel protectors.
- 8.3** All sealant lines and other cavities of the valve shall be filled with sealant before shipment.

- 8.4** Packaging and shipping instructions shall be as per API 6D.
- 8.5** The serial number of each valve indicated on its name plate shall appear on all required documentation in accordance with EN 10204 3.2.
- 8.6** Name Plate material shall be minimum stainless steel. Marking shall be as per MSS-SP-25
- 8.7** All valves shall be transported with ball in fully opened condition
- 8.8** On packages, following shall be marked legibly with suitable marking ink:
- a. Order Number
 - b. Manufacturer's Name
 - c. Valve size and rating
 - d. Tag Number
 - e. Serial Number

9 SPARES & ACCESSORIES

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

10 DOCUMENTATION

Documentation to be submitted by Manufacturer to Company is summarized below. Number of Copies (Hard copies / soft copies etc.) shall be as indicated in CONTRACT document.

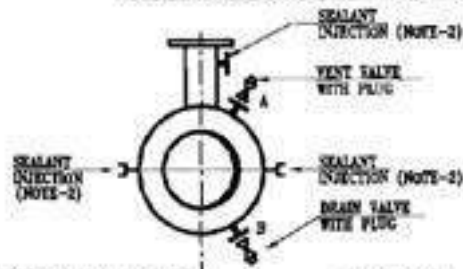
- 10.1** At the time of bidding, Manufacturer shall submit the following documents:
- a. Reference list of similar ball valves manufactured and supplied in last seven years indicating all relevant details including project, year, client, location, size, rating, service etc.
 - b. Torque curves for the power actuated valves along with the break torque, running torque for the valve stem and maximum allowable stem torque.
 - c. Copy of valid API 6D Certificate.
 - d. Fire Safe test certificate qualifying the valves as per API 6FA/ API 607/ ISO 10497 carried out in last 10 years shall be furnished.
 - e. Details of support foot including dimensions and distance from valve centreline to bottom of support foot.
 - f. List of recommended spares required during start-up and commissioning & 2 years of normal operation and maintenance.

- 10.2 After placement of order, the Manufacturer shall submit the following drawings, documents and specifications for Company's approval:
- a. General arrangement & detailed sectional drawings showing all parts with reference numbers and material specifications, overall dimensions and features. Number of turns of hand wheel required for operating the valve from full open to full close position for Gear Operated valves, painting/ coating scheme, Complete dimensional details of support foot (where applicable), shall be indicated in the GA.

Manufacture of valves shall commence only after approval of the above documents. Once the approval has been given by Company, any changes in design, material and method of manufacture shall be notified to Company whose approval in writing of all changes shall be obtained before the valve is manufactured.

- 10.3 Within 30 days from the approval date, Manufacturer shall submit to Company the approved drawings, documents and specifications as listed in clause 10.2 above.
- 10.4 Prior to shipment, Manufacturer shall submit to Company following:
- a. Test certificates as per clause 6.0 of this specification.
 - b. Manual for installation, erection, maintenance and operation instructions including a list of recommended spares for the valves.
- 10.5 All documents shall be in English language only.

ABOVE GROUND INSTALLATION



FULL BORE VALVES

VALVE SIZE, DN(mm)	A, DN(mm)	B, DN(mm)
50 TO 150	-	15
200 TO 600	15	25
650 & ABOVE	15	40

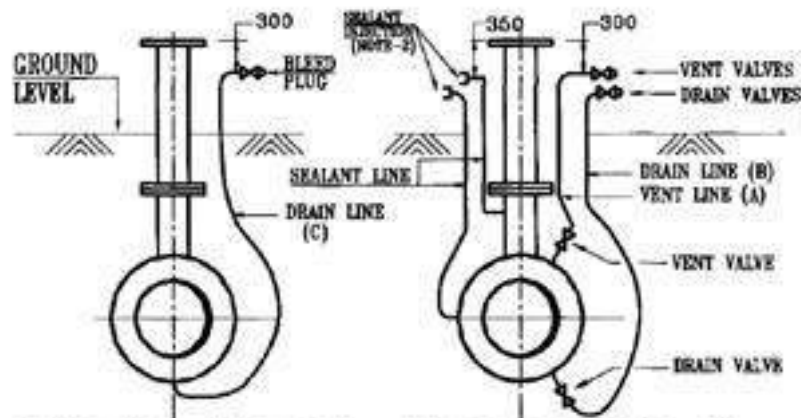
REDUCED BORE VALVES

VALVE SIZE, DN(mm)	A, DN(mm)	B, DN(mm)
50 TO 200	-	15
250 TO 750	15	25
ABOVE 750	15	40

NOTES:-

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

UNDERGROUND INSTALLATION



FB VALVES DN 50 mm(2") TO DN 150 mm(6") FB VALVES > DN 200 mm(8")
RB VALVES DN 50 mm(2") TO DN 300 mm(8") RB VALVES > DN 250 mm(10")

FULL BORE (FB) VALVES

VALVE SIZE, DN(mm)	A, DN(mm)	B, DN(mm)	C, DN(mm)
50 TO 150	-	-	15
200 TO 300	25	25	-
350 TO 600	25	25	-
650 & ABOVE	40	40	-

REDUCED BORE (RB) VALVES

VALVE SIZE, DN(mm)	A, DN(mm)	B, DN(mm)	C, DN(mm)
50 TO 200	-	-	15
250 TO 400	25	25	-
450 TO 750	25	25	-
800 & ABOVE	40	40	-

NOTES:-

1. ALL VALVES (BALL OR PLUG) AND PLUGS FOR A AND B SHALL BE APPROVED BY THE PURCHASER.
2. SEALANT POINTS SHALL BE PROVIDED FOR FULL BORE VALVES OF NOMINAL VALVE SIZE 200 mm (8") & ABOVE AND REDUCED BORE VALVES OF NOMINAL VALVE SIZE, DN 250 mm (10") AND ABOVE ONLY. SEALANT LINES SHALL HAVE PROVISION TO REPLACE THE SEALANT INJECTION FITTING UNDER FULL LINE PRESSURE. SEALANT LINES SHALL HAVE BLOCK VALVE & INTERNAL NON RETURN VALVE.
3. ALL VENT/DRAIN CONNECTION IN BURIED SECTION SHALL BE OF WELDED CONSTRUCTION. ALL PIPING INCLUDING VALVE ENDS IN BURIED PORTIONS OF VENT & DRAIN SHALL BE WELDED TYPE.

FIGURE-4.9



VCS QUALITY SERVICES PVT. LTD.

STANDARD SPECIFICATION FOR PLUG VALVES

VCS – SS – PP - 2051

00	03.05.2022	SR	MC	HK	HK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY	:	If printed
CONTROLLED COPY	:	If in soft and signed



ABBREVIATIONS:

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



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1.0 **SCOPE**

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

2.0 **REFERENCE DOCUMENTS**

- 2.1 All valves shall be manufactured and supplied in accordance with the American Petroleum Institute (API) Specification 6D, Latest Edition with additions and modifications as indicated in the following sections of this specification.
- 2.2 Reference has also been made in this specification to the latest edition (edition enforce at the time of issue of enquiry unless specified otherwise) of the following Codes, Standards and Specification.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

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

AMERICAN PETROLEUM INSTITUTE (API)

1104	:	Specification for Welding Pipelines and Related Facilities.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

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



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

MANUFACTURERS STANDARDIZATION SOCIETY (MSS)

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

SP-44 : Steel Pipeline Flanges.

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

VIS-I : Visual Standard.

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

Order of precedence shall be as follows:

- Data Sheets
- This Specification
- API 6D Specification
- Other Referred Codes & Standards
- Manufacturer's Standard

3.0 MATERIALS

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

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

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

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

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

3.4 **CHARPY V-NOTCH TEST REQUIREMENTS**

- 3.4.1** For valves specified to be used for Gas service or LPG service, Charpy V-notch test, on each heat of base material shall be conducted as per API 6D, for all pressure containing parts such as body,



end flanges and welding ends as well as bolting material for pressure containing parts. Unless specified otherwise, the Charpy Impact test shall be conducted at 0°C or minimum design temperature indicated in valve data sheet / MR, whichever is lower. Test procedure shall conform to ASTM A 370. The average absorbed energy value of three full sized specimens shall be 27 J. The minimum impact energy value of any one specimen of the three specimens analyzed as above shall not be less than 22 J.

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

3.5 HARDNESS TEST REQUIREMENTS

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

3.6 ELECTROLESS PLATING REQUIREMENTS

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

- SC2, Type II, Class 2.

The hardness of plating shall be minimum 50 RC.

Manufacturer shall ensure that the adhesive strength of plating is sufficient so as to prevent peeling of plating during operation of the valve.

4.0 DESIGN AND CONSTRUCTION REQUIREMENTS

4.1 GENERAL

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

All process-wetted parts, metallic and non-metallic, shall be suitable for the fluids and service specified by the Purchaser

4.2 VALVE PATTERN

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

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

4.3 PLUG DESIGN

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

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

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

4.6 SEALANT INJECTION REQUIREMENT

All valves shall have the provision for secondary sealant injection under full line pressure for seat and stem seals. All sealant injection connection shall be provided with an internal non-return valve. Valve design shall have a provision (e.g. Ball Type Check Valve/ Needle Valve) to replace the sealant injector fitting under full line pressure. Location and arrangement of sealant injection points shall be as per Fig - 4.6. Valves shall have vent and drain connections as per API 6D.

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

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

4.9 VALVE ENDS

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



dimensions not shown in API 6D or in ASME B 16.10 shall be as per Manufacturer Standard and shall be subject to approval by Company.

- b. Flanged ends, if specified, shall have flanges as per ASME B16.5 for valve sizes up to DN 600 mm (24") excluding DN 550 mm (22") and as per MSS-SP-44/ ASME B 16.47 Series A for valve sizes DN 550 mm (22") and for DN 650 mm (26") and above. Flange face shall be either raised face or ring joint type (RTJ) as indicated in Valve Data Sheet. Flange face finish shall be serrated or smooth as indicated in Valve Data Sheet. In case of RTJ flanges, the groove hardness shall be minimum 140 BHN.
- c. Butt weld end preparation shall be as per ASME B 16.25. The thickness of the pipe to which the valve has to be welded shall be as indicated in the Valve Data Sheet. Valves shall be without transition pups. In case difference exists between thickness of welding ends of valve and connecting pipe, the welding ends of valve shall have bevel preparation as per ASME B31.4 or ASME B31.8 as applicable.

4.10 POSITION INDICATORS

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

4.11 VALVE INSTALLATION

Valves shall be suitable for either buried or above ground installation as indicated in Valve Data Sheet, material Requisition & P&IDs

4.12 LOCKING DEVICES

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

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

4.14 STEM EXTENSIONS

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

- a. Valves provided with stem extension shall have water proof outer casing. Length of stem extension shall be as indicated in Valve Data Sheet. The length indicated corresponds to the distance between centerline of the valve opening and the top of mounting flange for valve operating device (gear operator/ power actuator as applicable).
- b. Seat sealant injection lines shall be extended and terminated adjacent to the valve operator by means of suitable piping anchored to the valve body/ stem housing. The pipe used shall be API 5L Gr. B/ ASTM A 106 Gr. B, with Sch 160. Fittings shall be ASTM A105/ ASTM A 234 Gr. WPB, Socket welded ANSI class 6000.
- c. Sealant injection lines shall be extended and terminated adjacent to the valve operator in manner as indicated in (b) above



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

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

For Power Actuated Valves, the valve stem shall be designed for maximum output torque of the selected power actuator (including gear box, if any) at the valves stem

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

4.16 OPERATING DEVICES

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

4.17 WELDING

All welds shall be made by welders and welding procedures qualified in accordance with the provisions of ASME Section IX, except that only positions 5G and 2G shall qualify all-positional welding. The procedure qualification shall also include impact test and hardness test when



required as per Clause 3.4 and 3.5 of this specification and shall meet the requirements as specified therein.

4.18 REPAIR WELDING

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

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

5.0 INSPECTION AND TESTS

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

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

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



b. All forgings shall be by ultrasonic method. Inspection procedure and acceptance shall comply with Annexure E of ASME B16.34.

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

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

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

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

5.8 All valves shall be tested in compliance with the requirements of API 6D. The drain, vent and sealant lines shall be either included in the hydrostatic shell test or tested independently. Test pressure shall be held for duration mentioned in API 6D. Hydrostatic shell testing shall ensure that the whole of the shell is subjected to the test pressure. If necessary, the empty shell shall be pressure tested prior to assembly of the plug. The drain, vent and sealant lines shall be either included in the hydrostatic shell test or tested independently

5.9 No leakage is permissible during hydrostatic testing. After pressure testing and acceptance, valves shall be thoroughly drained and dried. Drying of valves internal shall be with compressed air and lint free rags. The internal surfaces shall be coated with suitable water dispelling anti-corrosion fluid. To ensure total coverage, the valve shall be placed in the half open position, filled with the fluid and drained.

5.10 A supplementary air seat test as per API 6D shall be carried out for all valves. No leakage is allowed. Test pressure shall be held for at least 15 minutes.

5.11 Manufacturer who intends bidding must submit at bid stage, certificate and report for successful fire safe tests for all types of valves in accordance with BS:6755 (Part-II)/ API 6FA, as applicable in Valve Data Sheet. Failure to comply with the requirement shall be a cause of rejection of the offer

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

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



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

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

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

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

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

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

6.0 TEST CERTIFICATES

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

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

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

7.0 PAINTING

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



Manufacturer shall indicate the type of corrosion resistant paint used, in the drawings submitted for approval

8.0 MARKING & SHIPMENT

- 8.1** All valves shall be marked as per API 6D. The units of marking shall be metric except nominal diameter, which shall be in inches. Marking shall be done by die-stamping on the bonnet or on the housing. However, for buried valves the marking shall be done on the above ground portion of the stem housing only.
- 8.2** Valve ends shall be suitably protected to avoid any damage during transit. All threaded and machined surfaces subject to corrosion shall be well protected by a coat of grease or other suitable material. All valves shall be provided with suitable protectors for flange faces, securely attached to the valves. Bevel ends shall be protected with metallic or high impact plastic bevel protectors.
- 8.3** All sealant lines and other cavities of the valve shall be filled with sealant before shipment.
- 8.4** Packaging and shipping instructions shall be as per API 6D.
- 8.5** On packages, following shall be marked legibly with suitable marking ink:
- a. Order Number
 - b. Manufacturer's Name
 - c. Valve size and rating
 - d. Tag Number
 - e. Serial Number

9.0 SPARES AND ACCESSORIES

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

10.0 DOCUMENTATION

- 10.1.** The Manufacturer shall supply documentation in accordance with the Vendor Data Requirements List (VDRL) as attached with Purchase Order/ Material requisition. If not mentioned below minimum documentation shall be followed.

At the time of bidding, the bidder shall submit the following documents:

- a) General arrangement/ assembly drawings showing all features and relative positions & sizes of vents, drains, gear box & other external parts together with overall dimensions.



- b) Sectional drawing showing major parts with reference numbers and material specification.
- c) Reference list of similar plug valves manufactured and supplied in last five years, indicating all relevant details including project, year, client, location, size rating, service, etc.
- d) Torque curves for the power actuated valves along with break torque and maximum allowable stem torque. In addition, sizing criteria and torque calculations shall also be submitted for power actuated valves.
- e) Descriptive technical catalogues of the Manufacturer.
- f) Copy of valid API 6D certificate, wherever applicable.
- g) Details of support foot, including dimensions and distance from valve centre line to bottom of support foot.
- h) Quality Assurance Plan enclosed with this tender duly signed, stamped and accepted.

The drawings to be submitted alongwith the bid shall be in total compliance with the requirement of technical specification and data sheets of the valves with no exception & deviation.

10.2. Within two weeks of placement of order, the manufacturer shall submit six copies of, but not limited to, the following drawings, documents and specifications for approval :

- a) Design drawings and relevant calculations for pressure containing parts and other principle parts.
- b) Detailed sectional arrangement drawing showing all parts with reference numbers and materials specification.
- c) Assembly drawings with overall dimensions & clearances required and showing all features. Drawing shall also indicate the numbers of turns of handwheel (in case of gear operator) required for operating the valve from full open to full close position and the painting scheme.
- d) Welding, heat treatment, testing and quality control procedures.
- e) Details of corrosion resistant paint to be applied on the valves.
- f) Design calculation for pressure containing parts.

Manufacture of valves shall commence only after approval of the above documents. Once approval has been given by Purchaser, any change in design, material and method of manufacture shall be notified to the Purchaser, whose approval in writing for all changes shall be obtained before the valves are manufactured.



10.3. Within 30 days from the approval date, Manufacturer shall submit one reproducible and six copies of the approved drawings, documents and specification as listed in clause 10.2 of this specification.

10.4. Prior to shipment, Manufacturer shall submit one reproducible and six copies of following

t certificates as listed in clause 7.0 of this specification.

- b) Manual for installation, erection instructions, maintenance and operation instructions, including a list of recommended spares for the valves

10.5. All documents shall be in English Language.

11.0 GUARANTEE

11.1 Manufacturer shall guarantee that the materials and machining of valves and fittings comply with the requirements in this specification and in the Purchase Order.

11.2 Manufacturer is bound to replace or repair all valve parts which should result defective due to inadequate engineering or to the quality of materials and machining.

11.3 If valve defect or malfunctioning cannot be eliminated, Manufacturer shall replace the valve without delay.

11.4 Any defect occurring during the period of Guarantee shall be attended to by making all necessary modifications and repair of defective parts free of charge to the Purchaser as per the relevant clause of the bid document.

11.5 All expenses shall be to Manufacturer's account.

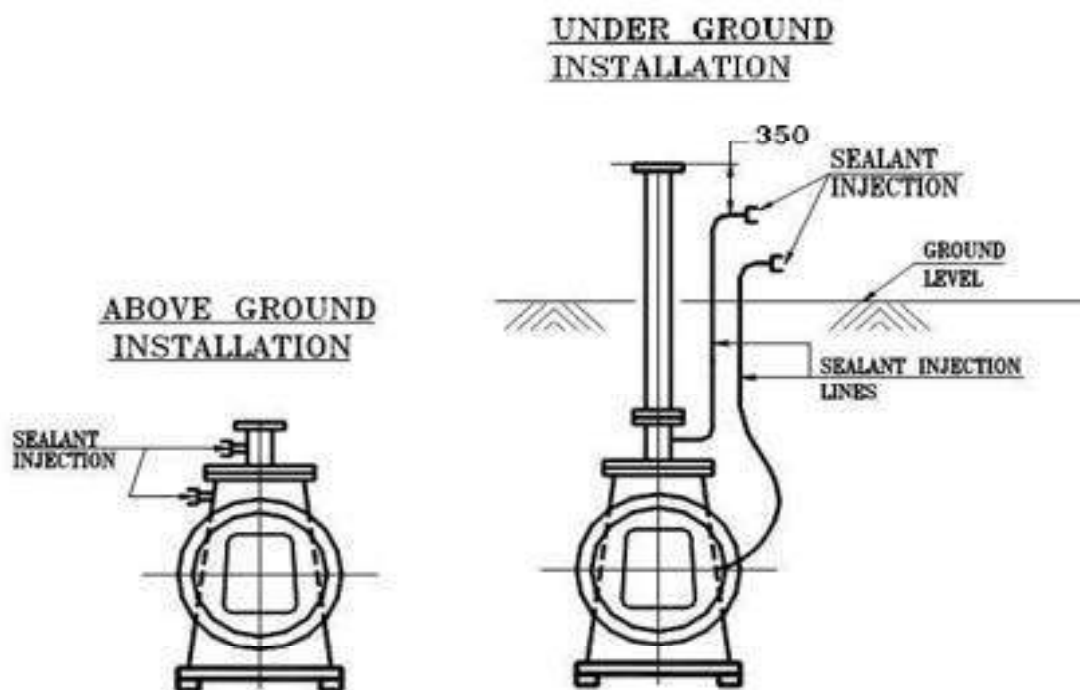


FIGURE- 4.6



VCS PROJECT CONSULTANTS PVT.LTD.

STANDARD SPECIFICATION FOR INSULATING JOINT

VPC-SS-PP-2029

01	28.01.2020	MB	MD	AD	SK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY	: If printed
CONTROLLED COPY	: If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	28.01.2020					
		MB	MD	AD	SK	

ABBREVIATIONS:

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

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1.0 SCOPE

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

2.0 REFERENCE DOCUMENTS

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

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

AMERICAN PETROLEUM INSTITUTE (API)

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

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

MANUFACTURERS STANDARDIZATION SOCIETY (MSS)

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

National Association of Corrosion Engineers (NACE)

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

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

VIS-I : Visual Standard.

SP-10 : Surface Preparation.

OIL INDUSTRY SAFETY DIRECTORATE (OISD)

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

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

MISCELLANEOUS

NEC : National Electric Code.

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

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

3.0 MATERIALS

3.1 METALLIC COMPONENTS

3.1.1 Material for the pressure containing parts of the insulating joints shall be as indicated in the Insulating Joint Data Sheets (DS), which shall be subject to approval by Company. In addition, the material shall also meet the requirements specified hereinafter.

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

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

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

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

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

3.1.6 The Manufacturer shall select materials as indicated in the data sheet along with the as defined operating (Temperature/ Pressure) parameters and in accordance with ASME B 31.4/ B 31.8, as applicable and ANSI B16.25 for butt welding ends. Internal bore of weld joints shall not impede the pigging

process or represent potential pig damage. The Manufacturer shall perform post weld heat treatment (PWHT) as/ if required by the corresponding approved weld procedures. The Manufacturer shall prove by calculations to ASME VIII Division I that the materials supplied satisfy the pressure/temperature rating as specified in Data Sheet.

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

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

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

3.2 NON METALLIC COMPONENTS

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

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

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

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

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

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

4.0 DESIGN AND MANUFACTURE

4.1 GENERAL

- a. The monolithic insulating joints as per figure shall be designed so as to provide an effective electrical barrier by isolation between the buried pipeline and the above ground pipeline and other pipelines. Suitable for above or below ground installation as defined in the data sheet. The Manufacturer shall provide a proven design.

- b. The insulating joints shall be of the monolithic bolt-less design comprising of forged sections assembled together by welding to form an integral unit. Insulating joint shall be fabricated by welding the forged retainer to pre-assembled insulating components and hub, under compression, so as to ensure effective sealing. Final assembly of joint shall be by welding only. Crimped and screwed closing joints are not permitted.
- c. The hydrostatic test pressure for the insulating joints shall be 1.5 times the design pressure.
- d. The insulating joints shall be designed for welding to the line pipe with weld ends. Bolted and flanged connections are not allowed.
- e. The insulating joint shall have a smooth clear bore and be suitable for uninterrupted passage of pigs, spheres and on-line inspection tools. The internal bore of insulating joint shall match the bore of connected pipe as indicated in data sheet.
- f. The design shall ensure that over the time of service the carrier product shall not permeate in the cavity.
- g. The selected seal material shall be resistant to the chemicals and the operating temperature and pressure of the pipe system. At least 90% of the gasket shall be in contact with bare metal surface. The sealing gasket shall be of sufficient thickness and shall be made out of one piece of material, no joints are permitted.
- h. When specified in data sheet, the insulating joint shall be able to sustain an internal vacuum of five (5) millibar.
- i. No stress inducing recess, protrusions or notches, are permitted in the internal surface of the supplied joint. Additional fillers are not permitted to fill these flaws.
- j. The cavities inside the joint shall be filled with low viscosity dielectric material that solidifies on curing. Air pockets and impurities in the dielectric material shall not be accepted.
- k. The Manufacturer shall submit the detailed sectional drawing of the longitudinal face of the joint. The cross sectional drawing shall show all parts, materials, dimensions surface finishes and tolerances.
- l. Calculations shall be provided to show that the designed joint can withstand torsional stress up to 10% of the SMYS of the pipe material.
- m. The electrical resistance of the joint shall not decrease with time. The joint shall include permanent terminals for survey lead connections.
- n. The insulating joint material shall be resistant to creep.
- o. The external fasteners shall be hot dip galvanized as per ASTM A 153.

4.2 DESIGN

4.2.1 MECHANICAL DESIGN

- a. Main components of insulating joints such as forged hub, the stub end and the retainer ring, gaskets etc. shall be designed in accordance with Section VIII, Division 1, Appendix-II of ASME, Boiler and Pressure Vessel Code. Design factor shall be in accordance with the data sheet.

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

4.2.2 PUPS

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

4.2.3 ELECTRICAL

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

4.2.4 WELDING

- a. All welds except closing weld shall be butt welds. The closing weld shall be full penetration girth weld in accordance with ASME BPVC Section VIII, Division I. The weld design shall conform to the ASME acceptable standards. Fillet welds if required, shall have minimum two passes.
- b. Welding end of the pipe pups to be welded to the insulating joint shall be prepared in accordance with ASME B31.4/ B31.8, as applicable. All butt weld ends shall be checked for surface defects using dye penetrate prior to welding.
- c. All welding shall be carried out by welders and welding procedure qualified in accordance with ASME Section IX. The procedure quantification to include hardness and impact test shall meet the requirement of clause 3.1.4 & 3.1.7.
- d. No repairs by welding shall be carried out on base metal of any component of insulating joint. Manufacturer shall obtain Purchaser approval prior to carrying out any repair of welds. The

repair welding shall be carried out by welders and welding procedures duly qualified per ASME Section IX and records for each repair shall be maintained. Welding procedure and repair welding procedure qualification shall include requirements for impact testing.

- e. Cold die stamping on insulating joints or pups is not permitted on the body. Cold die stamping can be done on the pipe bevel.
- f. The repair of the forging by welding is not permitted. All production welding, including tacking shall be done as per the qualified procedure by the qualified welder/ operators. The acceptable weld processes are:

S M A W (SMAW)

S m A W (SAW)

G M A W (GMAW)

- g. The Manufacturer shall ensure that all the mechanical works are completed prior to the post weld heat treatment and hydrostatic test. Any re-work (welding, cutting and grinding) on the surface of the material after the PWHT or hydrostatic testing is not permitted.
- h. The need for Post Weld Heat Treatment (PWHT) shall be assessed by the Manufacturer in accordance with the relevant weld procedure.

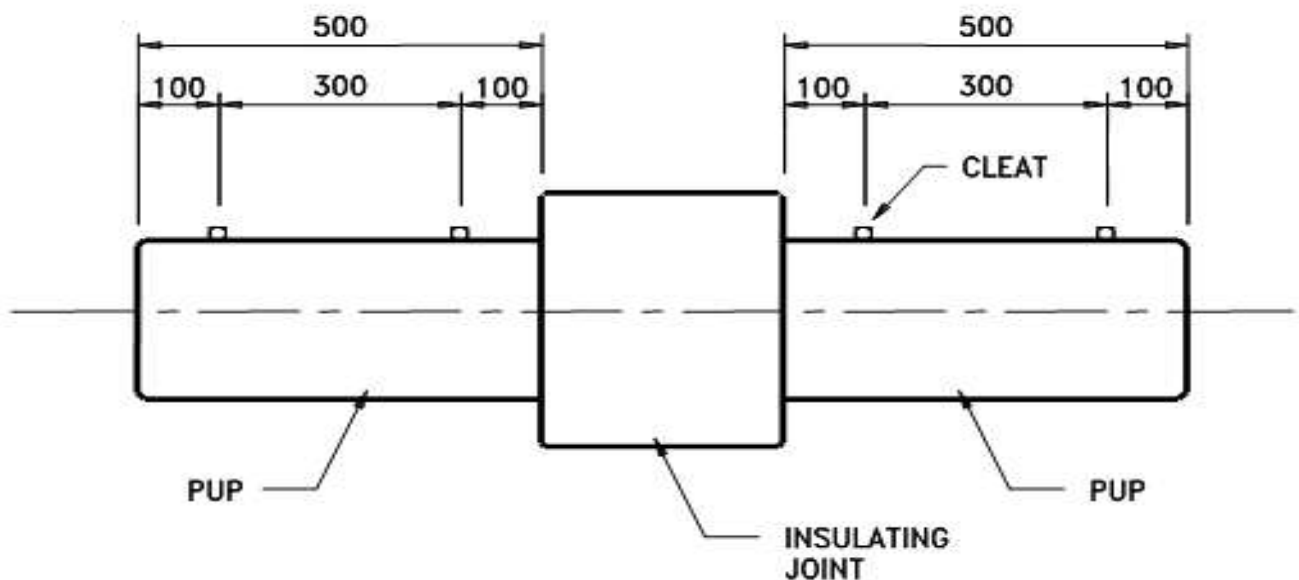


FIG. 4.1

5.0 INSPECTION AND TESTS

The Manufacturer shall ensure all equipment used for testing and inspection purposes is calibrated and certified accordingly. The Manufacturer shall record all inspection and testing activity on the

appropriate inspection certificate. The following inspection and testing shall be carried out prior to painting, marking and shipment of insulating joints.

5.1 TESTING OF MATERIALS

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

5.2 VISUAL INSPECTION AND DIMENSIONAL CHECK

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

5.3 NON-DESTRUCTIVE EXAMINATION

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

- a. Full length of all pressure containing butt welds, including welds that have been repaired, shall be examined by radiography. Acceptance limits shall be as per ASME Section IX.
- b. Any other weld that, in Purchaser's opinion, cannot be radiographed shall be inspected by ultrasonic or magnetic particle methods. Acceptance criteria shall be as per ASME Section VIII Appendix 12 and Appendix 6 respectively. Root pass of joint closure weld shall be examined by magnetic particle inspection method.
- c. 100 percent surface of all forging shall be wet magnetic particle inspected. Method of inspection and acceptance shall comply MSS-SP-53.
- d. Wet Magnetic Particle Inspection of all finished bevel surfaces shall be carried out. Any lamination extending into bevel face and having transverse dimension greater than 6.4 mm shall not be acceptable.
- e. All fillet welds shall be non-destructively examined as follows:

Fillet thickness < 6 mm : 100% by magnetic particle inspection, acceptance criteria as per ASME Sec VIII Appendix 6.

Fillet Thickness ≥ 6 mm : 100% by Ultrasonic Testing, acceptance criteria as per ASME Sec VIII Appendix 12 respectively.

- f. All NDT results shall be documented and be available for Purchaser's review.

5.4 HYDROSTATIC TEST

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

5.5 DIELECTRIC TEST

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

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

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

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

6.0 PAINTING

SURFACE PREPARATION

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

PAINTING

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

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

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

7.0 MARKING

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

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

8.0 TEST CERTIFICATES

Manufacturer shall submit following certificates to Company's inspector:

- Test certificates relevant to the chemical analysis and mechanical properties of the materials

used for construction of insulating joint as per this specification and relevant standards.

- Test reports on non-destructive testing.
- Test certificates for hydrostatic and air tests.
- Test certificate for electrical tests.

9.0 PACKING & SHIPPING

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

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

10.0 DOCUMENTATION

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



VCS QUALITY SERVICES PRIVATE LIMITED

STANDARD SPECIFICATION FOR CO₂ TYPE EXTINGUISHER

VCS-SS-ME-3003

01	01.11.2019	SS	RNR	RNR	SK
00	20.03.2019	SS	RNR	RNR	SK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By



ABBREVIATIONS:

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



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1.0 SCOPE

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

2.0 REFERENCES

IS: 2878 & IS: 307

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

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

3.2 Nominal size.

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

3.3 Contents

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

4.0 APPROVALS

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

5.0 MARKING

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

6.0 ACCESSORIES

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

7.0 INSPECTION

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



VCS QUALITY SERVICES PVT. LTD.

INSPECTION AND TEST PLAN FOR HFW LINE PIPES

VCS ITP PP 2016

04	19/12/2021	SR	MC	HK	GW
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY	:	If printed
CONTROLLED COPY	:	If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
0	11.10.2018					Issued as Standard
		BS	MC	AD	SK	
1	26.09.2019					Re-Issued as Standard
		SS	MC	AD	SK	
2	19.11.2019					Re-Issued as Standard
		SS	MC	AD	SK	
3	15.05.2020					Document formatting, Doc numbering updated from VPC-PL-ITP-026 to VCS-ITP-PP-2016 other detail update as marked
		SS	MC	AD	SK	
4	19.12.2021					Revised as Marked
		SR	MC	HK	GW	

ABBREVIATIONS:			
CE	Carbon Equivalent	PO	Purchase Order
HT	Heat Treatment	PQR	Procedure Qualification Record
IC	Inspection Certificate	RT	Radiography Testing
ITP	Inspection and Test Plan	TC	Test Certificate
MPS	Manufacturing Process Specification	TPI or TPIA	Third Party Inspection Agency
MPT/MT	Magnetic Particle Testing	UT	Ultrasonic Testing
MR	Material Requisition	VDR	Vendor Data Requirement
MTC	Material Test Certificate	WPQ	Welders Performance Qualification
NDT	Non-Destructive Testing	WPS	Welding Procedure Specification
PMI	Positive Material Identification		
LEGENDS:			
H - Hold (Do not proceed without approval)			
W - Witness (Give due notice, work may proceed after scheduled date)			
P - Perform			
R - Review			
RW - Random Witness (As specified or 10% [min.1 no. of each size and type of Bulk item])			



**INSPECTION AND TEST PLAN
FOR HFW LINE PIPES**

**DOC NO: VCS-ITP-PP-2016
Rev No : 04**

1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of Electric Welded Pipes.

2.0 REFERENCE DOCUMENTS:

PO/PR/ Standards referred there in/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

SL. NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
1.0	Procedure						
1.1	MPS	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	WPS, PQR & WPQ	Welding parameters & Qualification Record	100%	WPS, PQR & WPQ	-	H	W- New R- Existing (Qualified under Reputed TPIA)
2.0	Raw Material Procurement						



**INSPECTION AND TEST PLAN
FOR HFW LINE PIPES**

**DOC NO: VCS-ITP-PP-2016
Rev No : 04**

SL. NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
2.1	Inspection of Coils at Mills (Sub vendor works)	Chemical & Mechanical Properties, Method of manufacturing, Heat Treatment Condition etc.	100%	Mill Test Certificates (EN 10204-3.2)	H	H (Note-3)	R (Note-3)
3.0	In Process Inspection						
3.1	First Day Production test	All testing requirement as per PR/ MPS	As per PR/ MPS	Test Report	-	H	H
3.2	Raw material Inspection	Heat No, Coil /Plate, Visual & Dimension	100%	Inspection Reports	-	H	RW (Min.1%)
		1) Mechanical 2) Chemical 3) Impact	One/Heat	Inspection Report	-	W	W
3.3	Coil /Skelp UT as applicable	1) 25mm (Min) from edges 2) 20 % Min Coverage in Bal. part of Coil/ Plate	100%	Inspection Reports	-	H	RW (Min.1%)

SL. NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
3.4	Pipe Forming & Welding	Offset & Welding Parameters	100%	Inspection Reports	-	H	-
3.5	Heat Treatment	Weld Seam Normalising, Stress Relieving, Normalising, Tempering, Solution Annealing, Stabilization Heat Treatment, Heat Treatment temperature etc. as applicable	100%	HT Graph / Record	-	H	R
4.0	Final Inspection						
4.1	Hydrostatic Testing	Leak & pressure Drop, Calibration of Gauges/ Recorder	100%	Inspection Report	-	H	RW (Min.5%)
4.2	Calibration of UT system	Run with calibration pipe	1) Beginning of each shift 2) After Breakdown /Maintenance	Inspection Report	-	W	W

SL. NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
4.3	Final weld UT & Pipe body UT (If applicable)	Calibration, Seam Tracking. & Examination of Defects	100%	Inspection Report	-	H	RW (Min.5%)
4.4	Manual UT of Pipe end	Welding defects, crack/ lamination of base metal	100%	Inspection Report	-	W	RW (Min.1%)
4.5	Inspection of Pipe ends MPT	1. Examination of Surface Defects after Bevelling 2. Demagnetization	100%	Inspection Report	-	H	RW (Min.1%)
4.6	Final visual and dimension	1. Visual Examination 2. Dimensional Check Surface Condition, Straightness, End Finish, Bevel Angle, Root Face, Outer Dia., Thickness, Length, End Finish, Marking etc.	100%	Inspection Report	-	H	RW (Min.5%)
4.7	Lot Testing	1. Chemical Analysis 2. Tensile Tests 3. Flattening 4. Reverse Bend Test	As per MPS/API 5L/Spec.	Inspection Report	-	H	W



**INSPECTION AND TEST PLAN
FOR HFW LINE PIPES**

**DOC NO: VCS-ITP-PP-2016
Rev No : 04**

SL. NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
		5. Macro & Hardness Tests 6. Impact Tests 7. Drop Weight Tear Test, etc. as applicable					
4.8	Non-conforming product/stage	Repair / Retest /Reject	100%	Inspection Report	-	H	RW
4.9	Marking/Stenciling	Pipe No, Acceptance No., Heat. No., Size, Weight, Grade, Thickness, Colour Code etc	100%	Inspection Report	-	H	RW (Min.5%)
5.0	PAINTING						
5.1	Rust Preventive Coating & Colour Coding	Visual & Colour Coding as applicable	100%	Inspection Report	-	H	-
6.0	Documentation & IC						

SL. NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
6.1	Documentation & Inspection Certificate (IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Manufacturer TC & IC (Note-4)	-	H	H
6.2	Final documents as per PR/MR	Verification & compilation of inspection & test records for submission to customer	100%	Final dossier	-	H	H

NOTES (As applicable):

1. ITP shall be submitted including but not limited to the item/activity covered above. Any item/activity identified and required for the completeness shall also be covered in the ITP submitted by the manufacturers.
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.
3. Raw Material (Coils) shall be inspected at Mills (Sub vendors works) by TPIA appointed by Vendor.
4. Items shall be EN 10204 Type 3.2 certified based on this ITP/MR/PR for the Pipe (Final Product).



**INSPECTION AND TEST PLAN
FOR
FORGED, SEAMLESS & WELDED FITTINGS (16" NB & BELOW)**

DOC NO: VCS-ITP-PP-2005
Rev No : 01

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
3.5	Product Analysis	Chemical Composition	PR/ Purchase Specification	Test Reports	-	H	R
3.6	Destructive Testing	Mechanical, Impact, Hardness and Other test as applicable	One/Heat/Lot	Test Reports	-	H	H
3.7	MPT/LPT	Surface & Internal Imperfections	PR/ Purchase Specification	NDT Reports	-	H	R
4.0	Final Inspection						
4.1	Visual and Dimensional Inspection (VDI)	Surface finish, Dimensions, Marking etc	100%	Inspection report	-	H	RW
4.2	PMI Check	Chemical Check	As Per Spec./Code	Inspection report	-	H	RW



**INSPECTION AND TEST PLAN
FOR
FORGED, SEAMLESS & WELDED FITTINGS (16" NB & BELOW)**

DOC NO: VCS-ITP-PP-2005
Rev No : 01

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
4.3	Final Stamping	Stamping of accepted Items	100%	Inspection report	-	H	H
5.0	Painting						
5.1	Rust Preventive Coating & Colour Coding	Visual Inspection & Colour Coding	100%	Inspection report	-	H	-
6.0	Documentation & IC						
6.1	Documentation & Inspection Certificate (IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Vendor TC & IC	-	H	H
7.0	Final Documentation and Submission of Reports	Compilation of IR/IRC/DCN/MTC/DRGS. /VDR	100%	Compliance Certificate (Note-1)	-	H	-



**INSPECTION AND TEST PLAN
FOR
FORGED, SEAMLESS & WELDED FITTINGS (16" NB & BELOW)**

**DOC NO: VCS-ITP-PP-2005
Rev No : 01**

NOTES (As applicable):

1. If the certification is specified as EN 10204 Type 3.1 in Datasheet / Material Requisition, then '**W**' may be replaced with '**R**' with Material Traceability.
2. ITP shall be submitted including but not limited to the item/activity covered above. Any item/activity identified and required for the completeness shall also be covered in the ITP submitted by the manufacturers.

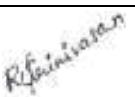
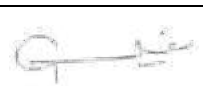


VCS QUALITY SERVICES PVT. LTD.

INSPECTION AND TEST PLAN FOR BALL VALVE VCS ITP PP 2007

04	27/05/2022	SR	MC	HK	GW
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY	:	If printed
CONTROLLED COPY	:	If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	16/06/2017					
		GS	ADE	AD	SK	
01	20/01/2020					Formatting update, Doc Numbering change from VCS-SD-ITP-007 to VCS-ITP-PP-2007
		AG	MC	AD	SK	
02	19/05/2020					Revised as Marked
		AG	MC	AD	SK	
03	19/12/2021					Revised as Marked
		SR	MC	HK	HK	
04	27/05/2022					Revised as Marked
		SR	MC	HK	HK	

ABBREVIATIONS:

CE	Carbon Equivalent	NDT	Non-Destructive Testing
DCN	Dispatch Clearance Note	PO	Purchase Order
DFT	Dry Film Thickness	PQR	Procedure Qualification Record
DPT	Dye Penetrant Testing	PR	Purchase Requisition
HT	Heat Treatment	RT	Radiography Testing
ITP	Inspection and Test Plan	TC	Test Certificate
IC	Inspection Certificate	TPI or TPIA	Third Party Inspection Agency
IGC	Inter Granular Corrosion	UT	Ultrasonic Testing
IR	Inspection Report	VDR	Vendor Data Requirement
IRC	Inspection Release Certificate	WPQ	Welders Performance Qualification
MPT / MT	Magnetic Particle Testing	WPS	Welding Procedure Specification
MTC	Material Test Certificate		

LEGENDS:

H - Hold (Do not proceed without approval)

W - Witness (Give due notice, work may proceed after scheduled date)

P - Perform

R - Review

RW - Random Witness [As specified or 10% (min.1 no. of each size and type of Bulk items)]

1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of Ball Valves.

2.0 REFERENCE DOCUMENTS:

PO / PR / Standards referred there in / Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

SL. NO.	COMPONENT & OPERATION	CHARACTERISTICS / METHOD OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT & ACCEPTANCE CRITERIA	FORMAT OF RECORD	SCOPE OF INSPECTION		
						SUB VENDOR	VENDOR	TPIA
1.0	PROCEDURES							
1.1	Hydrostatic Test, NDT and Other Procedures	Documented Procedures	100%		Procedure Documents	-	H	R
1.2	WPS,PQR & WPQ	Welding Parameters & Qualification Record	100%		WPS ,PQR & WPQ	-	H	W- New R- Existing
1.3	Pre-Qualification Tests	Fire safe, Cryogenic & Other Test as applicable	As per PR/Purchase Specification		Acceptance Report	-	H	H (If new)
2.0	RAW MATERIAL							
2.1	Forging / Casting:							
	1) Body	Visual & Dimension	100%	Material & Technical Specification	Inspection Report	H	H	-
	2) End Piece							
	3) Ball	Chemical: Chemical Analysis IGC (For SS component)	All Heats	Material & Technical Specification	Vendor Test Certificate	H	R	R
	4) Seat Ring							
	5) Pup Piece (as applicable)	Mechanical: Mechanical Test	All Heats	Material & Technical Specification	Vendor Test Certificate	H	R	W (Note-1)

**INSPECTION AND TEST PLAN
FOR
BALL VALVE**

**DOC NO: VCS-ITP-PP-2007
Rev No : 04**

SL. NO.	COMPONENT & OPERATION	CHARACTERISTICS / METHOD OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT & ACCEPTANCE CRITERIA	FORMAT OF RECORD	SCOPE OF INSPECTION		
						SUB VENDOR	VENDOR	TPIA
		Impact Test (@ - 29°C): for CS Impact Test (@ - 45°C): for LTCS	All Heats	Material & Technical Specification / ASME B 16.34	Test Report	H	R	W (Note-1)
		Non-Destructive Examination (NDT): Radiography (100% Critical Area)	100%	Material & Technical Specification / ASME B 16.34	RT Report	H	R (RT-Film review)	R (RT-Film review)
		Non-Destructive Examination (NDT): Magnetic Particle Examination (100% exterior & accessible interior)	100%	Material & Technical Specification / ASME B 16.34	MPI Report	H	R	R
		ENP (For Ball): Visual, Thickness & Hardness	100%	25 microns (min) & 50 HRC (min)	Vendor Test Certificate	H	R	R
3.0	INCOMING / BOF ITEMS							
3.1	Stem	Chemical: Chemical Analysis	All Heats	Material & Technical Specification	Vendor Test Certificate	H	R	R
		Mechanical: Mechanical Test	All Heats	Material & Technical Specification	Vendor Test Certificate	H	R	R
3.2	Fasteners	Chemical: Chemical Analysis	All Heats	Material & Technical Specification	Vendor Test Certificate	H	R	R
		Mechanical: Mechanical Test	All Heats	Material & Technical Specification	Vendor Test Certificate	H	R	R
		Impact Test (@ - 29°C): for CS Impact Test (@ - 45°C): for LTCS	All Heats	Material & Technical Specification / ASME B 16.34	Test Report	H	R	R
3.3	Gaskets, Gear units, Gland, Packings, etc.	Physical / Chemical Properties	100%	Material & Technical Specification	Test Certificates & Lab Report	H	R	R

**INSPECTION AND TEST PLAN
FOR
BALL VALVE**

**DOC NO: VCS-ITP-PP-2007
Rev No : 04**

SL. NO.	COMPONENT & OPERATION	CHARACTERISTICS / METHOD OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT & ACCEPTANCE CRITERIA	FORMAT OF RECORD	SCOPE OF INSPECTION		
						SUB VENDOR	VENDOR	TPIA
4.0	MACHINED COMPONENTS							
4.1	Body, Connector, Ball & Seat Ring	Surface examination & Dimension Inspection: Visual & Measurement	100%	Manufacturer’s Drawing	Inspection Reports	100%	R	R
5.0	IN-PROCESS							
5.1	Body & Connector joint welding	Non-Destructive Examination (NDT): Magnetic Particle Examination (MPI)	100%	ASME Sec VIII - Appendix V & VI	MPI Report	100%	R	R
5.2	Valve & Pup Piece Bevel Ends joint welding	Non-Destructive Examination (NDT): Radiography (100% on weld joint)	100%	ASME B16.34	RT Report	100%	R (RT-Film review)	R (RT-Film review)
6.0	FINAL INSPECTION							
6.1	Finished Valve Assembly: Pressure Test & Final Inspection	Shell Test: Hydrostatic	100%	Testing Procedure as per Code	Test Record	-	H	RW
6.2		Seat Test: Hydrostatic				-	H	RW
6.3		Seat Test: Pneumatic				-	H	RW
6.4		Functional Test - Actuated Valve @ Atm. Pressure & Max. Diff. Pressure: Operation- Open / Close				-	H	RW
6.5		Double Block & Bleed: Hydrostatic				-	H	RW
6.6		Final Inspection: Visual, Dimension, TC Verification, Special Requirements & Marking as per sale order	100%	Approved GA Drawing (if applicable)	Test Report	-	H	RW
6.7		Anti-Static Test	100%	API 6D & Technical Specification	Test Record	-	H	RW

SL. NO.	COMPONENT & OPERATION	CHARACTERISTICS / METHOD OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT & ACCEPTANCE CRITERIA	FORMAT OF RECORD	SCOPE OF INSPECTION		
						SUB VENDOR	VENDOR	TPIA
6.8		Fire Safe Test	100%	API-6FA / ISO-10497	Fire safe type test report	-	H	R
6.9	Final Stamping	Stamping Of Accepted Valves	Stamping of Valves which are witnessed by VCS/TPIA	As per Tender Specification	Inspection Report	-	H	H
6.10	Strip Test	Component integrity, PMI of BOM	One per size per rating	-	Test report	H	H	H
7.0	PAINTING & PACKING	Surface examination & DFT Inspection: Visual & Measurement	100%	As per Tender Specification	Painting Record	-	H	R
8.0	DOCUMENTATION & INSPECTION CERTIFICATE(IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	As per Tender Specification	Vendor TC & IC	-	H	H
9.0	FINAL DOCUMENTATION & SUBMISSION OF REPORTS	Compilation of IR/IRC/DCN/MTC/DRGS./VDR	100%	EN 10204 type 3.2/3.1 certification as specified in valve datasheet (Note-1)	Compliance Certificate	-	H	-

NOTES (As applicable):

1. If the certification is specified as EN 10204 Type 3.1 in Data sheet / Material Requisition, then 'W' may be replaced with 'R' with Material Traceability.
2. ITP shall be submitted including but not limited to the item/activity covered above. Any item/activity identified and required for the completeness shall also be covered in the ITP submitted by the manufacturers.



VCS QUALITY SERVICES PVT. LTD.

INSPECTION AND TEST PLAN FOR PLUG VALVES VCS ITP PP 2009

00	27/04/2022	<i>R. Jain</i>	<i>MC</i>	<i>HK</i>	<i>GW</i>
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

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CONTROLLED COPY	:	If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	27/04/2022	<i>R. J. J. J. J.</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	Issued as standard ITP
		SR	MC	HK	GW	

ABBREVIATIONS:			
CE	Carbon Equivalent	NDT	Non-Destructive Testing
DCN	Dispatch Clearance Note	PO	Purchase Order
DFT	Dry Film Thickness	PQR	Procedure Qualification Record
DPT	Dye Penetrant Testing	PR	Purchase Requisition
HT	Heat Treatment	RT	Radiography Testing
IC	Inspection Certificate	TC	Test Certificate
IR	Inspection Report	TPI or TPIA	Third Party Inspection Agency
IRC	Inspection Release Certificate	UT	Ultrasonic Testing
ITP	Inspection and Test Plan	VDR	Vendor Data Requirement
MPT/MT	Magnetic Particle Testing	WPQ	Welders Performance Qualification
MTC	Material Test Certificate	WPS	Welding Procedure Specification
LEGENDS:			
H - Hold (Do not proceed without approval)			
W - Witness (Give due notice, work may proceed after scheduled date)			
P - Perform			
R - Review			
RW - Random Witness [As specified or 10% (min.1 no. of each size and type of Bulk items)]			

1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of Valves.

2.0 REFERENCE DOCUMENTS:

PO / PR / Standards referred there in / Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
1.0	Procedure						
1.1	Hydrostatic Test, NDT and Other Procedures	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	WPS, PQR & WPQ	Welding Parameters & Qualification Record	100%	WPS, PQR & WPQ	-	H	W- New R- Existing

**INSPECTION AND TEST PLAN
FOR
PLUG VALVE**

**DOC NO: VCS-ITP-PP-2009
Rev No : 00**

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
2.0	Material Inspection						
2.1	Castings & Forgings (Body, Cover, Plug, Stem)	Chemical, Mechanical, Heat Treatment, NDT & Other Properties as applicable	100%	Test Certificates	H	R	W (Note-1)
2.2	Castings & Forgings (Body, Cover, Plug, Stem)	Visual & Dimension	100%	Inspection Report	H	H	-
2.3	Body, Cover and Plug Castings	Radiography Examination	As per PR / Purchase Specification	Films and report	H	R (RT-Film review)	R (RT-Film review) (Note-1)
2.4	Bars for Trim material	Chemical Analysis	Each Heat	Test Certificates& Lab Report	H	R	R
2.5	Gaskets, Gear units, Fasteners, Gland, Packings, etc.	Physical / Chemical Properties	100%	Test Certificates& Lab Report	H	R	R



**INSPECTION AND TEST PLAN
FOR
PLUG VALVE**

**DOC NO: VCS-ITP-PP-2009
Rev No : 00**

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
2.6	Actuators as applicable	Performance, Statutory Certificates as applicable	100%	Test Certificates& Lab Report	H	H	R
3.0	In Process Inspection						
3.1	Welding	Welding Parameters as per WPS / PQR	100%	Inspection Reports	-	H	R
3.2	Machining of components	Visual / Dimension	100%	Inspection Reports	-	H	-
4.0	Final Inspection						
4.1	Hydrostatic / Pneumatic Test	Hydrostatic Test Shell Pneumatic Test Seat	As per PR / Purchase Specification	Test Report	-	H	RW
4.2	Visual / Dimension	Surface & Dimension Check	100%	Test Report	-	H	RW
4.3	Final Stamping	Stamping Of Accepted Valves	Stamping of Valves which are witnessed by TPIA.	Inspection Report	-	H	H

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
4.4	Strip Test	Component integrity, PMI of BOM	One per size per rating	Test report	H	H	H
5.0	Painting						
5.1	Painting and Colour coding as applicable	Visual / DFT Check	100%	Inspection Report	-	H	R
6.0	Documentation & IC						
6.1	Documentation & Inspection Certificate (IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Vendor TC & IC	-	H	H
7.0	Final Documentation & Submission of Reports	Compilation of IR/IRC/DCN/MTC/DRGS. /VDR	100%	Compliance Certificate (Note-1)	-	H	-

NOTES (As applicable):

1. If the certification is specified as EN 10204 Type 3.1 i Data sheet / Material Requisition , the **W** may be replaced with **R** with Material Traceability.
2. ITP shall be submitted including but not limited to the item/activity covered above. Any item/activity identified and required for the completeness shall also be covered in the ITP submitted by the manufacturers.



VCS QUALITY SERVICES PVT. LTD.

INSPECTION AND TEST PLAN FOR INSULATING JOINTS VCS ITP PP 2006

02	19/12/2021	<i>R. Raminasan</i> SR	<i>[Signature]</i> MC	<i>[Signature]</i> HK	<i>[Signature]</i> GW
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY	:	If printed
CONTROLLED COPY	:	If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	06/06/2017					Issued as Standard
		GS	ADE	AD	SK	
01	22/04/2020					Document formatting, numbering updated from VCS-SD-ITP-006 to VCS-ITP-PP-2006 .
		MB	MC	AD	SK	
02	19/12/2021	<i>Reformat</i>				Revised as Marked
		SR	MC	HK	GW	

**INSPECTION AND TEST PLAN
FOR
INSULATING JOINTS**

DOC NO: VCS-ITP-PP-2006
Rev No : 02

ABBREVIATIONS:			
CE	Carbon Equivalent	PO	Purchase Order
DFT	Dry Film Thickness	PQR	Procedure Qualification Record
DPT	Dye Penetrant Testing	PR	Purchase Requisition
HT	Heat Treatment	RT	Radiography Testing
IC	Inspection Certificate	TC	Test Certificate
ITP	Inspection and Test Plan	TPI or TPIA	Third Party Inspection Agency
MPT/MT	Magnetic Particle Testing	UT	Ultrasonic Testing
MTC	Material Test Certificate	VDR	Vendor Data Requirement
NDT	Non-Destructive Testing	WPQ	Welders Performance Qualification
PMI	Positive Material Identification	WPS	Welding Procedure Specification
LEGENDS:			
H - Hold (Do not proceed without approval)			
W - Witness (Give due notice, work may proceed after scheduled date)			
P - Perform			
R - Review			
RW - Random Witness [As specified or 10% (min.1 no. of each size and type of Bulk items)]			

1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of Insulating Joints.

2.0 REFERENCE DOCUMENTS:

PO / PR / Standards referred there in / Job specifications / Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
1.0	Procedure						
1.1	Hydrostatic Test, NDT and other procedures	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	WPS/ PQR /WPQ	Documented procedures	100%	Procedure Documents	-	H	R-Existing W-New
2.0	Material Inspection						



**INSPECTION AND TEST PLAN
FOR
INSULATING JOINTS**

**DOC NO: VCS-ITP-PP-2006
Rev No : 02**

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
2.1	1) Forging 2) Pup Piece	Chemical / Mechanical Properties, NDT, HT and other requirement as per purchase specification.	100%	MTC & Inspection Record	H	W	W
2.2	Gasket, Insulating Ring, Filling Material, etc.	As per material spec./code	100%	MTC & Inspection Record	H	H	R
3.0	In Process Inspection						
3.1	Welding	Welding Parameters, NDT (as applicable)	100%	NDT Records/RT films	-	W	R
4.0	Final Inspection						
4.1	Hydro Testing, Air Leak test, Vacuum test (As applicable)	Leak Check	100%	Test Report	-	H	H



**INSPECTION AND TEST PLAN
FOR
INSULATING JOINTS**

**DOC NO: VCS-ITP-PP-2006
Rev No : 02**

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
4.2	Visual and Dimension Check	Visual and Dimension Check	100%	Inspection Report	-	H	RW
4.3	Dielectric Test	Insulating Resistance	100%	Inspection Report	-	W	W
5.0	Painting						
5.1	Final painting (as applicable)	Paint Scheme, Visual & Paint thickness check	100%	Inspection Report	-	H	R
6.0	Documentation & IC						
6.1	Stamping and review of inspection documents, issue of IC	Review of documents for compliance as per PR.	100%	IC	-	-	H

**INSPECTION AND TEST PLAN
FOR
INSULATING JOINTS**

DOC NO: VCS-ITP-PP-2006
Rev No : 02

SL.NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB VENDOR	VENDOR	TPIA
7.0	Review of final documentation	Compilation of documents as per VDR attached with PR records for submission to customer	100%	Dossier/Completion Certificate (EN 10204 Type 3.2)	-	H	H

NOTES (As applicable):

1. Items shall be EN 10204 Type 3.2 Certified.
2. ITP shall be submitted including but not limited to the item/activity covered above. Any item/activity identified and required for the completeness shall also be covered in the ITP submitted by the manufacturers.



M/s. VCS QUALITY SERVICES
PVT. LTD.

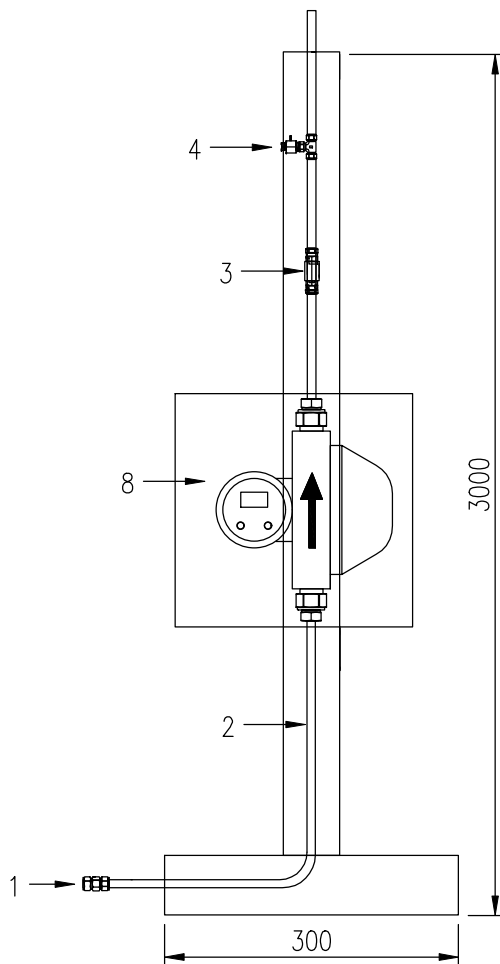
LCV LOADING POST WITH FLOW METER

DRAWING NO.

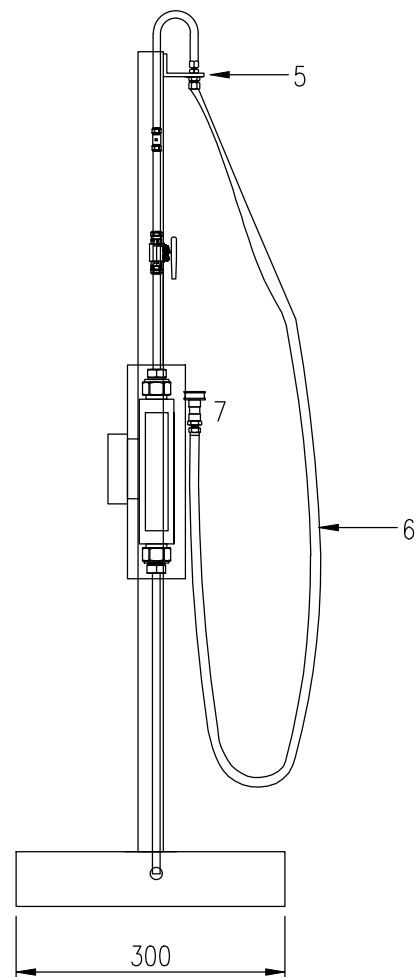
SD-ME-001

SHEET NO.

1 OF 1



FRONT VIEW



SIDE VIEW

S.NO.	PART NAME	MATERIAL	MAKE/MODEL
1	UNION 3/4" OD	SS 316	SWAGelok/PARKER/ DK LOK
2	TUBE 3/4" OD	A 269/213 TP316	SANDVIK/TUBACEX
3	TWO WAY BALL VALVE 3/4" OD	SS 316	SWAGelok/PARKER/ DK LOK
4	BLEED VALVE 1/4" NPTM	SS 316	SWAGelok/PARKER/ DK LOK
5	BULKHEAD UNION 3/4" OD	SS 316	SWAGelok/PARKER/ DK LOK
6	FILL HOSE 1/2" ID, LENGTH-4Mtr. (SS BRAIDED STAINLESS STEEL)	5000 PSIG	SWAGelok/TUBACEX/ETON
7	QRC 1/2" NPTF	SS 316	SWAGelok/PARKER/ DK LOK
8	FLOW METER WITH INTEGRATED DISPLAY (COROLIS TYPE) 0-100 Kg/min.	-	MICRO MOTION / E&H

NOTES :

1. ALL DIMENSIONS IN MM.
2. THIS DWG. IS INDICATIVE ONLY, VENDOR TO FURNISH FINAL DWG. BASED ON ARRANGEMENT FOR CNG FILLING FOR APPROVAL POST ORDER.
3. HOSE SHOULD CONFIRM TO NFPA52/CSA NGV 4.2-2014/CSA12.52-2014.

0	24.09.19	ISSUED FOR REVIEW	DK		RR		AD	
REV. NO.	DATE	SUBJECT OF REVISION	PREP		CHKD		APPD	



M/s. VCS QUALITY SERVICES
PVT. LTD.

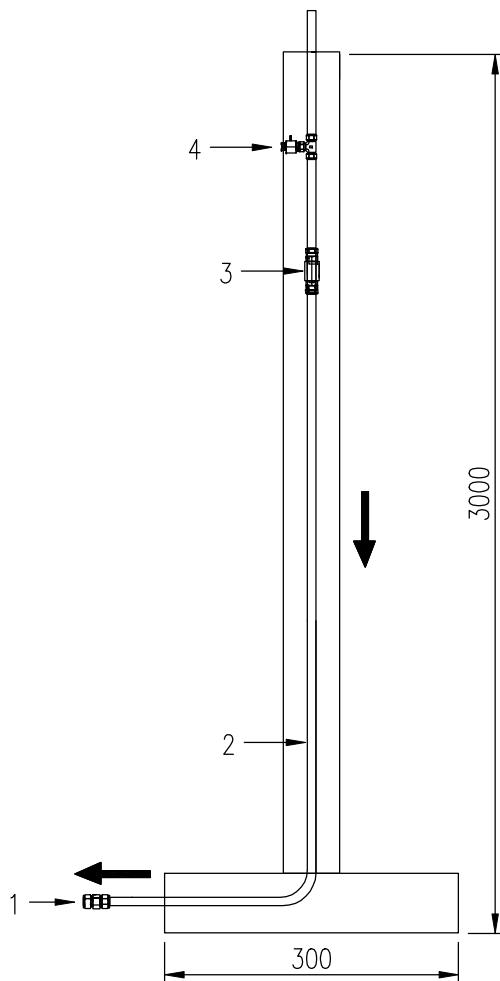
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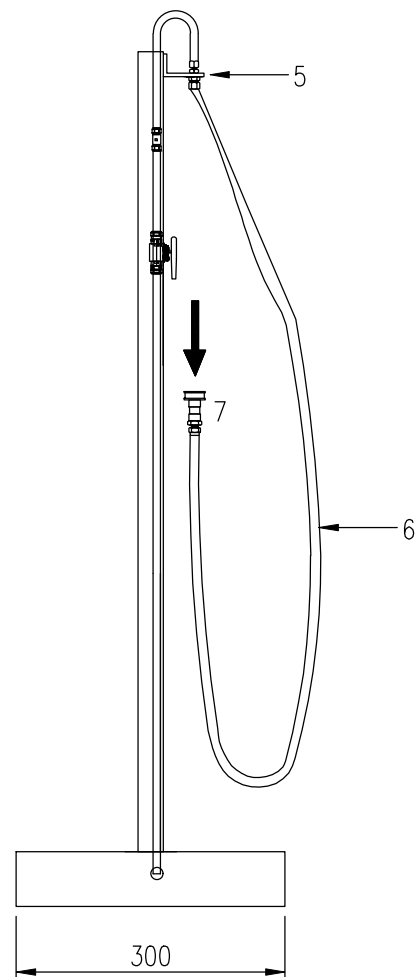
SD-ME-002

SHEET NO.

1 OF 1



FRONT VIEW



SIDE VIEW

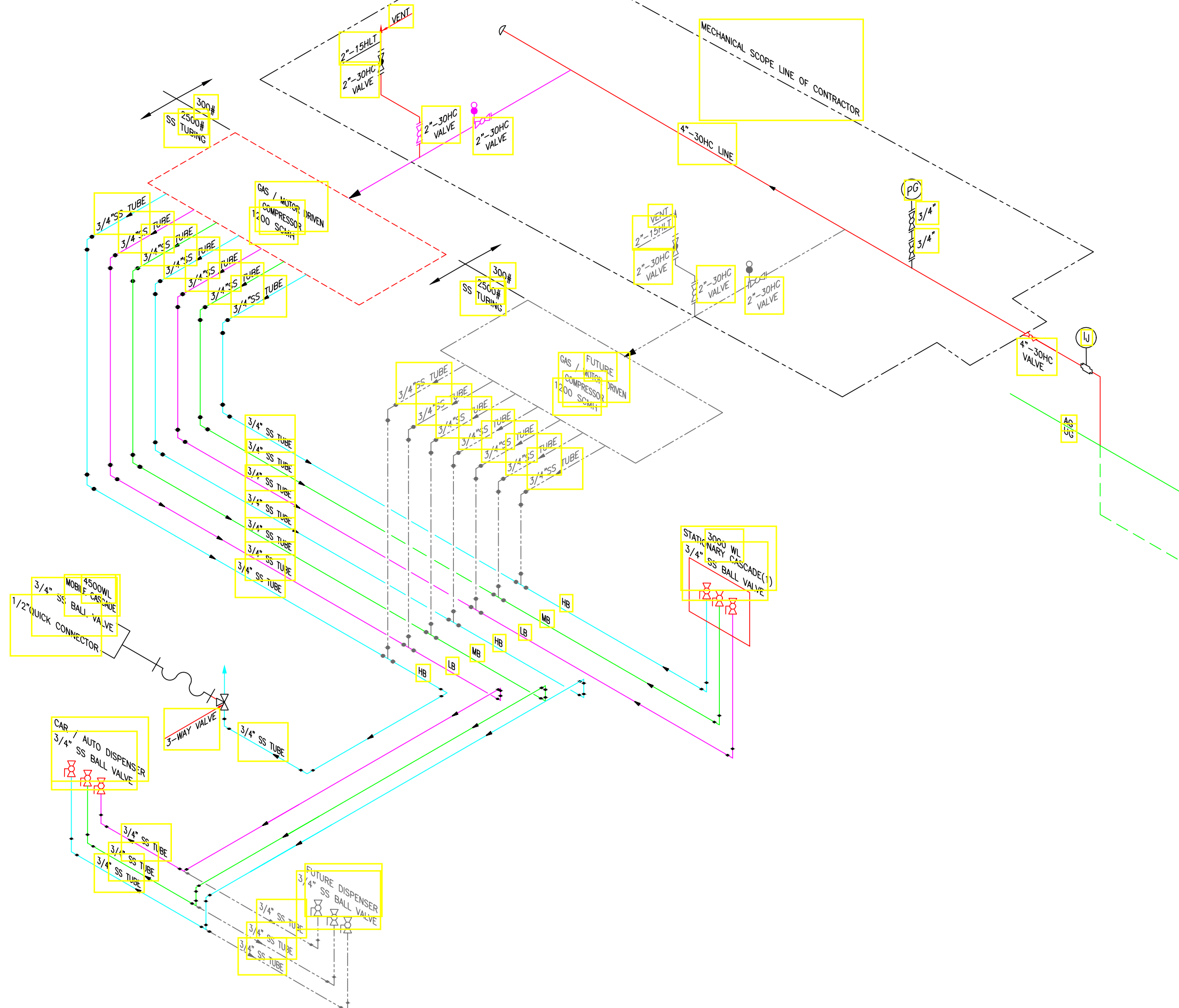
S.NO.	PART NAME	MATERIAL	MAKE/MODEL
1	UNION 3/4" OD	SS 316	SWAGelok/PARKER/ DK LOK
2	TUBE 3/4" OD	A 269/213 TP316	SANDVIK/TUBACEX
3	TWO WAY BALL VALVE 3/4" OD	SS 316	SWAGelok/PARKER/ DK LOK
4	BLEED VALVE 1/4" NPTM	SS 316	SWAGelok/PARKER/ DK LOK
5	BULKHEAD UNION 3/4" OD	SS 316	SWAGelok/PARKER/ DK LOK
6	FILL HOSE 1/2" ID, LENGTH-4Mtr. (SS BRAIDED STAINLESS STEEL)	5000 PSIG	SWAGelok/TUBACEX/ETON
7	QRC 1/2" NPTF	SS 316	SWAGelok/PARKER/ DK LOK

NOTES :

1. ALL DIMENSIONS IN MM.
2. THIS DWG. IS INDICATIVE ONLY, VENDOR TO FURNISH FINAL DWG. BASED ON ARRANGEMENT FOR CNG FILLING FOR APPROVAL POST ORDER.
3. HOSE SHOULD CONFIRM TO NFPA52/CSA NGV 4.2-2014/CSA12.52-2014.
4. BUSTING PRESSURE OF HOSE SHALL BE 20000 PSI.

0	24.09.19	ISSUED FOR REVIEW	DK		RR		AD	
REV. NO.	DATE	SUBJECT OF REVISION	PREP		CHKD		APPD	

CGS MOTHER STATION AT KOWARPARA



CGS MOTHER STATION ONE COMPRESSOR, ONE FUTURE COMPRESSOR, ONE STATIONARY CASCADE, ONE CAR / AUTO DISPENSER, ONE FUTURE DISPENSER, AND ONE MOBILE CASCADE

REFERENCE DRAWINGS											
DRAWING TITLE			DRAWING NUMBER								
C1	09.06.26	ISSUED FOR CONSTRUCTION	HS	AS	BND						
REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.						
CLIENT:											
		NORTH EAST GAS DISTRIBUTION COMPANY LIMITED									
PMC:											
		VCS QUALITY SERVICES PVT. LTD.									
PROJECT:											
CITY GAS DISTRIBUTION PROJECT AT DARRANG GEOGRAPHICAL AREAS											
SCALE	TITLE:										
N.T.S	P&ID FOR SS TUBING CGS MOTHER STATION AT KOWARPARA										
SIZE	JOB NO.	DRAWING NUMBER		SHEET	REV.						
A1	C241131	C241131-KOW-PC-PID-1001		1 OF 1	C1						

VENDER & TPIA LIST



LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS

**TOTAL
SHEETS**

61

DOCUMENT NO

VCS-00-00-VL-0001

LIST OF RECOMMENDED VENDORS FOR BOUGHT OUT ITEMS

17

01.04.2026

Issued as Standard

Durgesh
Baghel

Rajesh
Sharma

Ashwani
Chandra

REV

DATE

DESCRIPTION

PREP

CHK

APPR

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A. MECHANICAL & PIPELINE

1.0 CARBON STEEL PIPES

1.1 PIPE CARBON STEEL TO INDIAN STANDARDS

- a. A.S.T. Pipes Pvt. Ltd. (AST Group)
- b. Advance Steel Tube Ltd.
- c. Apl Apollo Tubes Ltd. (Er. Bihar Tubes Ltd.)
- d. Asian Mills Pvt. Ltd.
- e. Asrani Tubes Limited
- f. Dadu Pipes (P) Ltd.
- g. Essar Steel Limited (Er Hazira Pipes Mill)
- h. Gaurang Products Pvt Ltd. (Ast Group)
- i. Goodluck Steel Tubes Ltd.
- j. Hi-Tech Pipes Limited
- k. Indus Tube Limited
- l. Jindal Industries Ltd
- m. Jindal Pipes Ltd.
- n. Jindal Saw Ltd (Kosi Works)
- o. Jotindra Steel & Tube Ltd
- p. Lalit Pipes And Pipes Ltd.
- q. Maharashtra Seamless Ltd.
- r. Man Industries (India) Ltd. Pithampur
- s. Man Industries (India) Ltd. Anjar
- t. Mukat Tanks & Vessels Ltd.
- u. Nezone Tubes Limited
- v. North Eastern Tubes Limited

- w. Pratibha Industries Limited
- x. Pratibha Pipes & Structural Ltd.
- y. Psl Ltd (Chennai)
- z. Psl Ltd (V1, V2 & NC)
- aa. Rama Steel Tubes Ltd.
- bb. Ratnamani Metals And Tubes Ltd.
- cc. Ravindra Tubes Limited
- dd. Samshi Pipe Industries Limited
- ee. Surya Roshni Ltd.
- ff. Swastik Pipes Ltd.
- gg. Utkarsh Tubes & Pipes Ltd. (Formly Bmw)
- hh. Welspun Corp. Limited (Dahej)
- ii. Zenith Birla (India) Limited

1.2 PIPE & TUBULARS TO A.P.I. STANDARDS

- a. Arcelormittal Tubular Products Roman Sa, Romania
- b. Bhel (Trichy), India
- c. Dalmine Spa (Enquiry To Tenaris), Uae
- d. Eewkorea Co. Ltd (Germany), Korea
- e. Eew Korea Co. Ltd. (Korea), Korea
- f. Eisenbau Kramer Gmbh, Germany
- g. Hyundai Rb Co. Ltd. South Korea
- h. Ilva Lamiere E Tubi Srl (Enq To Ilva Spa, Italy)
- i. Inox Tech. Spa, Italy
- j. ISMT Ltd. Ahmednagr, India
- k. TATA Steel, India
- l. PSL
- m. Jindal Pipes Ltd., India
- n. Jindal Saw Ltd. (Kosi Works), India
- o. Jindal Saw Ltd. (Nashik Works), India
- p. Lalit Pipes And Pipes Ltd. India
- q. Maharashtra Seamless Ltd., India
- r. Man Industries (I) Ltd. (Pithampur), India
- s. Mukat Tanks & Vessels Ltd., India
- t. Pratibha Industries Limited, India

- u. Ratnamani Metals And Tubes Ltd., India
- v. Siderca S.A.I.C (Enquiry Totenaris), Uae
- w. Sumitomo Metal Ind. Ltd., India
- x. Surya Roshni Ltd., India
- y. Swastik Pipes Ltd, India
- z. Tata Steel Uk Limited (Formerly C702)
- aa. Tubos De Acero De Mexico Sa (Enq. Tenaris), Uae
- bb. Tubos Reunidos Sa Spain
- cc. Umran Steel Pipe Inc (Turkey), Turkey
- dd. Valcovny Trub Chomutov, Czech Republic
- ee. Vallourec And Mannesmann Tubes, France
- ff. Welspun Corp Limited (Dahej), India

1.3 PIPE/TUBE CS (SEAMLESS) TO ASTM STANDARDS

- a. Arcelormittal Tubular Products Roman Sa, Romania
- b. Bhel (Trichy), India
- c. Changshu Seamless Steel Tube Co. Ltd., China
- d. Dalmine Spa (Enquiry To Tenaris, Uae
- e. Heavy Metals & Tubes Limited (Mehsana), India
- f. Ismt Ltd. Ahmednagr, India
- g. Ismt Ltd. Baramati India
- h. Jfe Steel Corporation, Uae
- i. Jindal Sdaw Ltd (Nashik Works) India
- j. Klt Automotive And Tubular Products Ltd., India
- k. Mahalaxmi Seamless Limited, India
- l. Maharashtra Seamless Ltd, India
- m. Products Tubulares S.A.U, Spain
- n. Ratnadeep Metal Tubes Ltd., India
- o. Staineest Tubes Pvt Ltd., India
- p. Sumitomo Metal Ind. Ltd., India
- q. Tubos Reunidos Sa Spain
- r. Valcovny Trub Chomutov, Czech Republic
- s. Vallourec Andmannesmann Tubes France
- t. Yangzhou Chengde Steel Pipe Co. Ltd Dubai (UAE)
- u. Jindal SAW Ltd Kosi Kalan Mathura

1.4 PIPE CARBON STEEL (WELDED) TO ASTM STANDARDS

- a. Eew Korea Co. Ltd. (Germany), Korea
- b. Eew Korea Co. Ltd. (Korea), Korea
- c. Eisenbau Kramer Gmbh, Germany
- d. Hyundai Rb Co. Ltd., South Korea
- e. Inox Tech. Spa, Italy
- f. Jindal Saw Ltd (Kosi Works), India
- g. Lalit Pipes and Pipes Ltd., India
- h. Man Industries (I) Ltd.(Pithampur), India
- i. Man Industries (India) Ltd. Anjar, India
- j. Mukat Tanks & Vessels Ltd., India
- k. Ratnamani Metals And Tubes Ltd., India
- l. Sumitomo Metal India Ltd., India
- m. Tata Steel Uk Limited

2.0 VALVES

2.1 GLOBE VALVES

- a. BDK (New Delhi)
- b. Datre Corpn (Calcutta)
- c. KSB Pumps (New Delhi)
- d. L&T (New Delhi)
- e. Neco Schuber & Salzer Ltd. (New Delhi)
- f. Niton Valve (Mumbai)
- g. Ornate Valves (Mumbai)
- h. Panchavati Valves (Mumbai)
- i. AV Valves Ltd.
- j. BHEL (Trichy), India
- k. Econo Valves Pvt Ltd, India
- l. Fouress Engg (I) Ltd (Aurangabad)
- m. Guru Industrial Valves Pvt Ltd
- n. Leader Valves Ltd, India
- o. NSSL Ltd. (Neco Schubert & Salzerltd)
- p. Oswal Industries Ltd, India
- q. Petrochemical Engineering Enterprises, India
- r. Sakhi Engineers Pvt Ltd

- s. Shalimar Valves Pvt Ltd
- t. Steel Strong Valves India Pvt Ltd, India
- u. Petro Valves Pvt. Limited, Ahmedabad
- v. Hawa Engineers Limited, Ahmedabad (Non API)
- w. G M Engineering PVT LTD (Non API)
- x. Libra Valves India Pvt. Ltd.

2.2 CHECK VALVES

- a. Advance Valves Pvt. Ltd., Noida
- b. Aksons & Mechanical Enterprises, Mumbai
- c. Larsen & Toubro Limited (Audco India Limited, Chennai)
- d. AV valves Ltd., Agra
- e. BDK engineering India Ltd., Hubli
- f. BHEL, OFE&OE Group, New Delhi
- g. Datre Coroportion Limited, Calcutta
- h. Leader Valves Ltd., Jalandhar
- i. Neco schubert & Salzer Ltd., New Delhi
- j. Niton Valves Industries (P) Ltd., Mumbai
- k. Precision Engg. Co., Mumbai
- l. Econo Valves Pvt Ltd, India
- m. Fouress Engg (I) Ltd (Aurangabad)
- n. KSB Pumps Ltd (Coimbatore), India
- o. NSSL Ltd. (Neco Schubert & Salzer Ltd)
- p. Oswal Industries Ltd, India
- q. Panchvati Valves & Flanges Pvt Ltd, India
- r. Petrochemical Engineering Enterprises, India
- s. Sakhi Engineers Pvt Ltd
- t. Shalimar Valves Pvt Ltd
- u. Steel Strong Valves India Pvt Ltd, India
- v. Shiv Shakti Engineering Works (Approved up to 06 inch)
- y. Hawa Engineers Limited, Ahmedabad
- z. G M Engineering PVT LTD (Non API)
- aa. Libra Valves India Pvt. Ltd.

2.3 PLUG VALVES

- a. Breda Energia Sesto Industria Spa, Italy
- b. Fisher Sanmar Ltd., Chennai
- c. Larsen & Toubro Ltd., New Delhi
- d. Nordstrom Valves, USA
- e. Serck Audco Valves, UK
- f. Sumitomo Corporation India Pvt. Ltd., New Delhi
- g. Z Corporation, Korea
- h. Hawa Valves (India) Pvt. Ltd., Mumbai
- i. Steel Strong Valves India Pvt. Ltd., Navi Mumbai
- j. Econo Valves
- k. Flow-Serve PTE (Mfr. SERCK), India
- l. Libra Valves India Pvt. Ltd.

2.4 BALL VALVES

- a. Hawa Valves (India) Pvt. Ltd, Navi Mumbai
- b. Larsen & Toubro, Delhi
- c. Microfinish Valves Pvt. Ltd., Noida
- d. Oswal Industries Ltd., Gandhi nagar
- e. Virgo Engineers Ltd., Delhi
- f. Boteli Valve Group Co. Ltd., China
- g. Cameron (Malaysia) SDN BHD, Malaysia
- h. Dafram S.P.A., Italy
- i. Fangyuan Valve Group Co. Ltd., China
- j. Franz Schuck GmbH, Germany
- k. O.M.S. Saleri (Italy)
- l. Pibi Viesse S.P.A (Italy)
- m. Nuovo Pignone (Italy)
- n. Perar S.P.A (Italy)
- o. Pietro Fiorentini (Italy)
- p. Cooper Cameron Valv Italy SRL-FRM, Italy
- q. Petrol Valves SRL
- r. Tormene Gas Technology S.P.A (VALVITALIA)
- s. Petro Valves Pvt. Limited, Ahmedabad
- t. Shiv Shakti Engineering Works (Approved up to 08 inch)

- u. Hawa Engineers Limited, Ahmedabad
- v. G M Engineering PVT LTD.
- w. DelVal Flow Controls Pvt. Ltd
- x. Libra Valves India Pvt. Ltd.

2.5 GATE VALVES

- a. Libra Valves India Pvt. Ltd.

3.0 TEE

3.1 FLOW TEE

- a. Coprosider SPA, Italy
- b. GEA Energy System India Limited, Chennai
- c. Multitex Filtration
- d. Pipeline Engineering, UK
- e. Scomark Engg. Limited (U.K.)
- f. Skeltonhall Limited, Engaland(U.K.)
- g. Technospecial SPA, Italy
- h. Tectubi SPA, Italy
- i. RMA Germany
- j. Pipefit Engineers Pvt. Ltd.
- k. Vee Kay Vikram & Co.
- l. United Forge Industries

3.2 SPLIT TEE

- a. IPSCO, Canda
- b. TD Willamsons, USA
- c. Plant-Tech Power Technical Services Pvt Ltd
- d. Teemans, UK
- e. Vee Kay Vikram & CO.

4.0 FLANGES

- a. Aditya Forge Ltd., Vadodara
- b. Amforge Industries Ltd., Mumbai
- c. CD Engineering Co., Ghaziabad
- d. Echjay Forgings Pvt. Ltd. (Bombay), Mumbai
- e. Echjay Industries Ltd., Rajkot
- f. Forge & Forge Pvt. Ltd., Rajkot

- g. Golden Iron & Steel Works, New Delhi
- h. JK Forgings, New Delhi
- i. Metal Forgings Pvt. Ltd., Mumbai
- j. Perfect Marketings Pvt. Ltd., New Delhi
- k. Sky Forge, Faridabad
- l. S&G, Faridabad
- m. Chaudhry Hammer Works Ltd, India
- n. JAV Forgings (P) Ltd, India
- o. Kunj Forgings Pvt Ltd, India
- p. MS Fittings
- q. R.N. Gupta & Co. Ltd, India
- r. R.P. Engineering Pvt Ltd, India
- s. Sanghvi Forgings & Engineering Ltd
- t. Shri Ganesh Forgings Ltd., India
- u. Uma Shankar Khandelwal & Co., India
- v. Sawan Engineers, Baroda
- w. Stewarts & Lloyds of India Ltd., Kolkata
- x. Engineering Services Enterprises
- y. Pipefit Engineers Pvt. Ltd.
- z. Jindal Forging
- aa. Vivial Forges
- bb. N J Engineers (Up to 12 Inch Class 600 Only)
- cc. United Forge Industries

5.0 FITTINGS

- a. Commercial Supplying Agency, Mumbai
- b. Dee Development Engineers Ltd.
- c. Eby Industries, Mumbai
- d. Flash Forge Pvt. Ltd., Vishakhapatnam
- e. Gujarat Infra Pipes Pvt. Ltd., Vadodara
- f. M.S. Fittings Mfg. Co. Pvt. Ltd., Kolkata
- g. Stewarts & Lloyds of India Ltd., Kolkata
- h. Teekay Tubes Pvt. Ltd., Mumbai
- i. Pipe Fit, Baroda
- j. Sky Forge, Faridabad

- k. S&G, Faridabad
- l. Sawan Engineers, Baroda
- m. Eby Fasteners, India
- n. Leader Valves Ltd, India
- o. R.N. Gupta & Co. Ltd, India
- p. Exten Engg Pvt Ltd
- q. Sivananda Pipe & Fittings Ltd
- r. Jindal Forging
- s. Vivial Forges
- t. PK Tubes Rajasthan
- u. CSA Fitting
- v. Gujarat Infrapipes pvt ltd, Vadodara
- w. KS Pipes Fitting Pvt Ltd, Palwal
- x. Tube Bend, Kolkata
- y. United Forge Industries

6.0 PIG LAUNCHERS/ RECEIVERS/ PIG SIGNALERS

- a. Bassi Luigi Fittings B.V., Holland
- b. BRAUN STAHL PIPE TEC, GERMANY
- c. FORAIN, ITALY
- d. Fluidel SRL, ITALY
- e. RMA Maschinen- und, GERMANY
- f. Siiritec Nigi, Itlay
- g. SCHUCK ARMATUREN, GERMANY
- h. T.D. Williamson Inc., USA
- i. Tectubi SPA, Italy
- j. Taylor Forge Engineering System INC, USA
- k. Tormene Americana S.A. (Argentina)
- l. Tormene Gas Technology S.p.A., Italy
- m. PIPELINE ENGINEERING, UNITED KINGDOM
- n. Krohne, Oil & Gas BV, Drive Houston,
- o. Multitex Filtration Engrs. Ltd, New Delhi
- p. BGR ENERGY SYSTEMS LIMITED New Delhi
- q. Glapwell Contracting Services Ltd. UK

- r. FULGOSI GIOVANNI S.n.c di Corrado & C, ITALY
- s. VEEKAY VIKRAM & CO, GUJRAT
- t. GBM S.R.L, ITALY
- u. Cardew Ltd., Alexeander
- v. Forain S.R.L.
- w. GD Engineering, India
- x. Pipeline Engineering, UK
- y. Siirtec Nigi SPA
- z. Control Plus
- aa. Oswal Infrastructure

7.0 LONG RADIUS BENDS

- a. Jindal Saw Ltd. (Kosi Works), India
- b. PSL Limited (Gandhidham Mfrg), India
- c. BHEL, Trichy, Tamilnadu
- d. Welspun, Gujarat
- e. Sawan
- f. Gujarat Infra
- g. P K Tubes
- h. DEE Development
- i. Pipefit Engineers Pvt. Ltd.

8.0 CLEAN AGENT SYSTEM

- a. ADN Fire Safety Pvt Ltd (Vashi East, Thane)
- b. Chetan Corporation (Ahmedabad)
- c. Chetan Engineers (Ahmedabad)
- d. Mx Systems International Pvt. Ltd. (Mumbai)
- e. New Fire Engineers (P) Ltd (Sil Vassa)
- f. Nitin Fire Protection Industries Ltd (New Bombay)
- g. Nohmi Bosai (India) Private Limited
- h. Tyco Fire & Security India Pvt. Ltd (Bangalore)
- i. Vimal Fire Controls Pvt Ltd (Vadodara)

9.0 INSULATING JOINTS

- a. IGP Engineers
- b. V K Vikram

- c. Advance Electronics
- d. Nupros INC

10.0 GASKETS

- a. IGP Engineers (P) Ltd., Madras
- b. Madras Industrial Products, Madras
- c. Dikson & Company, Bombay
- d. Banco Products (P) Ltd., Vadodara
- e. Goodrich Gaskets Pvt Ltd
- f. Starflex Sealing India Pvt Ltd, India
- g. Teekay Meta Flex Pvt Ltd
- h. UNIKLINGER Ltd
- i. HEM Engg. Corp.
- j. Unique Industrial Packing Pvt. Ltd.

11.0 FASTENERS

- a. Nireka Engg. Co. (P) Ltd., Calcutta
- b. Precision Taps & Dies, Bombay
- c. AEP Company, Vithal Udyoug Nagar
- d. Fix Fit Fasteners, Calcutta
- e. Precision Engg. Industries, Baroda
- f. Echjay Forgings Pvt. Ltd., Bombay
- g. Capital Industries, Bombay
- h. Boltmaster India Pvt Ltd, India
- i. Deepak Fasteners Limited, India
- j. Fasteners & Allied Products Pvt Ltd, India
- k. Hardwin Fasteners Pvt Ltd, India
- l. J.J. Industries, India
- m. Multi Fasteners Pvt Ltd, India
- n. Nexo Industries, India
- o. Pacific Forging & Fasteners Pvt Ltd, India
- p. Pioneer Nuts & Bolts Pvt Ltd, India
- q. Precision Auto Engineers, India
- r. President Engineering Works, India
- s. Sandeep Engineering Works, India
- t. Syndicate Engineering Industries, India

12.0 WELDING ELECTRODES FOR PIPELINE/PIPING WORK

- a. For Mainline – Lincoln/ Bohler make
- b. For Terminal – For root pass –Lincoln/ Bohler make
For other passes – Lincoln, D&H or equivalent make Lincon
- c. D & H SECHERON ELECTRODE PVT. LTD. (For Mainline & Terminal- Root & Other pass)

13.0 STRAINERS

- a. Bombay Chemical Equipments
- b. Gujarat Auto filed
- c. Multitex Filtration Engineering Limited
- d. Grand Prix Engineering Limited

14.0 COLD APPLIED TAPES

- a. Denso GmbH
- b. Raychem

15.0 HEAT SHRINKABLE SLEEVE/ FIBREGLAS REINFORCED SLEEVE

- a. Covalence - Seal For Life India Pvt. Ltd. (Formerly Covalence Raychem- Berry Plastics Corporation)
- b. Canussa-CPS
- c. Rigil Techno India(Distributor for M/s CYG Changtong New Material Co Ltd,China)
- d. M/s Shri Narayan Impac-India LLP

16.0 STUD BOLTS WITH NUTS

- a. Multi Thread Fasteners, Baroda
- b. Darukhanwala
- c. Precision Engineers, Baroda
- d. Unbrako
- e. TVC

17.0 WARNING MAT

- a. Sparco Multiplast Pvt. Ltd., Ahmedabad
- b. Singhal Industries , Ahemdabad
- c. Puja Packing, Mumbai
- d. Bina Enterprises, Mumbai
- e. Shree Vijay Wire & Cable Industries

18.0 HDPE PIPES/DUCT

- a. Climax Synthetics (P) Ltd., Vadodra
- b. Indian Poly Pipes, Calcutta
- c. Jain Irrigation Systems Ltd., Jalgaon
- d. Kirti Industries (India) Ltd., Indore
- e. Ori Plast Limited, Calcutta
- f. Phoel Industries Limited, Delhi
- g. Sangir Plastics (P) Ltd., Mumbai
- h. Veekay Plast, Jaipur
- i. Kisan Irrigation
- j. Dutron Polymers Ltd.
- k. Manikya Plastichem (P) Ltd
- l. Himalyan Pipe Industries
- m. NorthEast Polypipes LLP
- n. Mukand Poly Products (for Duct)

19.0 DRY GAS FILTER & FILTER SEPERATOR

- a. Grand Prix Fab (Pvt.) Ltd. (New Delhi)
- b. Perry Equipment, USA
- c. Faudi Filter, Germany
- d. Forain S.r.l., Italy
- e. ABB, Faridabad
- f. Burgess Manning, USA
- g. Multitex Filtration Engineers India
- h. Triveni Plenty Engg. Ltd. (New Delhi)
- i. Siirtec International Contractor S.P.A (Italy)
- j. Flashpoint, Pune india
- k. Filtration Engineers (I) Pvt Ltd, India
- l. Gujarat Otofilt, India
- m. Tormene Gas Technology
- n. Ultrafilter (India) Pvt Ltd, India
- o. Ravi Techno Systems Pvt Ltd, India
- p. Siirtec Nigi S.P.A
- q. Filtan Filter Anlagenbau GmbH
- r. Fairley Arlon BV
- s. PECO Facet

- t. EPE Epenstenner GMBH
- u. Filtrex srl
- v. Petromar Engineered Soln
- w. Plenty Filter
- x. Eurofiltex
- y. PTI Technologies Inc
- z. R S Instrumentation and Services
- aa. Inel Gas Control Pvt Ltd

20.0 FILTER ELEMENT

- a. Peco Facet
- b. Velcon
- c. Pall Filterite
- d. Burgess Manning

21.0 NDT AGENCY

- a. NDT Services, Ahmedabad
- b. GEECY Industrial Services Pvt. Ltd., Mumbai
- c. Corrosion Control Services, Mumbai
- d. Perfect Metal Testing & Inspection Agency, Calcutta
- e. Inter Ocean Shipping Co., New Delhi
- f. RTD, Mumbai
- g. Sievert, Mumbai
- h. X-Tech, Vizag
- i. Industrial X Ray and Allied Radiographers (I) Pvt. Ltd.
- j. Inspection Technology
- k. IXAR
- l. Aditya NDT Services
- m. Riya NDT Engineers
- n. Star NDT Services
- o. Technical testing & Inspection Services
- p. PD Engineering Inspection Services
- q. Victor Engineering & Testing

22.0 Cold Applied Tapes

- a. Denso GmbH
- b. Polyken (Berry Plastics Corporation)

22.1 End Seal Tape-PVC

- a. MAASH Industries

23.0 PUR Coating

- a. Powercrete (Berry Plastics Corporation)

24.0 Casing End Closure

- a. Raci, Italy
- b. Raychem RPG Limited

25.0 Casing Insulators

- a. Raci, Italy
- b. Raychem RPG Limited
- c. VeekayVikram

26.0 FIRE FIGHTING EQUIPMENT

26.1 FIRE EXTINGUISHERS

- a. Avon Services (Production & Agencies) Pvt. Ltd., Bombay
- b. Kooverji Devshi & Co., Bombay
- c. Reliable (Fire Protection) India Ltd., Bombay
- d. Zenith Fire Services, Bombay
- e. Safex Fire Services, Bombay
- f. Brij Basi Hi
- g. tech Udyog
- h. Bharat Engg Works, India
- i. Gunnebo India Ltd
- j. Nitin Fire Protection Industries Ltd, India
- k. Supremex Equipments, India
- l. Vimal Fire Controls Pvt Ltd., India

26.2 FIRE HYDRANTS, MONITORS, DELUGE VALVE, NOZZLES

- a. Zenith
- b. Minimax
- c. Newage
- d. HD Fire
- e. Vijay Fire

- f. Asco Strumech Pvt Ltd, India
- g. Brij Basi Hi
- h. tech Udyog
- i. Gunnebo India Ltd
- j. Nitin Fire Protection Pvt Ltd
- k. Shah Bhogilal Jethamal & Brothers
- l. Pumps & Engineering Works

26.3 FIRE & GAS DETECTION & ALARM

- a. Ambetronics Engineers PVT LTD.

26.4 RRL Hose

- a. Jayshree
- b. Newage

26.5 HOSES

- a. Ashit Sales Corporation, Bombay
- b. Royal India Corporation, Bombay
- c. Gayatri Industrial Corporation
- d. Simplex Rubber Products Ltd., Ahmedabad
- e. Zaverchand Marketing Pvt. Ltd., Baroda
- f. Presidency Rubber Mill, Calcutta
- g. The Cosmopolite, Calcutta
- h. Simplex Rubber Products, Thane

NOTE:

- 1) For procuring bought out items from vendors other than those listed above, the same may be acceptable subject to the following: -
 - a) The vendor/ supplier of bought out item(s) is a manufacturer/ supplier of said item(s) for intended services and the sizes being offered is in their regular manufacturing supply range.
 - b) The vendor / supplier should not be in the Holiday list of CLIENT / VCS / other PSU.
 - c) Should have supplied at least one single random length (i.e. 5.5 meters to 6.5 meters) for item assorted pipes / tubes and for other items, which are to be supplied in quantity on number-basis (other than assorted pipes / tubes) minimum 01 (One) number of same or higher in terms of size and rating as required for intended services. The bidder should enclose documentary evidences i.e. PO copies, Inspection Certificate etc. for the above, along with their bids.
- 2) For any other item(s) for which the vendor list is not provided, bidders can supply those item(s) from vendors/ suppliers who have earlier supplied same item(s) for the

intended services in earlier projects and the item(s) offered is in their regular manufacturing/ supply range. The bidder is not required to enclose documentary evidences (PO copies, Inspection Certificate etc.) along with their offer, however in case of successful bidder, these documents shall require to be submitted by them within 30 days from date of Placement of Order for approval to CLIENT / VCS.

- 3) The details of vendors indicated in this list are based on the information available with VCS, Contractor shall verify capabilities of each vendor for producing the required quantity with. PMC does not guarantee any responsibility on the performance of the vendor. It is the contractor's responsibility to verify the correct status of vendor and quality control of each parties and also to expedite the material in time.

B. CIVIL AND STRUCTURAL

Sr. No.	Items/ Name of Products	Make/ Brands/ Manufactures
1.	Reinforcement Steel	TATA, SAIL, RINL, JSW.
2.	Cement	Ambuja, ACC, JK, Grasim, Ultratech, Birla, L&T, Cement Corporation of India
3.	Structural Steel	TATA, SAIL, RINL, IISCO, ESSAR
4.	Structural Steel Tubes ISI Marked	TATA, JINDAL, SURYA
5.	Mineral wool for thermal insulation of ceilings (Under deck insulation)	Rock wool (india) Ltd. Minwool Rock Fibres Ltd., Lloyd Insulation.
6.	Synthetic Enamel Paint (1st quality only)	ICI Paint (Dulux), Asian Paint (Apolite), Berger Paints (Luxol). Goodlass Nerolac Paints (Nerolac), Jenson & Nicholson Paints Ltd (Borolac)
7.	G.I SHEET	ESSAR, JSW, SAIL
8.	Sheeting Screw	Corroshield, Buildex,
9.	Chemical for Antitermite treatment	DE- NOCIL Bombay, Pest Control of India, Trishul
10.	Factory made Panelled Door shutter	Century; Godrej ; M/s Hindustan Housing factory Ltd., New Delhi ; M/s Delhi Construction Eqp, Sadar Bazar, Delhi ; M/s Joinery manufacturing Co., Calcutta;
11.	PVC Panel Door (Solid Core)	Rajshri Plastiwood Limited, Sintex, Hindopan, Marino
12.	Pressed steel door frames/ cupboard and window frames (manufacturers)	M/s SAIL, M/s TATA
13.	Pressed steel door frames/ cupboard and window frames (fabricators)	M/s Loyal safe works Mayapuri, N/Delhi M/s Multiwyn Industrial Corpn Calcutta M/s Metal Window Corpn N/Delhi

		M/s Chhabra Steel Udyog, 260 Sadar Bazar, Meerut Cantt. M/s Delite safe works, Rani Jhansi Road, N/Delhi
14.	Steel Windows, Ventilators (as per IS- 1038 of 1983) & frames pressed steel door/window	M/S Multiwyn Industrial Corpn, Calcutta ; M/S Metal Window Corp, N/ Delhi ; M/S Chhabra Steel Udyog 260, Sadar Bazar, Meerut Cantt ; Agent steel MFG Pvt Ltd, Ahmedabad ; Godrej ;
15.	AI Section for AI Door/ Window/ Partitions	Hindalco, Ajit India, Jindal
16.	AluminumI Door/ Window/ Glazing Fabricated and Anodized	M/s Alumilite Pvt Ltd, M/s Ajit India Pvt Ltd, M/s Ramniklal S Raste Agra, Argent Industries, M/s Aluminium Tech Industries, I-2249 DSIDC Narela, Delhi, M/s VR Associates, GH-14/242 Paschim Vihar, Delhi
17.	Aluminium door and windows Fittings	M/s Elite Enterprises C/6 Shalimar Hardware 133, Jarg Mahal, Dhobitalao Mumbai 400002. M/s Mohan Metal Industries 178/2-A, Bhole Nath Nagar, Shahadara, Delhi 110032. Mepro, Argent New Delhi, Classic, New Delhi. Jindal, Argent New Delhi, Golden Industries Pvt. Ltd. ECIE
18.	Aluminium Grill	Alu Grill, Arihant Aluminium Corporation, Decogrille
19.	Door Closer	Everite, Golden, Gandhi,
20.	Floor Spring	Prabhat, Everite
21.	Plywood for general purpose (IS-303)	National Plywood Inds Pvt Ltd, S Fancy lane, 8th floor, Calcutta-700001, Merino Plywood, Archid Ply, Ply, Swastik, Universal, Century, Greenply, National.
22.	Pre laminated Particle board	Kitply, Bhutan board, Ecoboard, Novapan, Archid ply, Merinova, Merino
23.	Laminated Sheets	Formica, Merino Lam, Greenlam, National, Century
24.	Modular Partitions	Godrej, Blowplast
25.	False Ceiling (Mineral Fibre Board)	Armstrong, Daiken, Luxalon, Llyods, Gypboard, Trac, Aerolite
26.	Aluminium False Ceiling	Lloyds, Armstrong, Luxlon, Trac
27.	Flooring Tiles (Mosaic / Terrazzo / PCC) (1st quality only)	Kajaria Ceramics, NITCO, Royal Tiles, Gem Tiles, Hindustan Tiles, M/S National Tiles & Industries, Ultra Tiles
28.	Glazed Ceramic Tiles, Non-Skid (Floor/Wall), (1st quality only)	Kajaria, Somany, NITCO. Murudeshwar Ceramic Ltd (Navin Diamond tile), Johnson (Marbonite),
29.	Vitrified/ Designer Vitrified Tiles (1st quality only)	Asian, Marbonite (Johnson), Kerrogres (Kajaria), NITCO, Orient
30.	PVC Tiles/Flooring (IS 3461) (1st quality only)	Marblex Tiles, Krishna Tiles, Polyfin, Armstrong, Wonder floor.

31.	False Flooring	Godrej or equivalent
32.	Glass Mosaic Tiles (1st quality only)	Paladio, Coral, Accura, Bisazza, Italia, Mridul.
33.	Designer Paver Tiles/ Interlocking tiles ISI marked/ Grass-jointed Tiles. (1st quality only)	Pavit, Ultra, Hindustan, Eurocon, Vyara, National Tiles, Gem, Unistone, Konkrete, Unitile
34.	Wall care Putty for Base preparation (1st quality only)	Birla Wall care putty, Berger, Jenson & Nicholson, JK White
35.	White Cement (1st quality only)	Birla, JK
36.	Cement based Paints (1st quality only)	Super Snowcem, Duracem, Super Acrocem.
37.	Dry Distemper / Oil bound Distemper (1st quality only)	Goodlass Nerolac Paint, Shalimar Paint, Jenson & Nicholson, Asian Paint, Berger. ICI Dulux
38.	Acrylic Washable Distemper (1st quality only)	Asian, Berger, ICI Dulux, Jenson & Nicholson, Nerolac, Shalimar, Garware & Goodlass
39.	Plastic Emulsion Paint (1st quality only)	Asian, Berger, ICI, Nerolac, Jenson & Nicholson, Shalimar, Garware & Goodlass
40.	Exterior Acrylic Emulsion (1st quality only)	ICI (Weathercoat), Excel (Nerolac), Apex (Asian), Berger, Jenson & Nicholson, Shalimar, Garware & Goodlass
41.	Polymer based Paint	STP, CICO
42.	Textured Paint / Wall Tile (1st quality only)	Unitile, Heritage, Spectrum, Iokos, Acropaints, Asian
43.	Flexible board for Expansion joint	STP or equivalent
44.	Grout	Shrinkomp, Fosroc, Fairmate
45.	Integral water proofing compound	STP, Pidilite, Fosroc, CICO, Sika.
46.	Concrete Admixture	Pidilite, Fosroc, CICO, Sika.
47.	Water proofing for cementations surface IS- 2645	Acrocrete & Acrocote, CICO, Fosroc, STP
48.	Bituminous Product	M/s Faridabad Spinning & Woolen Mills Pvt Ltd, 837, SP Mukherjee Marg Delhi, M/s STP Ltd (Formerly Shalimar Tar Products) M/s Bitufelt Pvt Ltd 123/377 Fazalm Ganj Kanpur 208012, Texas, Texas India Ltd, Multiplas
49.	Hardeners	Ironite, Ferrok, Hardonate
50.	Construction Chemicals	Choksey, CICO, Forsroc, Sika

51.	Stainless Steel Cladding	Jindal
52.	Punch Tape Concertina Coil	Global Technocrat, S.G. Engineers Delhi
53.	Stainless Steel Railing	Jindal
54.	FRP/ HDPE Garbage Bins	Sintex, Swift, Nutech, Sheetal
55.	Sanitary ware	Neycer Kermag (standard), Hindustan Sanitary Ware (Ist quality), Parryware (superfine), Cera (Ist quality), Classica (Ist / standard)
56.	WC seat cover ISI Marked	Parryware, Neycer Kermag (standard), Hindustan Sanitary Ware (Ist quality), Cera (Ist quality), Classica (Ist / standard)
57.	PVC Flushing Cistern IS: 774-1984 (ISI Certified)	Parryware, Hindustan Sanitary Wares, Cera.
58.	Faucets & Taps, Stop Valves & Pillar Taps, Surgical basin mixer, Shower rose etc.	Gem, Parko, Parryware, HSW, Jaquar
59.	Kitchen Stainless Steel Sink	Diamond, Nirali, Neel Kanth, Jayna
60.	Looking Mirror	Saint Gobain, Modi Float, Triveni Float Glass, Crown, Atul.
61.	Readymade Bathroom Cabinets	Commander Gratings (I) Pvt Ltd, Gratolite Cabinet, A- 4 Sector Viii Noida-202701, Alpina, Cera.
62.	Float Valve	Leader, Bombay Metal & Alloy Co, Bombay superflow.
63.	SGSW Pipes (IS-651) ISI Marked	Perfect Agra, Devraj Ind Gaziabad, Buran, RK, Prince,
64.	CI (Centrifugally Cast) Pipes for sewage disposal ISI marked	NICCO, SRIF, A-1 Singhal Casting Co Agra, Jindal Saw, Kesoram, NECO
65.	PVC rain water/sewage pipes (IS-4985)	Reliance, Finolex, Supreme, Kisan, Prince, Hindustan Plastic & machine corporation, Polypack industries (P) Ltd.
66.	HDPE Water storage tanks (Rotational Moulded)	Sintex, Swift, Nutech, Sheetal
67.	Cast Iron Pipes and Fittings	Hindustan Engineering Products Company Calcutta, S.L.C., Standard approved manufacturers of any other brand of fittings having ISI marking, RIF, BIS
68.	RCC Pipes	Indian Hume Pipe Company, Delhi / Allahabad / Chandigarh / Lucknow; Hindustan Pressure Pipes, Kolhapur; Dhere Concrete Products, Pune or any other approved manufacturer conforming B.I.S. Standard
69.	Brass Fittings	Leader Engineering Works, Jalandhar; L & K Mathura; Luster Sanitary, Jalandhar; Annapurna Metal Works, Calcutta; Neta Metal Works, Jalandhar
70.	C.P. Fittings	Ego Metal Works, Ballabhgarh; Jaquar Industries, Delhi; Soma Plumbing Fixtures Limited, Calcutta; Gem Sanitary Appliances Pvt. Ltd., Delhi; Essco

		Sanitations, Delhi.
71.	Stone Ware (Salt-Glazed) Pipes	Hind Ceramics Limited, Orissa; Ceramic Industries Limited, Sambalpur; Shrikamakshi Agencies, Madras; Binary Udyog Pvt. Limited, Howrah; Tirumati Moulds Limited, Nagpur.
72.	Asbestos Cement Pipes and Fittings	Ganga Asbestos Limited, U.P.; Hyderabad Asbestos Cement Products Limited; J.K. Super Pipe Industries, Nanded; Konark Cement and Asbestos Limited, Orissa; Maharashtra Asbestos Limited, Bombay.

List of Recommended Vender/Suppliers of Major Bought-Out Items: Unless otherwise specifically mentioned in the Schedule of Items, Contractor has to use materials as listed below, of only these brand names/Company's names, which are mentioned in the RECOMMENDED list for structural items thereon.

Sl. No.	Items/Name of Products	Makes/Brands/Manufactures
1	Structural Steel	SAIL / TATA / RINL / IISCO / ESSAR / ISPAT
2	Structural Steel Tubes ISI Marked	TATA / JINDAL / SURYA / SWASTIK
3	Synthetic Enamel Paint 1st Quality only	ICI Paint (Deluxe), Asian Paint (Apolite), Shalimar Paint (Superlac), Goodlass, Nerolac Paint (Nerolac), Berger Paints

Any materials not fully specified in these specifications and which may be offered for use in the works shall be subject to approval of Engineer, without which it shall not be used anywhere in the construction works.

C. ELECTRICAL

LIST OF SUPPLIERS OF MAJOR BOUGHT-OUT ITEMS

1.0 AIR CONDITIONER

- a. Blue Star
- b. O General.
- c. Daikin.
- d. Carrier
- e. Hitachi.
- f. LG.
- g. Lloyds
- h. Mitsubishi
- i. Panasonic
- j. Sharp
- k. Samsung.
- l. Blue star.
- m. Haier.
- n. Voltas.
- o. Videocon.

2.0 BATTERIES (LEAD ACID)

- a. Amco Batteries Ltd.
- b. Exide Industries Ltd.
- c. HBL Power System Ltd.
- d. Amara Raja Batteries Ltd.
- e. Su-Kam Power Systems Ltd.
- f. Base Corporation Ltd.
- g. Okaya Power Ltd.
- h. Southern Batteries Pvt Ltd.
- i. True Power International Ltd.
- j. Evolute Solutions Pvt Ltd.
- k. Greenvision Technologies Pvt Ltd.
- l. Artheon Electronics Ltd.

3.0 BATTERIES (NICKEL CADMIUM)

- a. Amco Saft Batteries Ltd.
- b. HBL Power Systems Ltd.

4.0 BATTERIES (Lithium-ion)

- a. PROSTARM INFO SYSTEMS LTD.

5.0 BATTERY CHARGER/DC-DC CONVERTER

- a. Amara Raja Power System(P)Ltd.
- b. BCH.
- c. Chhabi Electricals Pvt. Ltd.
- d. Caldyne Automatics Limited.
- e. HBL Nife Power Systems Ltd..
- f. Universal Instrument Mfg. Co Pvt Ltd.
- g. Hitachi HI-REL Power Electronics P. Ltd
- h. Mass-Tech Controls Pvt Ltd
- i. Dubas Engineering Pvt Ltd
- j. Chloride Power Systems & Solutions Ltd
- k. Synergee
- l. Enertech
- m. Vertiv

6.0 CABLE FIRE ALARM & COMMUNICATION CABLES

- a. Cords Cable Industries Ltd.
- b. CMI.
- c. Delton cables Ltd.
- d. ELKAY Telelinks.
- e. KEI Industries Ltd.
- f. Elkay Telelinks

7.0 CABLE HT(XLPE)

- a. Universal Cable Ltd.
- b. KEI Industries Ltd.
- c. Industrial Cables.
- d. NICCO Corporation Ltd.

- e. Uniflex.
- f. Polycab.
- g. Torrent cables Ltd.

8.0 CABLE LT / MV POWER AND CONTROL

- a. Cords Cable Industries Ltd.
- b. Universal Cable Ltd.
- c. KEI Industries Ltd.
- d. Havells.
- e. Delton.
- f. Elkay Telelinks.
- g. Evershine Electricals.
- h. Ecko.
- i. Ravin.
- j. Rallison.
- k. Suyog.
- l. Netco.
- m. Uniflex.
- n. Paramount.
- o. Gloster.
- p. Associated cables Pvt Ltd.
- q. CMI.
- r. Gemscab.
- s. Industrial cables.
- t. NICCO.
- u. Polycab.
- v. Torrent.

9.0 CABLE GLAND

- a. Baliga.
- b. Comet.
- c. Flexpro.
- d. Flameproof.
- e. FCG.

- f. Electro Werke.
- g. Dowels.
- h. CCI.
- i. Sudhir Switchgear
- j. Keyson Techno Equipments,
- k. RAY Flameproof Pvt Ltd

10.0 CABLE LUGS & TERMINAL BLOCKS

- a. Dowels.
- b. Jainson.
- c. Sharma Electrical
- d. Punitam
- e. Yamuna Powers
- f. Rapid Manufacturer
- g. Varun Controls.

11.0 CABLE TRAY

- a. Ercon Composites.
- b. Yamuna Power & Infrastructure Ltd.
- c. MEM
- d. Bharti
- e. Profab.
- f. Ratan.
- g. Slotco.

12.0 CABLE TERMINATION AND JOINTING KIT

- a. CCI.
- b. Raychem.
- c. M-Seal.

13.0 CEILING/EXHAUST/PEDESTAL FANS & CIRCULATORS

- a. Bajaj Electricals Ltd.
- b. Crompton Greaves Ltd.
- c. Khaitan Electricals Ltd.

- d. Havell s.
- e. Philips
- f. Usha
- g. Orient

14.0 CONTRACTORS AC POWER

- a. Andrew Yule.
- b. ABB.
- c. BHEL.
- d. C&S.
- e. Havell s.
- f. L&T.
- g. Schneider.
- h. Siemens Ltd.
- i. Telemecanique.
- j. GE India Industrial

15.0 CONTROL TRANSFORMER

- a. AE.
- b. Indushree.
- c. Intra Vidyut.
- d. Kalpa Electricals.
- e. Transpower Industries Ltd.
- f. Siemens.
- g. PROSTARM INFO SYSTEMS LTD.

16.0 GAS GENERATOR/DIESEL GENERATOR SET

- a. Sterling and Wilson.
- b. Jackson Limited.
- c. Sudhir Gensets.
- d. Power Engineering (India) Pvt Ltd.
- e. Prasha Technologies Limited.
- f. Kumar Generator house.
- g. Ashok Leyland Ltd.

- h. Powerica Limited.
- i. Supernova Engineers Limited.
- j. Bhaskar Power Products (P) Ltd.
- k. Caterpillar India (P) Ltd.
- l. Cummins India Ltd.
- m. Escorts Ltd.
- n. Greaves Cotton Ltd.
- o. Kirloskar Ltd.
- p. Mahindra & Mahindra Ltd.
- q. Honda.
- r. Perkins.
- s. Eicher.
- t. Tata Motors.
- u. Ashok Leyland.

17.0 FLAME PROOF LDB S/ JB S/CONTROL STATION/ SWITCHES

- a. FCG.
- b. Sudhir switchgears.
- c. Prompt Engineering Works
- d. Flame Proof equipments pvt. Ltd.
- e. Baliga Lighting Equipments Pvt. Ltd.
- f. Flexpro Electricals Pvt. Ltd.
- g. Exprotecta, Beroda.
- h. FFLP Control Gears.
- i. Sterling.
- j. Kaysons Techno Equipment
- k. Bajaj
- l. Phoenix Contact
- m. RAY Flameproof Pvt Ltd

18.0 HIGH MAST

- a. Bajaj Electricals Limited.
- b. Crompton Greaves Limited.
- c. Philips India Limited.

- d. Surya Roshani.
- e. Transrail

19.0 HIGH VOLTAGE PCC/ MCC PANELS

- a. BHEL.
- b. Control and Switchgear.
- c. Siemens.
- d. Tricolite Electrical Industries.
- e. Schneider.
- f. CGL.
- g. L&T.
- h. ABB.

20.0 INDICATING LAMPS

- a. Alstom Ltd.
- b. BCH.
- c. L&T Ltd.
- d. Siemens Ltd.
- e. Vaishno Electricals.
- f. Tecknik
- g. ABB

21.0 INDICATING METERS

- a. L&T
- b. ABB.
- c. AMCO.
- d. AE
- e. Alstom Ltd. (EE).
- f. Conzerv/Schneider
- g. Elecon Measurement Pvt. Ltd.
- h. HPL Electric & Power Pvt. Ltd.
- i. MECO Instruments Ltd.
- j. Minilec.

- k. Rishabh Instruments Pvt. Ltd.
- l. Trinity energy system.
- m. Kaycee.
- n. Salzer.
- o. Trinity
- p. Secure Meters Limited

22.0 LIGHTING FIXTURES

- a. GE Lighting Pvt. Ltd.
- b. Bajaj Electricals Ltd.
- c. Crompton Greaves Ltd.
- d. Philips India Ltd.
- e. Havells
- f. Wipro
- g. Osram
- h. Siska
- i. Halonix
- j. Surya
- k. Polycab
- l. Kawlity Photonix

23.0 LIGHTING FIXTURES FLAMEPROOF

- a. Bajaj Electricals Ltd.
- b. Baliga Lighting Equipment Pvt. Ltd.
- c. Crompton Greaves Ltd.
- d. CEAG Flameproof Controlgear Pvt. Ltd.
- e. Flexpro Electricals Pvt. Ltd.
- f. Philips India Ltd.
- g. Sudhir Switchgears Pvt. Ltd.
- h. FCG.

24.0 MINIATURE CIRCUIT BREAKERS (MCBS) AND LIGHTING DB

- a. ABB.
- b. Hagger.
- c. Havell s I dia Ltd.

- d. Indo Asian Fusegear Ltd.
- e. Legrand.
- f. MDS Switchgear Ltd.
- g. Schneider.
- h. Siemens Ltd..
- i. HPL.
- j. L & T
- k. Siemens

25.0 MOULDED CASE CIRCUIT BREAKER (MCCBS)

- l. ABB.
- m. Andrew Yule.
- n. Larsen & Toubro.
- o. Schneider.
- p. Siemens.
- q. Control and Switchgear.
- r. Indo Asian,
- s. Hager.
- t. Merlin Gerin.
- u. Havell s India Ltd
- v. General Electric

26.0 PROTECTION RELAYS

- a. BCH.
- b. L&T Ltd.
- c. Siemens Ltd.
- d. Tele-mechanique & Controls (India) Ltd.
- e. Eaton
- f. Alstom
- g. ABB
- h. Ashida
- i. Novatek Electronics
- j. Cantronics
- k. Control & Switchgear
- l. Frick Electronics

- m. Indian Technologies
- n. Rao Electromechanical
- o. Kudam Corporation

**27.0 LOW/MEDIUM VOLTAGE POWER CONTROL CENTER (PCC)/ MCC/
PDB/ MLDB/ LDB**

- a. ABB.
- b. BCH.
- c. BHEL.
- d. C & S.
- e. Elecmech Switchgear & Instrumentation.
- f. KMG ATOZ.
- g. L&T.
- h. Pyrotech Electronics Pvt. Ltd.
- i. Risha Control Engineers Pvt. Ltd.
- j. UDKAM PROCESS EQUIPMENT INDIA PVT. LTD
- k. Tricolite Electrical Industries.
- l. Unilec Engineers Ltd.
- m. Vidyut Control India Pvt. Ltd.
- n. Control and Schematic.
- o. Zenith Engineering.
- p. Schneider Electric,
- q. AEG,
- r. HAVELL S,
- s. MDS
- t. Synergy System
- u. Expert Engineers
- v. R K Engineering & Infrastructure

28.0 PUSH BUTTONS

- a. BCH.
- b. Alstom Ltd.
- c. L&T.
- d. Siemens Ltd.
- e. Tele-Menchanique & Controls (India) Ltd.

- f. Vaishno Electricals.

29.0 SWITCHES-CONTROL

- a. BCH.
- b. Easum Reyrolle Relays & Devices Ltd.
- c. Alstom.
- d. Kaycee Industries Ltd..
- e. L&T.
- f. Siemens Ltd.

30.0 SWITCHES 5/15A PIANO/ PLATE, SWITCH SOCKET

- a. Anchor Electronics & Electricals Pvt. Ltd.
- b. Kingal Electricals Pvt. Ltd.
- c. North-West Switchgear Ltd.
- d. Schneider
- e. Havells
- f. Cona
- g. Orient
- h. Panasonic

31.0 SWITCH SOCKET OUTLETS (INDUSTRIAL)

- a. Alstom Ltd.
- b. Best & Crompton Engineering Ltd.
- c. BCH.
- d. Crompton Greaves Ltd.
- e. Essen Engineering Company Pvt. Ltd.

32.0 SOLAR POWER SYSTEM MODULES

- a. Tata Power Solar Systems Ltd
- b. REIL,
- c. CEIL,
- d. HBL Power.
- e. Vikram Solar.
- f. Waaree Solar.
- g. Solar Semiconductor.

- h. Sonali.
- i. Mundra Solar
- j. Vikram Solar
- k. Bharat Electronics Limited
- l. Waaree
- m. Lumipex
- n. Independent Qualitative Accessories
- o. Statcon Energy
- p. Volks Energy
- q. Green Engineering

33.0 SOLAR PCU/CHARGE CONTROLLER

- a. Statcon Energy
- b. Enertech UPS Pvt Ltd
- c. Consul Nowatt
- d. OPS India
- e. Schneider
- f. Delta Electronics
- g. ABB Ltd
- h. KACO
- i. SMA
- j. HBP Power
- k. Universal Instrument

34.0 TERMINALS BLOCKS

- a. Connectwell.
- b. Controls & Switchgear Co. Ltd.
- c. Elmex Controls Pvt. Ltd.
- d. Essen Engineering Co. Pvt. Ltd.
- e. Phoenix Contact

35.0 DISTRIBUTION TRANSFORMERS

- a. ABB.
- b. Andrew Yule.
- c. Areva.

- d. BHEL.
- e. Bharat Bijlee
- f. Crompton Greaves.
- g. EMCO Ltd.
- h. Intra Vidyut.
- i. Indushree.
- j. Indcoil
- k. Kirloskar.
- l. Skippers Electricals.
- m. Transformers & Rectifiers (I) Ltd.
- n. Voltamp.

36.0 UPS SYSTEM AND INVERTER

- a. DB Power.
- b. Keltron.
- c. Hi-Rel/HITACHI.
- d. Dubas.
- e. Toshiba Corporation.
- f. Fuzi Electric Co Ltd.
- g. Emerson.
- h. Synergy System.
- i. Eaton.
- j. Enertech
- k. PROSTARM INFO SYSTEMS LTD.

37.0 GI-OCTAGONAL POLE

- a. Bajaj.
- b. Transrail.
- c. Wipro.
- d. K.L. Industries.

38.0 ELECTRICAL MOTORS

- a. Siemens.
- b. Crompton Greaves.
- c. Kirloskar.
- d. BHEL.

- e. Bharat Bijlee.
- f. Hindustan motors.
- g. Alstom.
- h. Texmo.
- i. GE India.
- j. National Motors.
- k. ABB.

39.0 ELECTRICAL PROCESS HEATER

- a. Escorts Limited, Faridabad, Haryana.
- b. Spherehot / Kanti Lal Chuni Lal & Sons Appliances Pvt Ltd.Surat.
- c. Kerone, Bhayander(E), Thane 401105.
- d. Excel Heaters, Andheri (West), Mumbai - 400 053, India.
- e. Nirmal Industrial Controls Pvt. Ltd., Mulund(W), Mumbai - 400 080.

40.0 CATHODIC PROTECTION AGENCIES/CONTRACTOR/ VENDERS

- a. CALTECH Engineering Service.
- b. Universal Corrosion Prevention India.
- c. Cathodic Technology Limited.
- d. Cathodic Control Company Pvt. Ltd.
- e. CORRTECH International Pvt Ltd.
- f. MITCORR Cathodic Protection Pvt Ltd.
- g. Underground Pipeline & NDTs Pvt. Ltd.
- h. JG Corrosion Solution.
- i. Mercury Cathodic Protection Service.
- j. UNDTs Corrosion Service.
- k. SARK EPC Projects Pvt. Ltd.

41.0 BACKUP AGENCY FOR INTERFERENCE SURVEY & MITIGATION

- a. PLE Germany
- b. Vendor Velde
- c. Nippon Japan
- d. SSS India CIPL / interference survey.
- e. Balslev Denmark, .
- f. SSS Germany

- g. Jef Techno Slutions Pvt. Ltd.
- h. SARK EPC Projects Pvt. Ltd.

42.0 PERMANENT REFERENCE CELL

- a. PERMACELL/ HARCO (USA)
- b. CORRTECH (ZULU), INDIA
- c. TINKER RASOR, USA
- d. SILVION, UK

43.0 CP CABLES

- a. Brooks Cables.
- b. Nicco Corporation Ltd.
- c. CCI Ltd.
- d. Delton Cables Ltd.
- e. KEI Industries.
- f. Torrent Cables.
- g. Universal cables.
- h. Victor Cables.
- i. Associated Flexible & Wires Pvt Ltd.
- j. Asain Cables (RPG Cables).
- k. Fort Gloster (Gloster Cables Ltd).
- l. Finolex Cable.
- m. Rediant Cables.
- n. NETCO Cables Pvt Ltd.
- o. Havells Ltd.

44.0 CP SACRIFICIAL ANODES

- a. Scientific Metals Engineers Pvt. Ltd., Karaikudi
- b. PSL Holding Pvt. Ltd., Mumbai.
- c. Cathodic Controls, Bangalore.
- d. BHEL, Bhopal.
- e. Nippon Corrosion, Japan.
- f. AFIC, KSA.
- g. Platt Bros. and Company, USA

- h. Wilson Walton International.
- i. Impalloy International.
- j. Corrpro International.
- k. HOCKWAY, UK
- l. NAKABOHTEC, Japan .
- m. Cortech International
- n. Titanor Component
- o. Shakti Metals, Ahmedabad
- p. Shaktianodes Private Limited, Ahmedabad

45.0 CP PORTABLE /PERMANENT REFERENCE CELL

- a. M/S PERMACELL/HARCO, USA
- b. M/S BORIN MANUFACTURER, USA
- c. M/S M.C.MILLER, USA
- d. M/S TINKER RASOR

46.0 CPTR (AC OPERATED)

- a. Canara Electric
- b. CATHODIC CONTROL COMPANY PVT LTD.
- c. Kriston Systems

47.0 PIN BRAZING / THERMITWELD

- a. SAFETRACK, SWEDEN
- b. CadWeld
- c. BAC, UK
- d. ERICO, USA
- e. THERMOWELD, USA
- f. ERICO, EUROPE

48.0 CP SURGE DIVERTER/SPARK GAP ARRESTOR (EX-D)

- a. Dhen,
- b. OBO
- c. Corrpro system
- d. Sohne
- e. Dairyland

49.0 CP SOLID STATE POLARISATION CELL.

- a. Dairyland

- b. Metricorr
- c. Rustol
- d. Dhen
- e. Kriston Systems

50.0 PETROLEUM COKE BREEZE:

- a. M/S LORESCO, USA
- b. M/S ASBURY, USA
- c. M/S GOA CARBON, GOA
- d. M/S INDIA CARBON, CALCUTTA
- e. M/S PETROCARBON & CHEMICAL COMPANY, HALDIA

51.0 CP ANODE (MMO TYPE):

- a. Corrttech
- b. Scientific Metal Engineers Karaikudi
- c. Titanor Component Ltd., Goa, India.
- d. Denora Permelic S.P.A (Italy). .
- e. Oronzio De Nora S.A. Ingano Switzerland
- f. CER Anode Technologies International USA
- g. ACTEL, UK
- h. ELTECH System Corporation, Texas
- i. MAGNETO-CHEMIE, Netherlands
- j. MATCOR (USA)

52.0 HEAT SHRINK CAP FOR CP ANODE

- a. MATCOR (USA) To Cable Joint
- b. Seal For Life

**53.0 ER- PROBE (EXTERNAL CORROSION) ER- PROBE & CORROSION
COUPON ASSEMBLY**

- a. Rose Corrosion Services UK
- b. Metal Samples, USA. .
- c. Roharbak Cosasco USA
- d. Caproco UK
- e. Emetricorr, Denmark

54.0 HEAT SHRINK CAP FOR ANODE TO CABLE JOINT

- a. Raychem, USA
- b. Matcor (USA)

55.0 MMO WIRE ANODES (WITH FACTORY PRE-PACKED COKE BREEZE)

- a. Matcor (USA)
- b. Covalence (USA)
- c. Berry Plastics (USA) (Seal for Life Industries)

56.0 MMO WIRE ANODES (WITHOUT FACTORY PRE-PACKED COKE BREEZE)

- a. GROUPPO DENORA, GOA, INDIA
- b. CERANODE TECHNOLOGIES, USA
- c. TELPRO, USA

57.0 MMO TUBULAR/ STRIP/ RIBBON ANODES

- a. GROUPPO DENORA, GOA, INDIA
- b. ORANZIO DE NORA, ITALY
- c. MAGNETOCHEMIE, HOLLAND
- d. ACTEL LTD., U.K.
- e. ELTECH SYSTEMS CORPORATION, USA
- f. CERANODE TECHNOLOGIES, USA
- g. MATCOR (USA)

Note: -

For any other brought out item(s) for which the vendor list is not provided in the tender , bidders can supply those item(s) from vendors/ suppliers who have earlier supplied similar item(s) for the intended services in earlier Oil and Gas projects and the item(s) offered is in their regular manufacturing/ supply range.

- 1) The vendor/supplier should not be in the Holiday list of OWNER/ CONSULTANT/other PSU
- 2) The bidder is not required to enclose documentary evidences (PO copies, Inspection & Completion with satisfactory working certificates etc.) along with their offer, however in case of successful bidder, these documents shall required to be submitted by them within 30 days from date of Placement of Order for approval to OWNER / CONSULTANT.

D. INSTRUMENTATION

LIST OF RECOMMENDED VENDER/SUPPLIERS OF MAJOR BOUGHT-OUT ITEMS

1.0 PRESSURE GAUGES

- a. AN Instruments Pvt Ltd
- b. Badotherm Process Instruments B.V.
- c. Baumer Bourdon Haenni S.A.S
- d. British Rototherm Co Ltd
- e. Budenberg Gauge Co Ltd
- f. Dresser Inc
- g. Forbes Marshall (Hyd) Pvt Ltd
- h. General Instrument Consortium
- i. H. Guru Instruments (South India) Pvt Ltd
- j. Manometer (India) Pvt Ltd
- k. Nagano Keiki Seisakusho Ltd
- l. Hirlekar Precision, India
- m. Waaree Instruments Ltd
- n. Walchandnagar Industries Ltd (Tiwac Divn)
- o. Wika Alexander Wiegand & Co GmbH
- p. Wika Instruments India Pvt Ltd
- q. Ashcroft India Pvt Ltd.
- r. ITEC Measures Pvt Ltd

2.0 TEMPERATURE GAUGES

- a. AN Instruments Pvt Ltd.
- b. Badotherm Process Instruments B.V.
- c. Bourdon Haenni S.A.
- d. Dresser Inc.

- e. General Instruments Consortium
- f. H. Guru Instruments (South India) Pvt Ltd
- g. Nagano Keiki Seisakusho Ltd
- h. Solartron ISA
- i. Walchandnagar Industries Ltd (Tiwac Divn)
- j. Wika Alexander Wiegand & Co GmbH
- k. Wika Instruments India Pvt Ltd
- l. Pyro Electric, Goa
- m. Ashcroft India Pvt Ltd.
- n. ITEC Measures Pvt Ltd

3.0 TEMPERATURE ELEMENTS INCLUDING SKIN TYPE

- a. ABB Automation Ltd
- b. Altop Industries Ltd
- c. Bourdon Haenni S.A.
- d. Detriv Instrumentation & Electronics Ltd
- e. General Instruments Consortium
- f. Japan Thermowell Co Ltd
- g. Tecnomatic S.P.A
- h. Tempsen Instrument India Ltd
- i. Thermo Electric Co. Inc.
- j. Thermo-Couple Products Co
- k. Thermo-Electra B.V.
- l. Wika Alexander Wiegand & Co GmbH
- m. Altop Industries Ltd., Baroda
- n. Nagman Sensors (Pvt.) Ltd.
- o. Pyro Electric, Goa
- p. ITEC Measures Pvt Ltd

4.0 POSITIVE DISPLACEMENT FLOW METERS

- a. RMG (Germany)
- b. Elster Instromet
- c. Romet
- d. Dresser
- e. Itron

- f. FMG
- g. Common
- h. Metreg
- i. Raychem RPG
- j. Vemmtec

5.0 TURBINE FLOW METER

- a. Daniel
- b. Elster Instromet
- c. Itron
- d. RMG
- e. Rockwin

6.0 ELECTRONIC VOLUME CORRECTOR

- a. Elgas
- b. Itron
- c. Plum
- d. Pietro Fiorentini

7.0 ORIFICES (METER RUN, FLOW CONDITIONER, ORIFICE PLATE AND ASSEMBLY)

- a. Emerson
- b. FMC, USA
- c. Pietro Fiorentini S.P.A (Italy)
- d. Canalta Controls, Canada

8.0 ULTRASONIC FLOW METERS

- a. Daniel (USA)
- b. RMG (Germany)
- c. Instromet International (Belgium)
- d. Sick Maihak, Germany
- e. FMC, Germany

9.0 MASS FLOW METERS

- a. Daniel Measurement & Control Asia Pacific
- b. Endress + Hauser Instruments International
- c. FMC Measurements Solutions
- d. Heinrichs Messtechnik GMBH
- e. Rheonik MessGerate GMBH

10.0 FIELD INSTRUMENTS (P, DP, F, L, T)

- a. ABB Ltd
- b. Honeywell
- c. Fuji Electric Instruments Co Ltd
- d. Yokogawa
- e. Invensys India Pvt.Ltd

11.0 LEVEL GAUGES/ LEVEL INSTRUMENTS

- a. Bliss Anand
- b. Chemtrols
- c. V-Automat
- d. Levcon
- e. Nivo Controls
- f. Sbeletro Mechanicals
- g. TRAC

12.0 PRESSURE REGULATOR AND SLAM SHUT VALVE

- a. Pietro Fiorentini S.P.A. (Italy)
- b. Emerson
- c. RMG-Regel Messtechnik (Germany)
- d. Mokveld Valves BV (Netherlands)
- e. Schlumberger (USA)
- f. Gortter Controls B V (Netherlands)
- g. Instromet International NV

- h. Nirmal Industrial Controls Pvt Ltd. (up to 6 size only)
- i. ESME Valves Ltd
- j. Kaye & Macdonald Inc.
- k. Nuovo Pignone S.P.A (Italy) (GE Oil Co.)
- l. Richards Industries (Formerly Treloar)
- m. Samson AG Mess-und Regeltechnik
- n. Tormene Gas Technology
- o. Dresser Inc, USA (upto 8 size, 300# class only)

13.0 PRESSURE SAFETY VALVES

- a. Keystone Valves (India) Pvt. Ltd.
- b. Larson & Toubro Ltd.
- c. Lesser GmbH & Co KG
- d. Mekaster Engg Ltd..
- e. Tyco Sanmar Ltd. (New Delhi)
- f. Anderson Greenwood Crosby
- g. BHEL (Trichy)
- h. Curtiss Wright Flow Control Corporation
- i. Dresser Inc.
- j. Fukui Seisakusho Co. Ltd
- k. Nakakita Seisakusho Co Ltd
- l. Nuovo Pignone S.P.A (Italy) (GE Oil co)
- m. Parcol S.P.A
- n. Safety Systems UK Ltd
- o. Tai Milano S.P.A
- p. Weir Valves & Controls France
- q. Bliss Anand Pvt Ltd.

14.0 CONTROL PANEL & ACCESSORIES

- a. Keltron Controls Ltd., Kerala
- b. Elechmec Corporation Ltd., Mumbai
- c. Industrial Controls & Appliances Pvt. Ltd.,
- d. Alstom System Ltd., Noida
- e. Emerson Process Management (I) Pvt. Ltd.
- f. ABB Instruments Ltd., New Delhi
- g. Larsen & Toubro Ltd.

- h. Control & Automation, New Delhi
- i. GE Fanuc Systems Pvt. Ltd., New Delhi
- j. Rockwell Automation (I) Ltd., Ghaziabad
- k. Honeywell Automation Ltd.
- l. Rittal
- m. Pyrotech Elcronics Pvt Ltd.
- n. Positronics Pvt Ltd.
- o. Electronics Corporation of India Ltd.
- p. Phoenix Contact (I) Pvt. Ltd

15.0 JUNCTION BOXES AND CABLES GLANDS

- a. Ex-Protecta
- b. Flameproof Control Gears
- c. Baliga
- d. Flexpro Electricals
- e. RAY Flameproof Pvt Ltd (Flameproof Weatherproof)

16.0 CONTROL AND SIGNAL CABLES

- a. Associated Cables
- b. Brook
- c. Associated Flexibles & Wires (Pvt) Ltd
- d. Universal Cables Ltd, India
- e. Delton Cables Ltd, India
- f. KEI Industries Ltd INDIA
- g. CMI Limited
- h. Cords Cable Industries Ltd, India
- i. Elkay Telelinks (P) Ltd., India
- j. Udey Pyrocables Pvt Ltd, India
- k. Goyolene Fibres (I) Pvt Ltd, India
- l. Netco Cable Industries Pvt Ltd, India
- m. Nicco Corporation Ltd, India
- n. Paramount Communications Ltd, India
- o. Polycab Wires Pvt Ltd, India
- p. Radiant Cables Pvt Ltd, India
- q. Reliance Engineers Ltd., India
- r. Suyog Electricals Ltd, India

- s. Thermo Cables Ltd

17.0 GAS DETECTION SYSTEM

- a. Crowcon Detection Instruments Ltd
- b. Detection Instruments (I) Pvt Ltd
- c. Detector Electronics Corporation
- d. Drager Safety AG & Co. KGAA
- e. General Monitors Ireland Ltd
- f. Mine Safety Appliances Company
- g. MSA Mines Safety Appliances(India) Ltd
- h. Industrial Scientific Oldham France S.A.
- i. Riken Keiki Co Ltd
- j. Simrad Optronics Icare
- k. Honeywell Analytics
- l. Net Safety Monitoring Inc.
- m. Simtronics SAS
- n. Pollution Protection Systems Mumbai Pvt Ltd

18.0 MOV ACTUATOR:

- a. Rotork- UK, USA & INDIA
- b. Limitorque
- c. Auma- India
- d. Biffi- Italy
- e. DelVal Flow Controls Pvt. Ltd

19.0 PNEUMATIC ACTUATOR (SOLENOID OPERATED ON-OFF TYPE)

- a. Metso Automation
- b. Tyco
- c. Samson Controls
- d. L&T
- e. Emerson
- f. Fisher
- g. Masoneilan Process Control
- h. Instrumentation Limited (IL)-Palghat

- i. Micro Finish
- j. Rotex

20.0 SOLENOID VALVES

- a. Avcon
- b. Festo
- c. DelVal Flow Controls Pvt. Ltd

21.0 ELECTRO HYDRAULIC ACTUATOR

- a. Avcon Rotork controls (Deutschland Gmbh)
- b. Biffi Italia Srl
- c. Ledeen (Italy)
- d. Virgo Valves and Controls ltd.-India
- e. Limittorque
- f. Reineke
- g. Voith
- h. Bettis
- i. Rotork- UK, USA & INDIA
- j. Rotex
- k. Schuck Group
- l. DelVal Flow Controls Pvt. Ltd

22.0 GAS OVER OIL ACTUATOR

- a. Biffi Italia Srl,
- b. Ledeen(Italy)
- c. Virgo Valves & Control ltd.-India,
- d. Voith,
- e. Bettis,
- f. Rotork-UK, USA, India,
- g. Rotex,
- h. Schuck Group,
- i. Valve Italia.

23.0 OFC

Manufacture/ Procurement, Testing and supply of suitable OFC Joint closures including all necessary accessories of any of the following make:

- a. Raychem
- b. 3M
- c. Siemens
- d. Any other make from the approved vendor list of client with supporting paper.

24.0 FLOW CONTROL VALVES

- a. Fouress Engg. (New Delhi)
- b. Fisher Xomox (New Delhi)
- c. MIL Control Ltd. (Noida)
- d. KOSO India Pvt Ltd
- e. Samson Control (Thane)
- f. Dresser Valves India Pvt Ltd.
- g. Fisher Controls
- h. Valvitalia Italy
- i. CCI Valve technology
- j. Flowserve Pvt Ltd.
- k. Metso Singapore Pvt Ltd.
- l. Instrumentation Ltd Palghat
- m. Dresser Inc. USA

25.0 FLOW COMPUTERS

- a. Emerson
- b. Instromet International (Belgium)
- c. FMC Measurement Solutions (UK)
- d. RMG (Germany)
- e. OMNI Flow Computers Inc.
- f. Thermo Fisher, USA

26.0 INDICATORS & CONTROLLERS

- a. Yokogawa
- b. Eurotherm Chessel
- c. Honeywell
- d. Emerson

27.0 BARRIERS

- a. MTL
- b. STHAL

- c. P&F
- d. Phoenix Contact (I) Pvt. Ltd.

28.0 GAS CHROMATOGRAPH

- a. ABB
- b. Emerson
- c. Instromet International, NV
- d. RMG Regal+Messtechnik GmbH
- e. Yokogawa

29.0 I/P CONVERTERS

- a. ABB
- b. Emerson
- c. IMI Watson Smith Ltd.
- d. Moore Controls Ltd
- e. Shreyas Instruments Pvt Ltd, India
- f. Thermo Brandt Instruments

30.0 SS FITTINGS, INSTRUMENT VALVES & MANIFOLDS

30.1 FOR CNG WORK:

- a. DK-LOK
- b. Swagelok Co.
- c. Parker
- d. Dawsons Tech Components LLP
- e. ASTEC Valves & Fittings Pvt Ltd
- f. Thomas & Brian Mfg. Pvt. Ltd
- g. Global Valves and fittings(India) Pvt Ltd

30.2 EXCEPT CNG WORK:

- a. Swagelok Co.
- b. Parker
- c. Aura INC.
- d. HOKE
- e. Excelsior Engineering works
- f. Swastik Engineering works India
- g. Comfit and valves pvt ltd
- h. Arya craft and engineering Pvt ltd

- i. DK lok
- j. ASTEC Valves & Fittings Pvt Ltd
- k. Dawsons Tech Components LLP
- l. DelVal Flow Controls Pvt. Ltd
- m. Thomas & Brian Mfg. Pvt. Ltd
- n. Global Valves and fittings(India) Pvt Ltd

31.0 SS TUBES

31.1 FOR CNG WORK:

- a. Swagelok Co.
- b. Parker
- c. Sandvik
- d. Jindal Saw
- e. Tubacex Tubes and Pipes Private Ltd
- f. Krystal Global Engineering Ltd.
- g. Maxim Tubes Company Pvt. Ltd.
- h. VENUS PIPES & TUBES LIMITED

31.2 EXCEPT CNG WORK:

- a. Swagelok Co.
- b. Parker
- c. Sandvik
- d. Heavy metal and tube limited
- e. Nuclear fuel complex India
- f. Scorodite
- g. Ratnamani Metals and Tubes
- h. Jindal Saw

E. SHOP & FIELD PAINTING

LIST OF RECOMMENDED VENDER/SUPPLIERS OF MAJOR BOUGHT-OUT ITEMS

1.0 INDIAN VENDORS

- a. Asian Paints (I) Ltd.
- b. Berger Paints Ltd.
- c. Goodlass Nerlolac Paints Ltd.
- d. Jenson And Nicholson Paint Ltd & chokuGu Jenson & Nicholson Ltd.
- e. Shalimar Paints Ltd.
- f. Sigma Coating, Mumabai
- g. CDC Carboline Ltd.
- h. Premier Products Ltd.
- i. Coromandel Paints & Chemicals Ltd.
- j. Anupam Enterprises
- k. Grand Polycoats
- l. Bombay Paints Ltd.
- m. Vanaprabha Esters & Glycer, Mumbai
- n. Sunil Paints and Varnishes Pvt. Ltd.
- o. Courtaulds Coating & Sealants India (Pvt.) Ltd.
- p. Mark-chem Incorporated, Mumbai (for phosphating chemicals only)
- q. VCM Polyurethane Paint (for polyurethane Paint only)

2.0 FOREIGN VENDORS FOR OVERSEAS PRODUCTS

- a. Sigma Coating, Singapore
- b. Ameron, USA
- c. Kansai Paint, Japan
- d. Hempel Paint, USA
- e. Valspar Corporation, USA
- f. Courtaulds Coating, UK.

Notes:

1. Bidder can select equipment of two different makes, selected from this VENDOR LIST and mention the same in the checklist for technical evaluation attached with the tender. The offered bid must include filled datasheet indicating make, model, size, rating of offered instrument/ equipment duly supported by sizing calculation of offered equipment (wherever applicable).
2. Vendors who have already supplied above equipment in other terminals of client, shall also be considered qualified for this tender provided the supplied equipment are commissioned and running successfully and they have not been put on holiday.
3. Equipment / Instruments of any make which is offered by one bidder and acceptable to client shall be accepted for other bidder also. After placement of order, on request of the successful bidder list of other qualified makes for a particular item (for which successful bidder wants to change the vendor) shall be provided.
4. Bidder shall take prior approval of the make / model no of the offered item and it shall be from the list given above. However additional vendors will be considered in exceptional cases, provided they have supplied for similar application to reputed gas transmission/distribution companies, in quantities at least half the numbers being supplied for this tender, and working satisfactorily for minimum 6 months. Documentary evidence substantiating above shall be submitted for taking approval.

F. FOR PE & LMC WORK (GI/CU)

1.0 MDPE PIPE

- a. Mukand Poly Products,
- b. Dewa Polymers Pvt. Ltd.
- c. Rungta Irrigation Ltd.

2.0 MDPE FITTINGS & MDPE VALVES

- d. Aliaxis,
- e. George Fischer,
- f. Al-Aziz,
- g. Kimplas,
- h. Banides,
- i. Agru,
- j. Friatech,
- k. Plasson

3.0 GI PIPE

- a. Swastik Pipe Ltd.
- b. Jindal Industries Ltd.
- c. Vishal Pipes Ltd.
- d. Indus Tubes Ltd
- e. Advance steel Tubes Ltd.
- f. Good Luck Tubes Ltd.
- g. Surya Roshni Limited
- h. APL Apollo Tubes Limited
- i. Jindal Pipes Limited
- j. RK Steel Manufacturing Company Private Limited
- k. PSL Tubes Limited

4.0 CASTING GI FITTINGS

- a. Sarin Industries Ltd.
- b. Jupiter Metal Industries Ltd.
- c. Jainsons Industries Ltd.
- d. Jinan Meide Casting Co. Ltd.
- e. Green Malleable Pvt. Ltd.
- f. Chandan Enterprises

- g. Unique Pipe Fitting Co

5.0 FORGED GI FITTING (FOR HIGH RISE SEGMENT)

- a. Jainsons Industries
- b. B.M. Meters Pvt. Ltd.

6.0 COPPER TUBES & FITTINGS

- a. Jay Banas Mehta Tubes Limited- Trade Mark "MEXFLOW"
- b. Rajco metal (Tubes & Fittings)
- c. Paras Industries
- d. MERCURE METAL & ALLOYS PVT LTD
- e. Chandan Enterprises (Fittings only)

7.0 BRASS VALVES

- a. Universal srl, Italy
- b. Tiemme Raccorderie Sede, Italy
- c. Enolgas Bonimu s.a.s., Italy
- d. Fratelli Fortis s.r.l, Italy
- e. Giacomo Climbrio, Italy
- f. Parker Hannifin S.P.A., USA
- g. Singapore Valve & Amp; Fittings Pte Limited, Singapore /Bengaluru
- h. Rubinetterie Utensilerie Bonomi (RUB), Italy
- i. Zhegiang Valogin Technology Co. Ltd., China,
- j. Ningbo Zhiqing Industrial Co. Ltd., China,
- k. Zhegiang Dunan Valve Co. Ltd.,
- l. Ningbo Huaping, China.
- m. Chandan Enterprises

8.0 Isolation & Appliance valves

- a. Chandan Enterprises

9.0 BRASS FITTINGS

- a. Chandan Enterprises
- b. Paras Industries Ltd.
- c. Chokhawala Distributors Brass Adaptor.

10.0 STEEL RE-INFORCED RUBBER HOSE (TYPE-4)

- a. Super Seal Flexible Hose Ltd.
- b. Suraksha Products Pvt. Ltd.
- c. Vansh Industries
- d. T & L Gases

11.0 CORRUGATED FLEXIBLE METAL HOSES (ANACONDA)

- a. KPC Flex Tubes
- b. Vestas Hose Division
- c. Alpha Flexi Tubes
- d. Chandan Enterprises

Note:

1. Vendor may procure material from any of approved vendors listed.
2. For equipment/components other than the above, vendor shall submit past track record for the proposed sub-vendors and obtain written approval from Owner / Consultant before placing order.
3. In case of exigencies like long delivery periods from approved vendors, the contractor shall list down the proposed suppliers/vendors for such items and submit the same for owner review/approval along with necessary documents/PTR.
4. Non-acceptance of a particular proposed vendor due to any reasons whatsoever shall not be a cause of schedule and cost implication. If equipment is sourced from outside India, vendor shall obtain prior approval for make of equipment before placement of order.

Above mentioned vendor list is tentative and further addition/deletion may be done as per discretion of Owner/VCS.



Energising Quality

LIST OF AUTHORIZED THIRD-PARTY INSPECTION AGENCY (TPIA)

DOC. NO.- VCS-C&P-TPIA-001

Rev No : 17

SL. NO.	NAME OF TPIA
1	Det Norske Veritas (DNV)
2	Germanischer Lloyd Industrial Services GmbH
3	Bureau Veritas (India) Pvt. Ltd.
4	Moody International (India) Pvt. Ltd. (Industry Services Division)
5	SGS India Pvt. Ltd.
6	Certification Engineer International Limited (CEIL)
7	TÜV SÜD South Asia Pvt. Ltd.
8	ABS Industrial Verification (India) Pvt. Ltd.
9	Lloyd Register of Industrial Services
10	IRCLASS Systems and Solutions Private Limited
11	Tata Projects Limited
12	International Certification Services Pvt. Ltd.
13	TUV India Pvt. Ltd., Industrial Services Division
14	Intertek India Pvt. Ltd. (Industry Services Division)
15	Quality Austria Central Asia Pvt. Ltd.
16	Edlipse Engineering Global Pvt. Ltd.
17	TUV-Rheinland
18	Hertz Inspection & Services Pvt Ltd
19	Alfred H Knight India Pvt Ltd (Formely known as Dr. Amin Controllers Pvt Ltd)

**VOLUME B
(CIVIL)**



**North East Gas Distribution Company Limited
(NEGDCCL)**

**COMPOSITE WORK OF MOTHER STATION AT
MANGALDOI FOR CITY GAS DISTRIBUTION
PROJECT OF NEGDCCL**

E-Tender No.:- _ _ _ _ _
DATED:- _ _ _ _ _

(VOLUME II OF II TECHNICAL)



**PREPARED AND ISSUED BY
VCS QUALITY SERVICES PVT. LTD.
Noida, India**



**COMPOSITE WORK OF MOTHER STATION AT MANGALDOI FOR CITY GAS
DISTRIBUTION PROJECT OF NEGDCL**

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Energising Quality

PROJECT NUMBER: C241131



**SCOPE OF WORK
CIVIL- STRUCTURAL AND ARCHITECTURAL**

Total Sheets

4

Document No

C241131

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CS

SOW

6001



North East Gas Distribution Company Limited (NEGDCL)

**COMPOSITE WORK OF MOTHER STATION AT MANGALDOI
FOR CITY GAS DISTRIBUTION PROJECT OF NEGDCL**

**SCOPE OF WORK FOR
CIVIL-STRUCTURAL AND ARCHITECTURAL**

C1	18.16.26	Issued for Client Review	RS	SA	MKC
REV	DATE	DESCRIPTION	PREP	CHKD	APPR

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1.0 INTRODUCTION

North East Gas Distribution Company Limited (NEGDCCL) is a consortium of Assam Gas Company Limited (AGCL) and Oil India Limited (OIL) having its registered office in 6th Floor, central Mall, G.S. Road, Guwahati. NEGDCCL won authorization for C3 geographical areas (GAs) in the northeast region of India viz. GA of Darrang, Udalguri, Sonitpur, Biswanath, Lakhimpur and Dhemaji districts in Assam (GA ID: 11.03) and GA of Sepahijala and South Tripura districts (GA ID: 11.56) and GA of North Tripura, Khowai, Dhalai and Unakoti districts in Tripura (GA ID:11.57).

NEGDCCL intends to develop the City Gas Distribution (CGD) Network in all districts of the GA so as to leverage the synergies anticipated during infrastructure creation, operations & maintenance, and administration of each of the individual GA.

2.0 BRIEF SCOPE OF WORK

The scope of Civil-Structural and Architectural works under this Contract shall include detailing, supply and construction of all relevant civil-structural works as per Drawings enclosed with the document.

Major Civil/Structural and Architectural works involved shall include but not be limited to the following:

- a. Site Clearing / Grading.
- b. Existing trees in the plot shall be retained, no cutting of trees shall be permitted.
- c. Earthwork in Excavation, Backfilling & Disposal in Foundation including dewatering during excavation, if required.
- d. Plain & Reinforced cement concrete.
- e. Centering & Shuttering.
- f. Pits and Cable Trenches, earth retaining structure for underground works.
- g. Brick masonry.
- h. RCC/Paver Block pavements, Roads, Footpath.
- i. Structural steel works.
- j. Painting of Building and Structural Steel works.
- k. Preparation of fabrication drawings for all structural steel works and bar bending schedules for all RCC works.
- l. As built drawings / documents of all station.
- m. For scope of other Civil Structural works, Pipeline, Instrumentation, Mechanical and Electrical scope of works shall also be referred to.

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- n. Any other civil and structural works required/directed by Engineer-in-charge for the satisfactory and successful completion of the project shall be included in the lump sum cost and at no extra cost to the owner.

3.0 SCOPE OF WORK

Civil structural and architectural work complete in all respect for following units: -

- a. Control Building.
- b. Boundary wall.
- c. Chain link fencing.
- d. Imported earth Filling
- e. Foundation like check meter, compressor, odorizing unit, DG/GG set, Stationary cascade, Air compressor, Air receiver, CO2 flooding, DRS,
- f. Electrical trench, SS tube trench, Drain.
- g. Pavement.
- h. Soak Pit, Manholes, Septic Tank, Gully Trap, Percolation pit
- i. Dispenser Island and canopy.
- j. Plaster & Painting Works
- k. LCV Platform and Stand
- l. Barbed wire, Concertina coil, Y-angle
- m. 4mtr wide gate & 2 mtr wide gate.

4.0 SCOPE OF SUPPLY

All materials (consumables/non-consumables) including cement, structural steel and reinforcement bars required to complete the civil & structural works including Tools & Tackles shall be supplied by the contractor.

5.0 LIST OF STANDARDS, SPECIFICATIONS & DRAWINGS

Attached elsewhere in the Tender document.

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Energising Quality

PROJECT NUMBER: C241131

NEGDCL

North East
Gas Distribution
Company Limited

Funding dreams for a
sustainable tomorrow

**LIST OF ATTACHMENT
CIVIL- STRUCTURAL AND ARCHITECTURAL**

Total Sheets

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6001



North East Gas Distribution Company Limited (NEGDCL)

**COMPOSITE WORK OF MOTHER STATION AT MANGALDOI
FOR CITY GAS DISTRIBUTION PROJECT OF NEGDCL**

**LIST OF ATTACHMENT
CIVIL-STRUCTURAL AND ARCHITECTURAL**

C1	18.06.26	Issued for client review	RS	SA	MKC
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**COMPOSITE WORK OF MOTHER STATION AT MANGALDOI FOR
CITY GAS DISTRIBUTION PROJECT OF NEGDCCL**

CONTENTS

1.0 LIST OF ATTACHMENTS.....3

2.0 STANDARD DRAWINGS 3

3.0 SPECIFICATIONS.....5

1.0 LIST OF ATTACHMENTS

Contractor shall carry out all works strictly in accordance with the drawings/documents/specifications indicated in subsequent paragraphs.

2.0 STANDARD DRAWINGS

Sr. No	Standard Drawings Number	Description	Sheet No.
1	VCS-STD-CS-6001	Detail of Road Curves and Crossing	1
2	VCS-STD-CS-6002	Chain Link Fencing	2
3	VCS-STD-CS-6003	Detail Of Soak Pit	1
4	VCS-STD-CS-6004	Detail Of Septic Tank	1
5	VCS-STD-CS-6005	Standard section of storm water drains	1
6	VCS-STD-CS-6006	Trench Sand Bedding	1
7	VCS-STD-CS-6007	Concrete Bedding & Encasement for Pipes	1
8	VCS-STD-CS-6008	Pipe Culvert for Storm Water Drainage	1
9	VCS-STD-CS-6009	Rain Water Harvesting Pit	1
10	VCS-STD-CS-6010	Cross Section of Road	3
11	VCS-STD-CS-6012	Man Holes (SWS) type-1 for depth < 1M(<300)	1
12	VCS-STD-CS-6013	Man Holes type-2 sanitary waste system for depth <2M(500)	1
13	VCS-STD-CS-6015	Brick masonry compound wall	1
14	VCS-STD-CS-6017	Brick footpath	1
15	VCS-STD-CS-6018	RCC pavement details	1
16	VCS-STD-CS-6019	Concrete trapezoidal storm water drain (height (h)<3.0m)	1
18	VCS-STD-CS-6031	Standard Typ. Details of Cable Trench	1
19	VCS-STD-CS-6032	R.C.C Flooring Details(Type I & II)	2
20	VCS-STD-CS-6033	Handrail On Steel Platform	1
21	VCS-STD-CS-6034	Sliding T- Support	2
22	VCS-STD-CS-6035	Small operating platforms on grade/ RCC elevation structure	3
23	VCS-STD-CS-6036	Standard Grating Details	3
24	VCS-STD-CS-6037	Pipe sleeper Crossover	3

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Sr. No	Standard Drawings Number	Description	Sheet No.
25	VCS-STD-CS-6038	Miscellaneous Details	1
26	VCS-STD-CS-6039	Details of Steel Ladder	3
27	VCS-STD-CS-6040	Metal Insert Plates	7
28	VCS-STD-CS-6041	Cantilever Pipe Support	1
29	VCS-STD-CS-6043	Standard for detail of Pedestal for stair / ladder	1
30	VCS-STD-CS-6044	Details of Block foundation for transformers (up to 2000 KVA rating)	1
31	VCS-STD-CS-6046	Details for M.S. rungs for conc. structures	1
32	VCS-STD-CS-6048	Reinforcement details at circular cut-out in slab	1
33	VCS-STD-CS-6049	Reinforcement details at sq. / rect. cut-out in slab	1
34	VCS-STD-CS-6050	Standard lugs	1
35	VCS-STD-CS-6051	Box culvert Type I,II,III & IV	1
36	VCS-STD-CS-6052	Typical grating support.	1
37	VCS-STD-CS-6053	Typical Chequered Plate Support	1
38	VCS-STD-CS-6054	M.S. anchor bolt assemblies	4
39	VCS-STD-CS-6055	RCC pipe support	1
40	VCS-STD-CS-6060	Standard for Detail of False Flooring	3
41	VCS-STD-CS-6061	Wash Basin Fixing Detail	1
42	VCS-STD-CS-6062	European Type W.C. Fixing Detail	1
43	VCS-STD-CS-6063	Urinal Fixing Detail	1
44	VCS-STD-CS-6064	Standard for Detail of Glazed Aluminum Doors	2
45	VCS-STD-CS-6065	Wooden Flush Door	1
46	VCS-STD-CS-6066	Glazed Aluminum Window	1
47	VCS-STD-CS-6067	False Ceiling	1
48	VCS-STD-CS-6068	Standard for Detail of Hung Gate	4
49	VCS-STD-CS-6070	Typ. Plinth protection	1
50	VCS-STD-CS-6071	Aluminum sliding window	1
51	VCS-STD-CS-6072	Aluminum ventilator	1

 Energising Quality	LIST OF ATTACHMENT CIVIL -STRUCTURAL AND ARCHITECTURAL	Document No.	Rev
		C241131-00-CS-LOA-6001	C1
		Page 4 of 6	

Sr. No	Standard Drawings Number	Description	Sheet No.
52	VCS-STD-CS-6073	Standard for Detail of Barbed wire fencing(With angle Iron post)	1

3.0 SPECIFICATIONS

Sr. No	Specification Number	Description	Sheet No.
2	VCS-SS-CS-6002	Earthwork in site grading	09
3	VCS-SS-CS-6003	Earthwork for underground piping	08
4	VCS-SS-CS-6004	Roads and flexible pavements (up to WBM layer)	12
5	VCS-SS-CS-6006	Concrete pavement	11
6	VCS-SS-CS-6007	Flexible pavement with bitumen premix carpet	09
7	VCS-SS-CS-6008	RCC pipe culverts & ERC crossing etc.	06
8	VCS-SS-CS-6010	Gravel filling	06
9	VCS-SS-CS-6011	Misc. civil & structural works for underground services	07
10	VCS-SS-CS-6012	Plumbing & drainage	09
11	VCS-SS-CS-6013	Chain link fencing	08
12	VCS-SS-CS-6020	General scope	05
13	VCS-SS-CS-6021	Materials	17
14	VCS-SS-CS-6022	Earth work in foundations	13
15	VCS-SS-CS-6023	Plain and reinforced cement concrete	35
16	VCS-SS-CS-6024	Structural steel works	26
17	VCS-SS-CS-6026	Miscellaneous steel works	13
18	VCS-SS-CS-6027	Brick masonry	09
19	VCS-SS-CS-6028	Stone masonry	10
20	VCS-SS-CS-6029	Demolition & dismantling	08
21	VCS-SS-CS-6030	Miscellaneous items	09
21	VCS-SS-CS-6031	Soil Investigations	35
22	VCS-SS-CS-6040	Floor finishing	19
23	VCS-SS-CS-6041	Wood work	08

 Energising Quality	LIST OF ATTACHMENT CIVIL -STRUCTURAL AND ARCHITECTURAL	Document No.	Rev
		C241131-00-CS-LOA-6001	C1
		Page 5 of 6	

COMPOSITE WORK OF MOTHER STATION AT MANGALDOI FOR CITY GAS DISTRIBUTION PROJECT OF NEGDCCL

Sr. No	Specification Number	Description	Sheet No.
24	VCS-SS-CS-6042	Steel aluminum doors, windows and ventilators	09
25	VCS-SS-CS-6043	Plastering & Pointing	10
26	VCS-SS-CS-6044	Roof Treatment	05
27	VCS-SS-CS-6045	White washing, Colour washing, distempering, painting and polishing	15
28	VCS-SS-CS-6046	Roofing	10
29	VCS-SS-CS-6047	False ceiling, false flooring, under deck insulation & partitioning	12
30	VCS-SS-CS-6048	Acid proof tile lining	06
31	VCS-SS-CS-6100	Inspection and Test Plan (ITP) for Civil Structural & Architectural Works	31



Energising Quality

LIST OF ATTACHMENT CIVIL -STRUCTURAL AND ARCHITECTURAL

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C1

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VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD DRAWING FOR OF ROAD CURVES AND CROSSINGS

STANDARD DRAWING NO.

VCS-STD-CS-6001

SHEET NO.

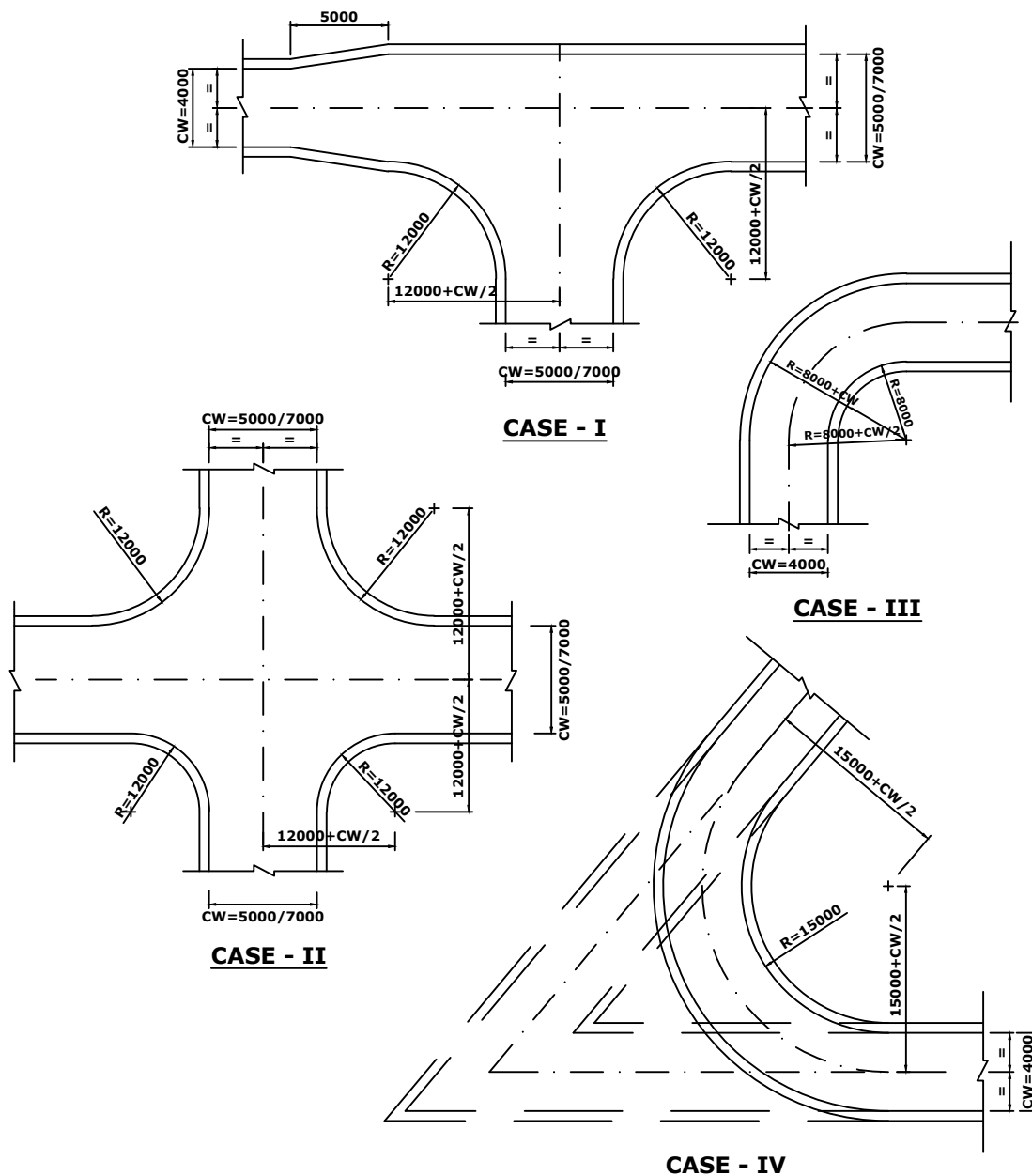
1 OF 1

REV.

03

SIZE

A4

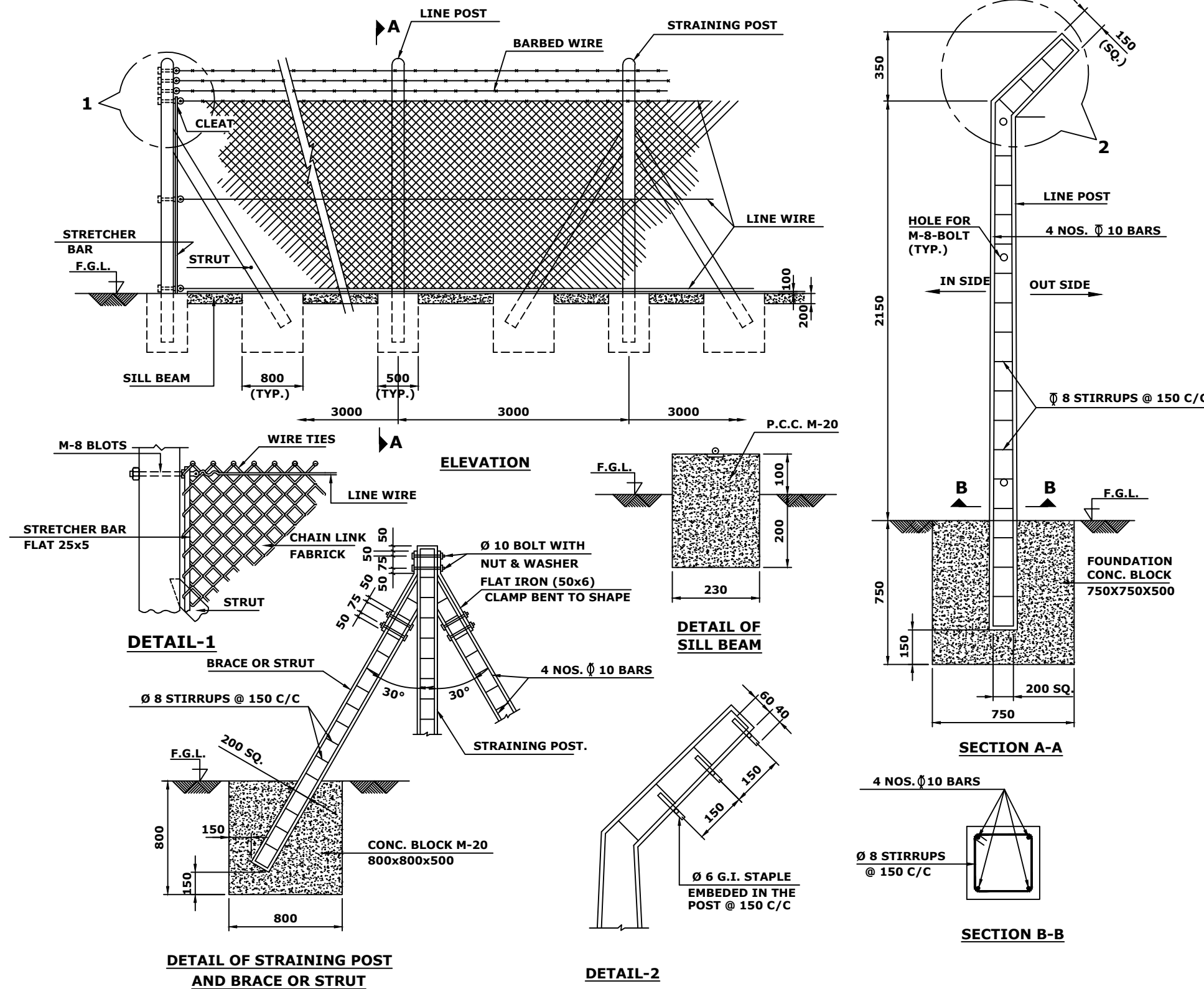


NOTES:-

1. ALL DIMENSIONS ARE IN MM. UNLESS OTHERWISE MENTIONED.
2. MINIMUM RADIUS OF CURVES FOR ROADS WITH $CW=4.0m$
3. MINIMUM RADIUS OF CURVES FOR ROADS WITH $CW>4.0m$ SHALL BE 12m.
4. RADIUS OF CURVES FOR APPROACH ROADS TO BUILDINGS AND OTHERS AREAS MAY BE REDUCED AS PER SERVICES REQUIRMENTS.
5. FOR ROAD CURVES WITH ACUTE ANGLE TURNING. THE MINIMUM RADIUS SHALL BE 15m AND ANGLE NOT LESS THAN 50° .

6. RADIUS OF CURVES AND CROSSING WHEN DIFFERENT FROM THOSE GIVEN IN THIS STANDARD TO MEET ANY SPECIAL REQUIRMENT SHALL BE SO MARKED IN THE AREA DRAWINGS.

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



NOTES:-

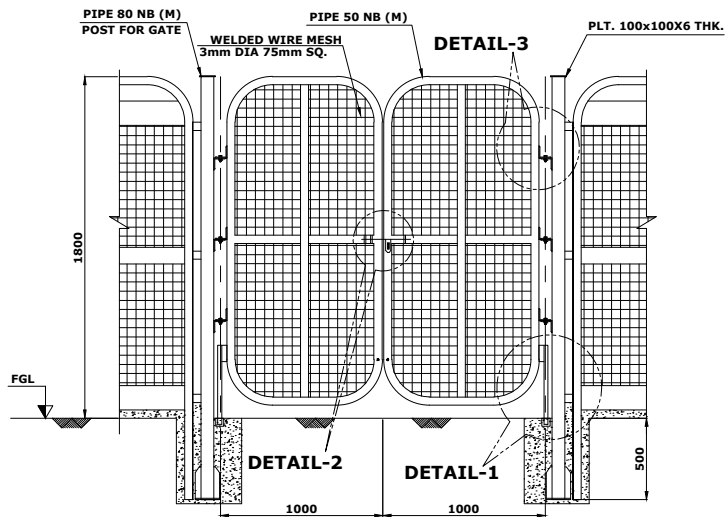
- ALL DIMENSIONS ARE IN MILLIMETERS.
- THE GALVANISED STEEL BARBED WIRE A1 TO IS:278 SHALL HAVE LINE WIRE OF Ø 2.5 MM POINT WIRE OF Ø 2.0 MM & MINIMUM WEIGHT OF COMPLETE BARBED WIRE SHALL BE 108gm/m WITH 75 MM DISTANCE BETWEEN TWO BARS.
- LINE POST SHALL BE PLACED AT 3.0 M C/C.
- STRUT SHALL BE PROVIDED AT EVERY 15 TH. POST LAST BUT ONE END POST & CORNER POST ON BOTH SIDE & END POST ON ONE SIDE ONLY.
- REINF. STEEL SHOWN THUS Ø SHALL CONFORM TO IS:1786 LATEST & REINF. STEEL SHOWN THUS Ø SHALL CONFORM TO GRADE Fe 415 (MIN.) LATEST.
- STRAINING BOLTS SHALL BE PROVIDED AT THE END POST & AT PLACES AS DIRECTED BY ENGINEER INCHARGE.
- SIZE OF STRAINING POST SHALL BE SAME AS THAT OF LINE POST.
- GRADE OF CONC. SHALL BE AS FOLLOWS:
MODERATE SOIL SEVRE/
AGGRASSIVE SOIL
i) LINE & STRAINING POSTS RCC M25 RCC M30
ii) FOUNDATION BLOCKS PCC M20 PCC M20
iii) SILL BEAM PCC M20 PCC M20
iv) BRACE OR STRUT RCC M25 RCC M30
- MANUFACTURE OF CONC. POSTS SHALL CONFORM TO IS:4996.
- THE CHIAN LINK FABRIC SHALL CONFORM TO IS:2721.
- STRETCHER BAR SHALL BE HOT DIP GALVANISED.
- SUITABLE INSERTS SHALL BE PROVIDED ON THE TOP OF THE SILL BEAM TO TIE THE BOTTOM LINE WIRE WITH THE SILL BEAM.



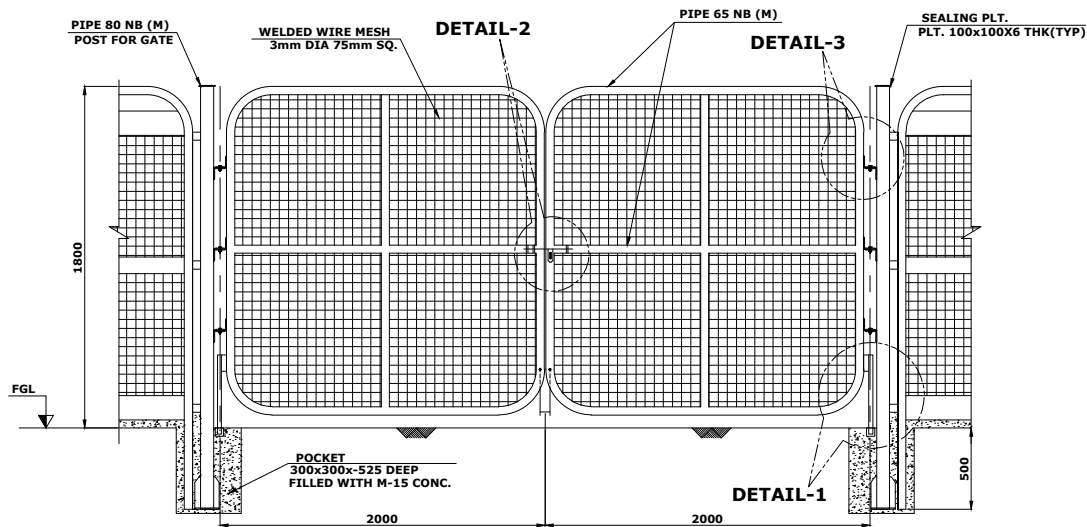
VCS QUALITY SERVICES
PRIVATE LIMITED

DETAIL OF CHAIN LINK
FENCING (WITH CONC. POST)

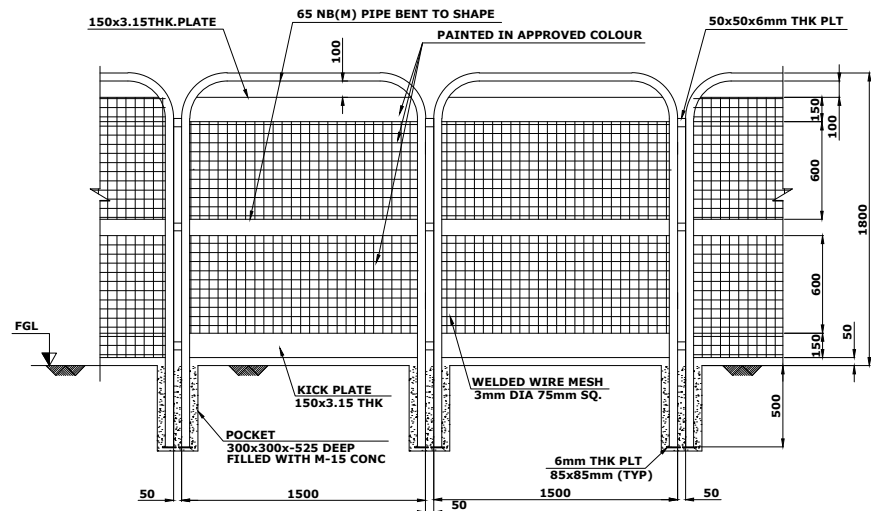
							STANDARD DRAWING NO.		REV.	SIZE
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG				
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK	VCS-STD-CS-6002		03	A3
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY	SHEET NO.	1 OF 2		



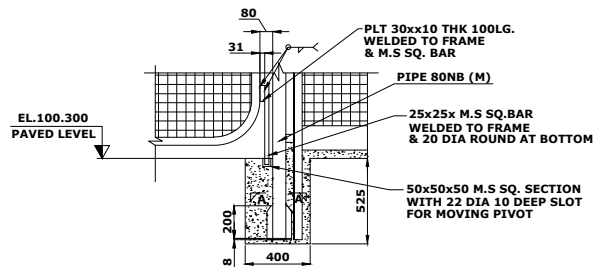
**2.0 WIDE GATE DETAIL
2100 HIGH**



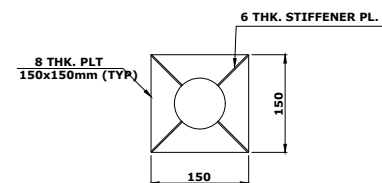
4.0 WIDE GATE DETAIL



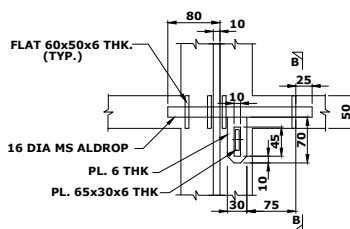
TYPICAL FENCING DETAIL



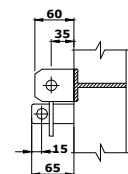
DETAIL - 1



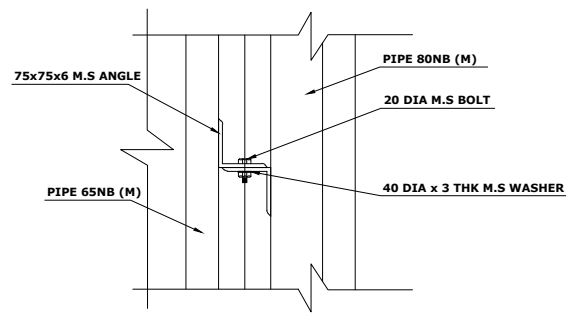
SECTION A-A



DETAIL - 2



SECTION B-B



DETAIL - 3

1. ALL DIMENSIONS AND LEVELS ARE IN mm. (UNLESS MENTIONED OTHERWISE)
2. ONLY FIGURED DIMENSIONS ARE TO BE FOLLOWED.
3. ALL STRUCTURAL STEEL SHALL CONFORM TO I.S :2062-2011 GRADE-A.
4. FABRICATION SHALL BE DONE IN ACCORDANCE TO I.S :800-2007
5. ALL WELD SHALL BE 6MM FILLET WELD UNLESS OTHERWISE STATED.
6. ALL SHOP JOINTS SHALL BE COMPLETELY WELDED WITH CONTINUOUS FILLET WELD FOR CONTACT LENGTH.
7. FABRICATION OF ALL MEMBERS TO BE DONE AFTER FULL SCALE SHOP LAYOUT BEFORE CUTTING MEMBERS.
8. FOR ACTUAL LAYOUT AND LOCATION OF CHAIN LINK FENCING AND GATE REFER PLOT PLAN.



 VCS QUALITY SERVICES PRIVATE LIMITED Energising Quality	DETAIL OF CHAIN LINK FENCING & GATE (WITH STEEL POST)								STANDARD DRAWING NO.		REV.	SIZE
		03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG	VCS-STD-CS-6002		03	A3
		02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK				
		REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY	SHEET NO.	2 OF 2		



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD DRAWING FOR DETAIL OF SOAKPIT

STANDARD DRAWING NO.

REV.

SIZE

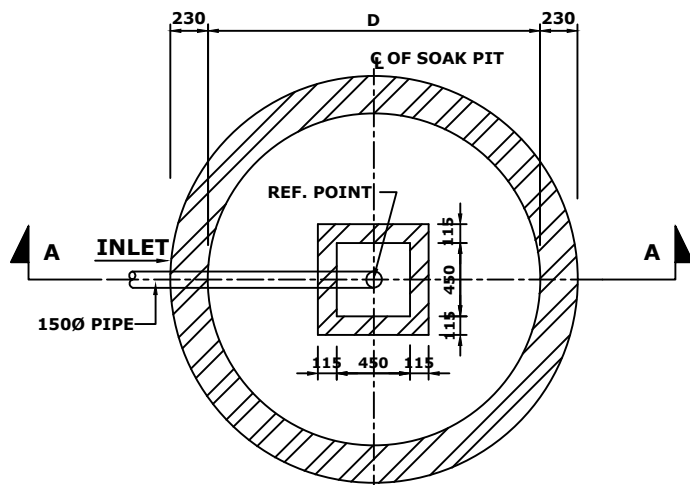
VCS-STD-CS-6003

03

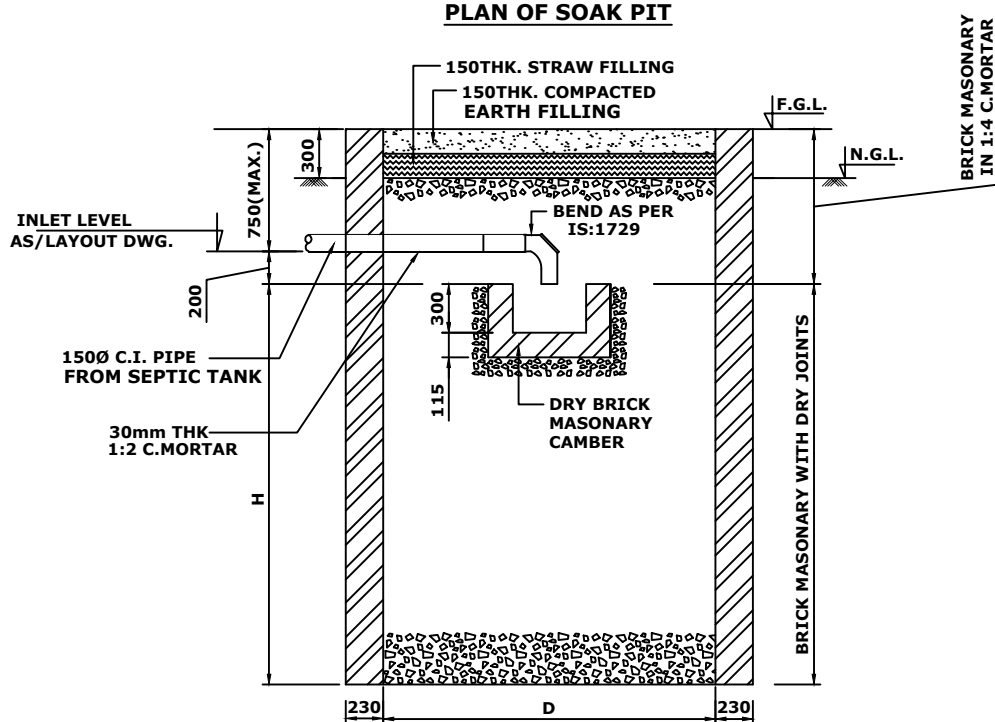
A4

SHEET NO.

1 OF 1



PLAN OF SOAK PIT



SECTION A-A

TABLE

TYPE	NO. OF USERS	DEPTH IN METERS	DIA IN METERS	AREA OF ABSORPTION
1	10	2.5	2.5	24.53
2	25	5.0	3.25	59.35
3	50	7.0	3.6	89.30
4	100	10.0	5.0	196.25

NOTES:-

- ALL DIMENSIONS ARE IN MILLIMETERS EXCEPT LEVELS AND CO-ORDINATES WHICH ARE IN METERS.
- THE FILLING OF BRICK BATS IN SOAKPIT SHALL BE DONE SIMULTANEOUSLY WITH CONST. OF BRICK WALLS AS WORK PROGRESS.
- C.I. PIPE SHALL CONFORM TO IS: 3486.
- DEPTH AND DIA CAN BE SUITABLY ADJUSTED TO GIVE THE ABSORPTIVE AREA DEPENDING UPON THE SUB SOIL WATER TABLE.
- BOTTOM OF THE SOAKPIT SHOULD NOT BE LESS THAN 600mm ABOVE THE SUB SOIL WATER.

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD DRAWING FOR DETAIL OF SEPTIC TANK

STANDARD DRAWING NO.

VCS-STD-CS-6004

SHEET NO.

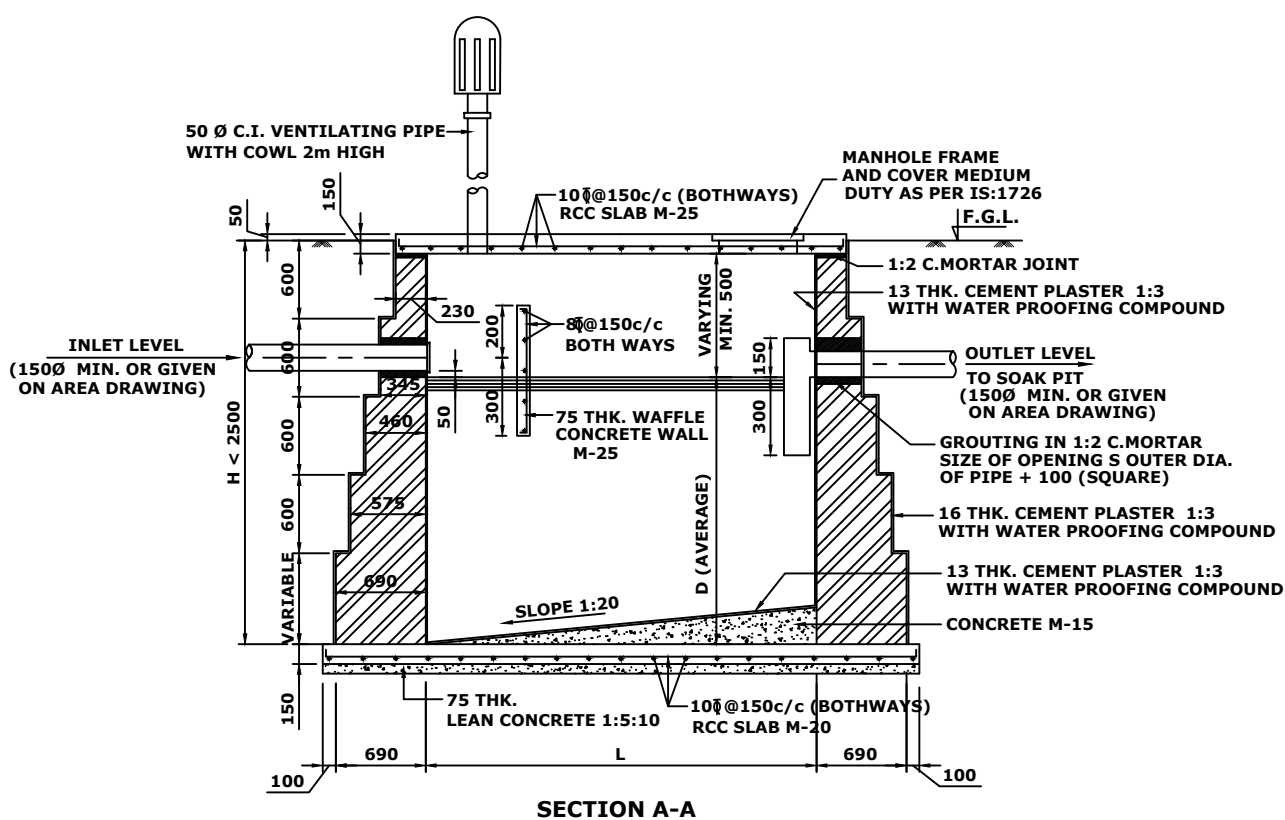
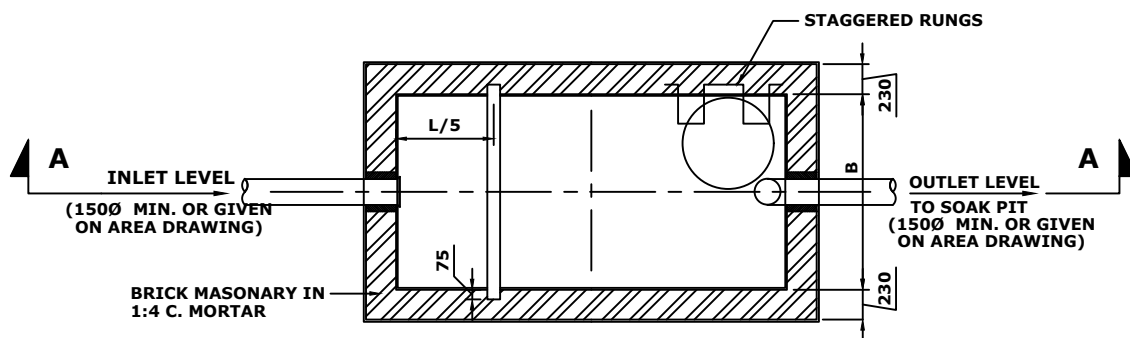
1 OF 1

REV.

03

SIZE

A4



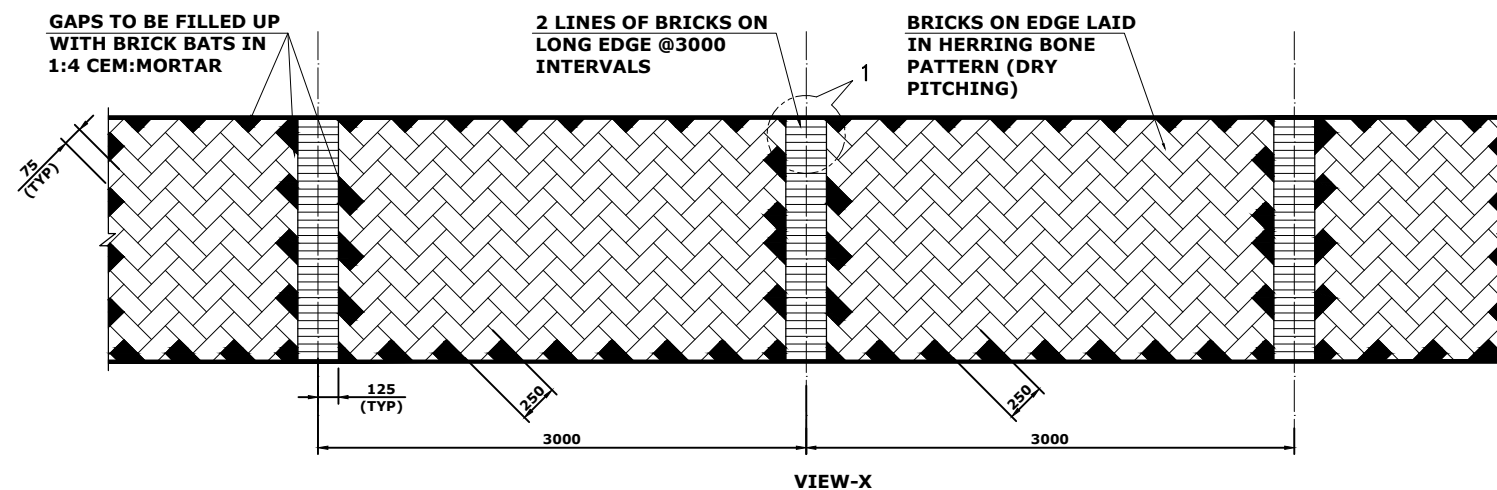
RECOMMENDED DIMENSIONS OF SEPTIC TANK

TYPE	NO. OF USERS	LENGTH (L)	BREADTH (B)	LIQUID DEPTH (D)
1	10	2000	900	1000
2	20	2300	1100	1300
3	30	4000	1400	1300
4	50	4750	1700	1500

NOTES:-

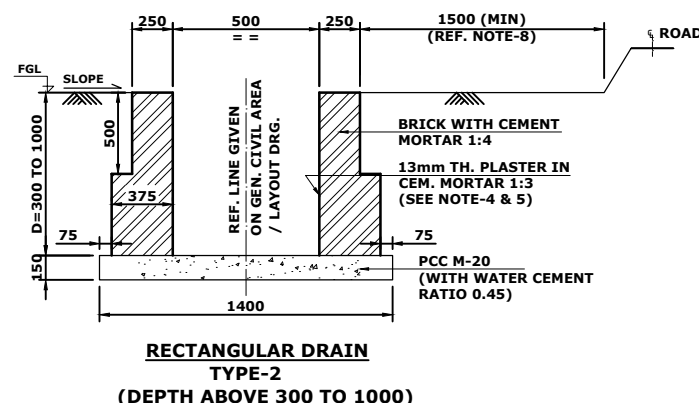
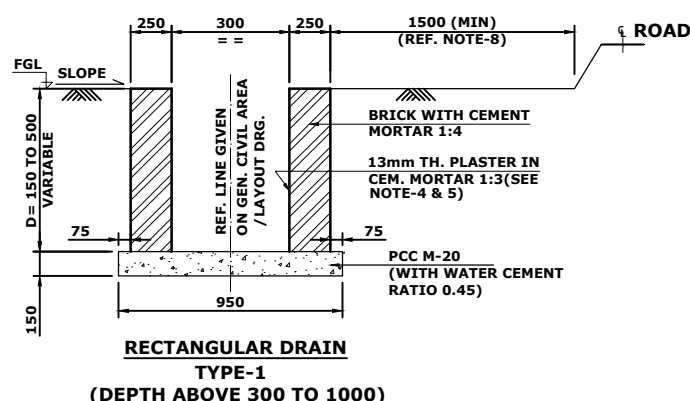
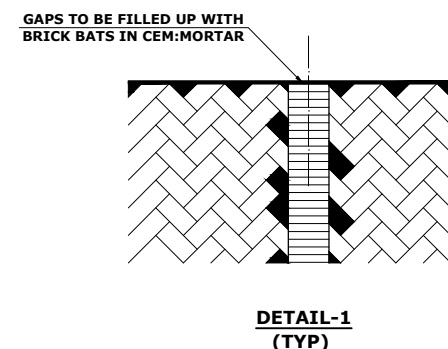
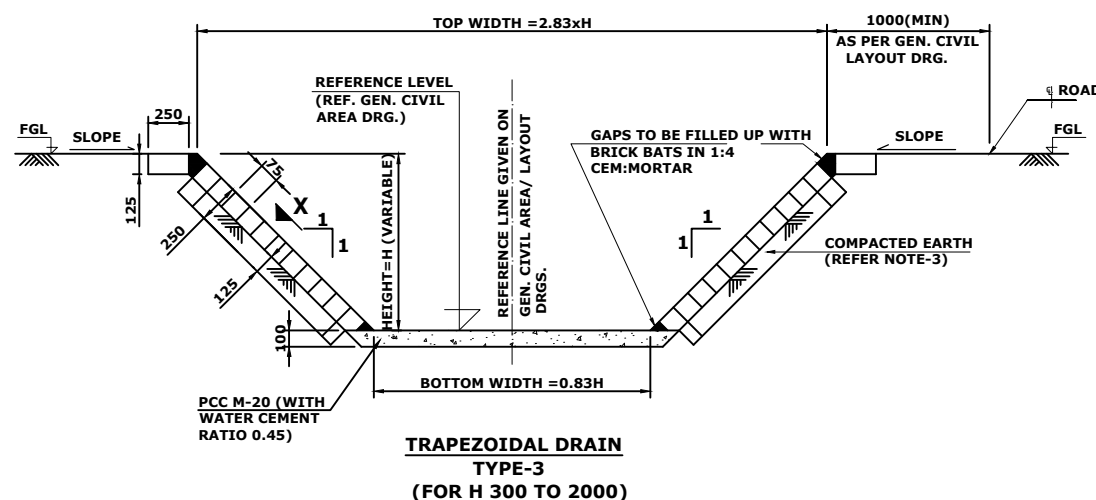
1. ALL DIMENSIONS ARE IN MM. & LEVEL IN METRES.
2. FOLLOW WRITTEN DIMENSIONS ONLY. DO NOT SCALE.
3. CLEAR COVER TO MAIN REINF. SHALL BE: (a) SLAB = 30 mm
4. Φ DENOTES HIGH YIELD STRENGTH DEFORMED BARS OF GRADE Fe 415 (MIN.) CONFORMING TO IS -1786 .
5. DESLUDGING SHALL BE DONE PERIODICALLY EVERY YEAR PREFERABLY BY A PORTABLE NON CLDG. PUMP.

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



NOTES:-

1. ALL DIMENSIONS ARE IN MM. UNLESS NOTED OTHERWISE.
2. (a) THIS STD. IS APPLICABLE FOR OFFSITE AREAS ONLY.
(b) WHEREVER TYPE 1 & 2 DRAINS ARE LAID IN EXPANSIVE SOIL. A LAYER OF MINIMUM 250mm THICK SAND SHALL BE PROVIDED BELOW AND AROUND THE SIDES OF DRAIN.
(c) TRAPEZOIDAL DRAIN (TYPE-3) IS NOT SUITABLE FOR AREAS WITH EXPANSIVE SOIL AND SANDY SOIL.
3. BRICK PITCHING SHALL BE DONE ONLY AFTER THE SIDES OF DRAIN ARE CUT, COMPACTED TO 90% OF MAX. LABORATORY DRY DENSITY AND DRESSED TO THE REQUIRED SLOPE.
4. 13mm THK. PLASTER IN CEM. MORTAR 1:3 SHALL BE PROVIDED ON BENDS UP TO A DISTANCE OF 1.5M ON EITHER SIDE OF THE BEND FOR ALL DRAINS. FLUSH CEMENT POINTING IN CEMENT MORTAR 1:3 SHALL BE DONE AT OTHER PLACES.
5. INTERNAL PLASTER OF SAME SPECIFICATION AS SHOWN IN NOTE-4 IN RECTANGULAR DRAIN TYPE-1 & 2 SHALL BE DONE ONLY FOR THE PORTION OF DRAIN LOCATED NEAR BUILDING.
6. EXACT THICKNESS OF BRICK MASONRY WORK SHALL BE ACCORDING TO THE SIZE OF LOCALLY AVAILABLE BRICK HERE BRICK SIZE IS CONSIDERED AS 250x125x75.
7. THIS STANDARD DRG. SHALL BE VALID WHERE WATER TABLE IS UP TO FGL.
8. 1500 mm (MIN) HAS BEEN KEPT TO AVOID THE IMPACT OF SURCHARGE PRESSURE OF ROAD EMBANKMENT OF THE WALL OF THE DRAIN.



 VCS QUALITY SERVICES PRIVATE LIMITED Energising Quality	STANDARD SECTION OF STORM WATER DRAINS								STANDARD DRAWING NO.		REV.	SIZE
		03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG	VCS-STD-CS-6005		03	A3
		02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK				
		REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY	SHEET NO.	1 OF 1		



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD
FOR
TRENCH SAND BEDDING

STANDARD DRAWING NO.

VCS-STD-CS-6006

SHEET NO.

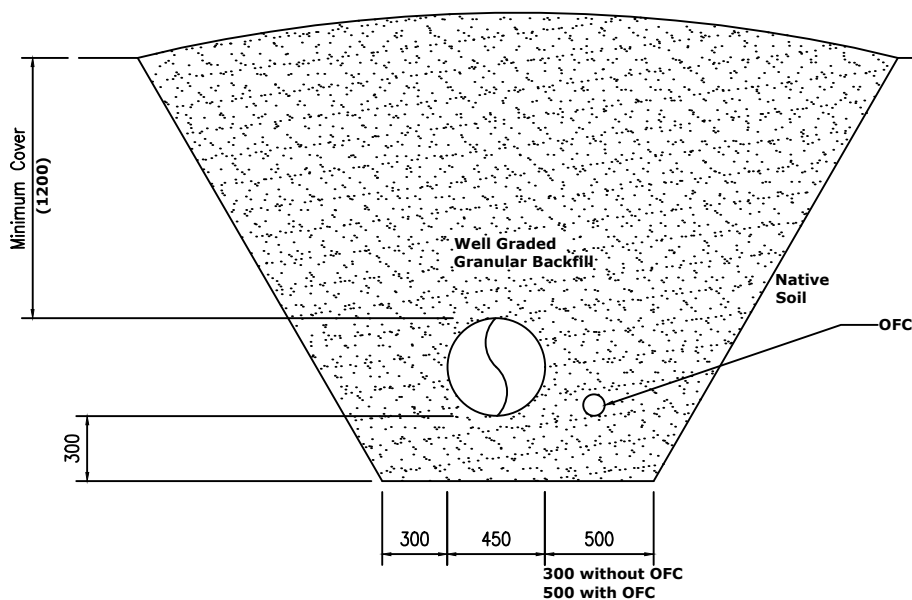
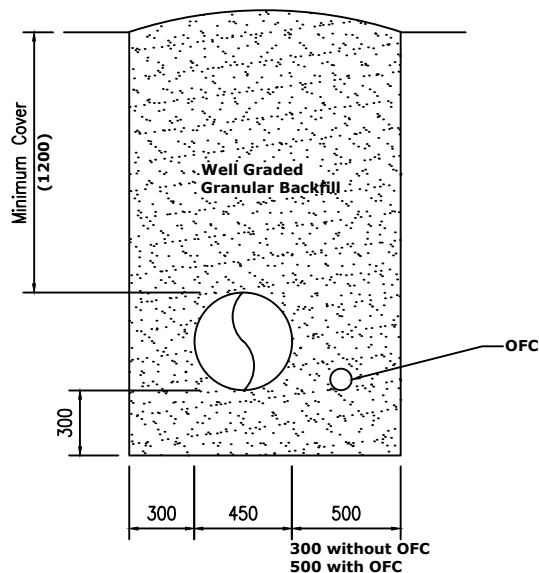
1 OF 1

REV.

03

SIZE

A4



03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD DRAWING FOR
CONCRETE BEDDING AND
ENCASEMENT FOR PIPES

STANDARD DRAWING NO.

VCS-STD-CS-6007

SHEET NO.

1 OF 1

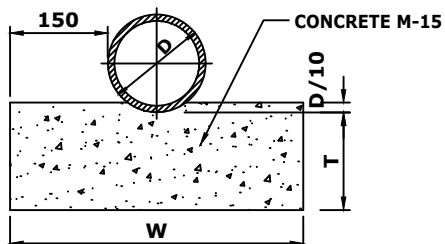
REV.

03

SIZE

A4

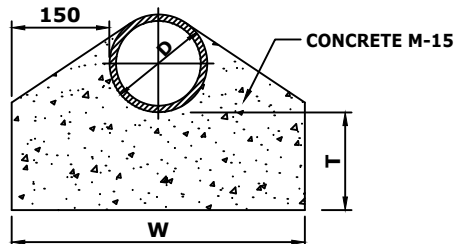
TYPE-I



SECTION ELEVATION OF BEDDING

(FOR C.S PIPE SEWER WHERE SUPPORT IS REQUIRED)

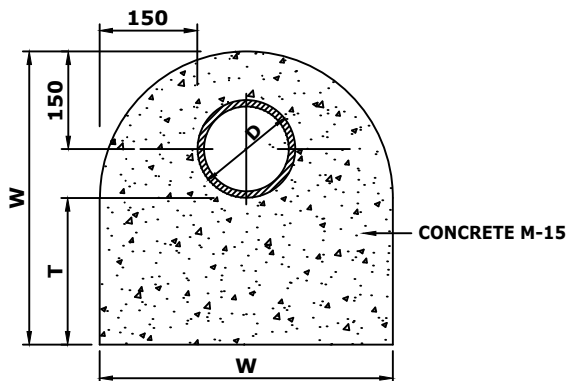
TYPE-II



SECTION ELEVATION OF HAUNCHING

(FOR HDPE, SW PIPE SEWERS)

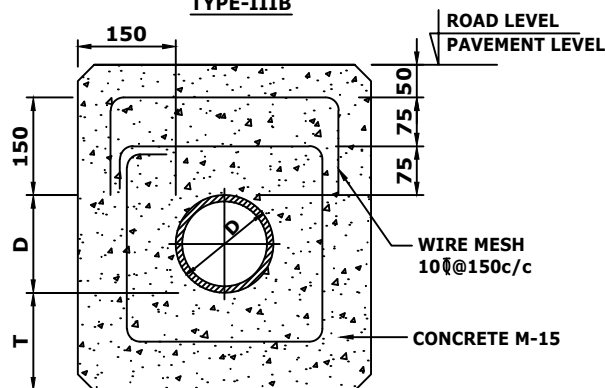
TYPE-IIIA



SECTION ELEVATION SURROUND OR ENCASING

(FOR SEWERS UNDER ROADS COVER > 600mm)

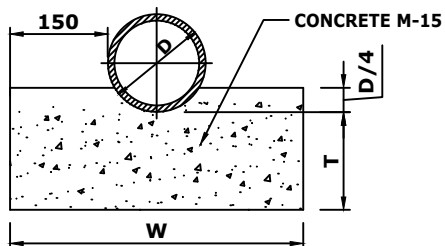
TYPE-IIIB



SECTION ELEVATION SURROUND OR ENCASING

(FOR SLEEVES/PIPES CULVERTS UNDER ROADS FOR COVER < 600mm)

TYPE-IV



SECTION ELEVATION CONCRETE GRADE BEDDING

(FOR SEWERS - CONCRETE PIPE)

LEGEND

D = EXTERNAL DIA OF PIPE

W = D+300

T = 100 FOR PIPES UNDER 150 NOMINAL DIA.

T = 150 FOR PIPES OF 150 NOMINAL DIA AND ABOVE.

NOTES:-

1. BEDDING:- WHERE BEDDING IS USED, THE CONCRETE SHALL BE BROUGHT UP TO ATLEAST TO THE INVERT LEVEL OF THE PIPE TO FORM A CRADLE & TO AVOID LINE CONTACT BETWEEN THE PIPE AND BED.
2. HAUNCHING:- THE FULL WIDTH OF THE BED SHALL BE CARRIED TO THE LEVEL OF THE HORIZONTAL DIAMETER OF THE PIPE AND SPLAYS FROM THIS LEVEL CARRIED ON BOTH SIDES OF THE PIPE TO MEET THE PIPE BARREL TANGENTIALLY.
3. SURROUNDED OR ENCASING TYPE-IIIA:- THE SURROUND OR ENCASING SHALL BE SIMILAR TO HAUNCHING UP TO THE HORIZONTAL, DIA OF THE PIPE & THE PORTION OVER THIS SHALL BE FINISHED IN A SEMI-CIRCULAR FORM TO GIVE A UNIFORM ENCASING FOR THE TOP HALF OF THE PIPE.
TYPE-IIIB:- IT IS SIMILAR TO TYPE-IIIA ABOVE EXCEPT THAT THE TOP PORTION OVER THIS SHALL BE FINISHED RECTANGULAR AS SHOWN AND THE SECTION PROVIDED WITH REINFORCEMENT AS PER REQUIREMENTS.
4. CONCRETE CRADLE BEDDING:- IS THE METHOD OF BEDDING PIPES IN WHICH THE LOWER PART OF THE PIPE EXTERIOR IS BEDDED IN CRADLE CONSTRUCTION OF CONCRETE WITH DIMENSION AS SHOWN.
5. CONCRETE WORK SHALL BE CONFORM TO IS: 456.

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD DRAWING FOR
PIPE CULVERT FOR STORM
WATER DRAINAGE

STANDARD DRAWING NO.

VCS-STD-CS-6008

SHEET NO.

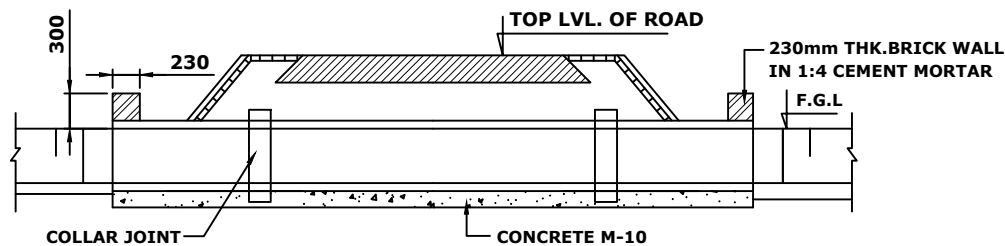
1 OF 2

REV.

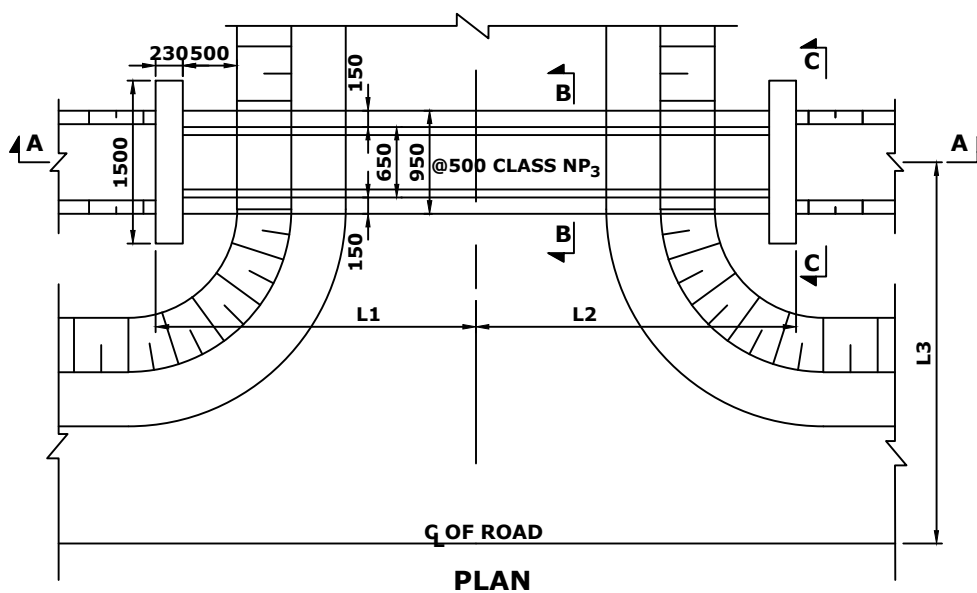
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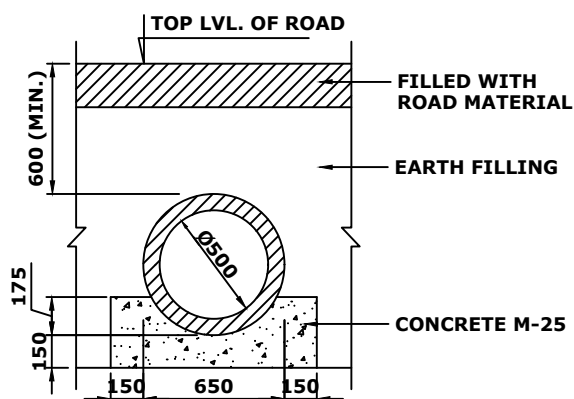
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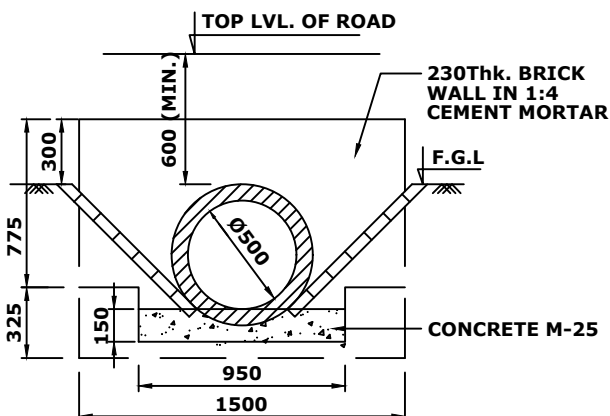
SECTION A-A



PLAN



SECTION B-B



SECTION C-C

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD DRAWING FOR
PIPE CULVERT FOR STORM
WATER DRAINAGE

STANDARD DRAWING NO.

VCS-STD-CS-6008

SHEET NO.

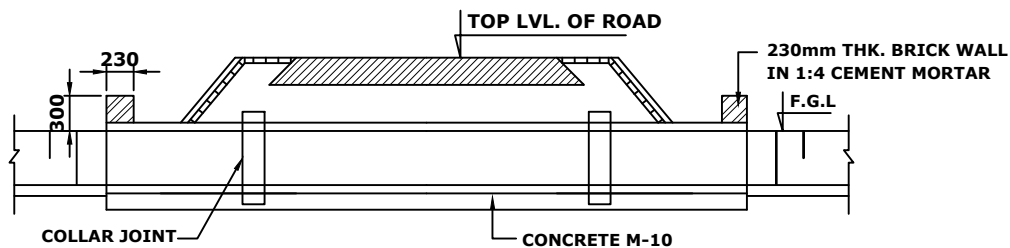
2 OF 2

REV.

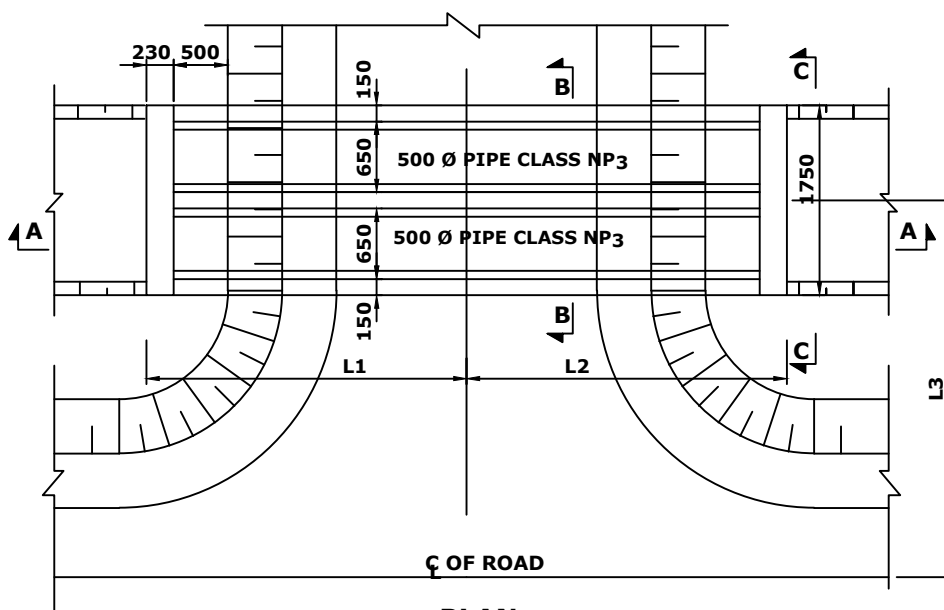
03

SIZE

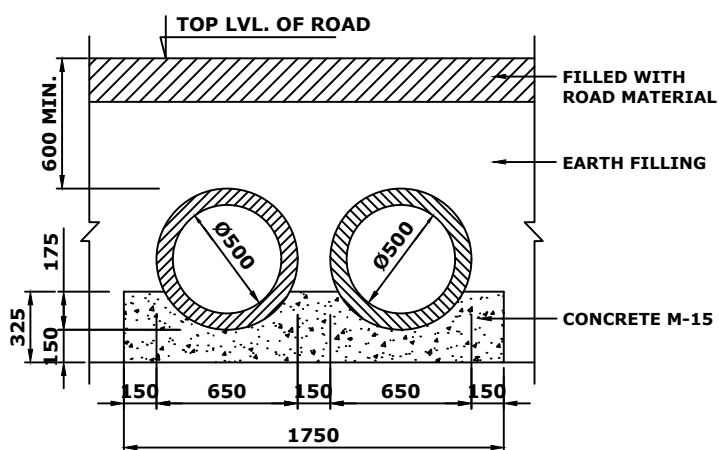
A4



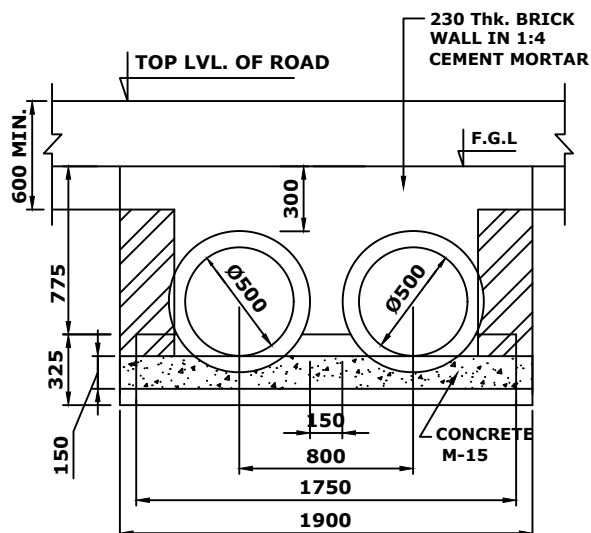
SECTION A-A



PLAN



SECTION B-B



SECTION C-C

03	10.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD DRAWING FOR RAIN WATER HARVESTING PIT

STANDARD DRAWING NO.

VCS-STD-CS-6009

SHEET NO.

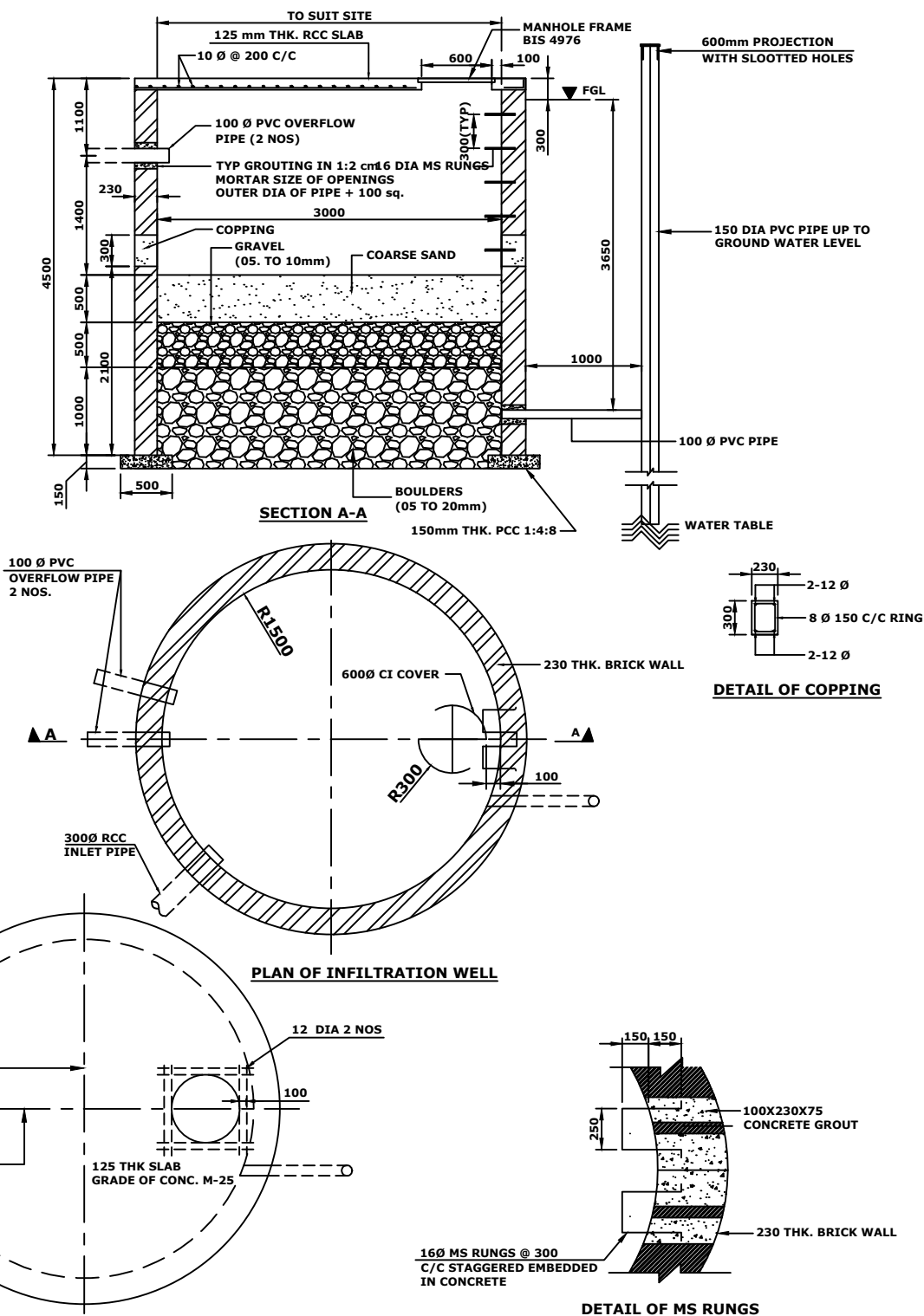
1 OF 1

REV.

03

SIZE

A4



REIN. STEEL SHOWN THUS Ø SHALL CONFORM TO GRADE Fe415 (MIN.) LATEST

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD DRAWING FOR
CROSS SECTION OF ROAD
(6.0 M WIDE)

STANDARD DRAWING NO.

VCS-STD-CS-6010

SHEET NO.

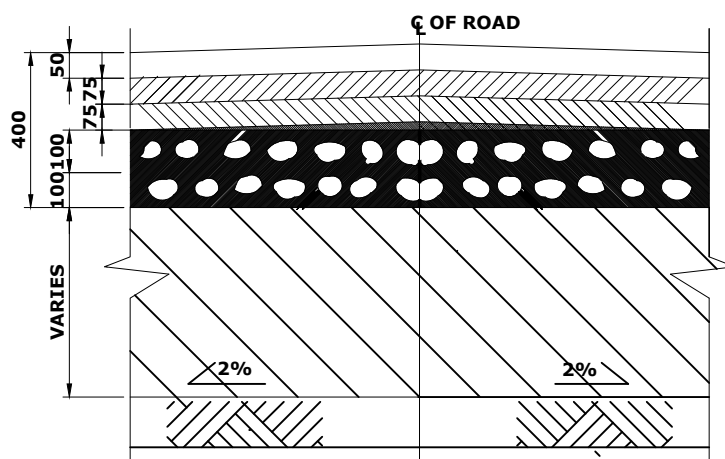
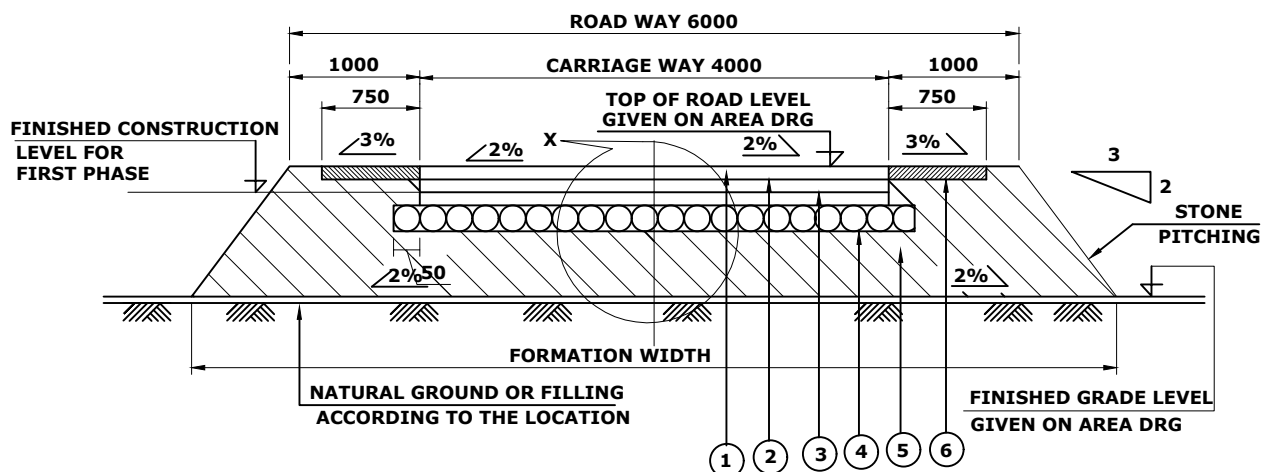
1 OF 3

REV.

03

SIZE

A4



DETAIL - X

LEGEND

1. PREMIX BITUMENOUS CARPET WITH SEAL COAT.
2. SECOND LAYER WATER BOUND MACADAM COURSE WITH GRADE-II AGGREGATE.
3. FIRST LAYER WATER BOUND MACADAM COURSE WITH GRADE-II AGGREGATE.
4. SUB BASE COURSE TWO LAYERS OF WBM WITH GRADE-I AGGREGATE.
5. APPROVED MATERIAL FROM SITE COMPACTED TO 90% OF MAXIMUM LAB. DRY DENSITY AS IS 2720 PART VIII.
6. 75mm THK. WATER BOUND MACADAM COURSE WITH GRADE-II AGGREGATE.

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD DRAWING FOR
CROSS SECTION OF ROAD
(7.5 M WIDE)

STANDARD DRAWING NO.

REV.

SIZE

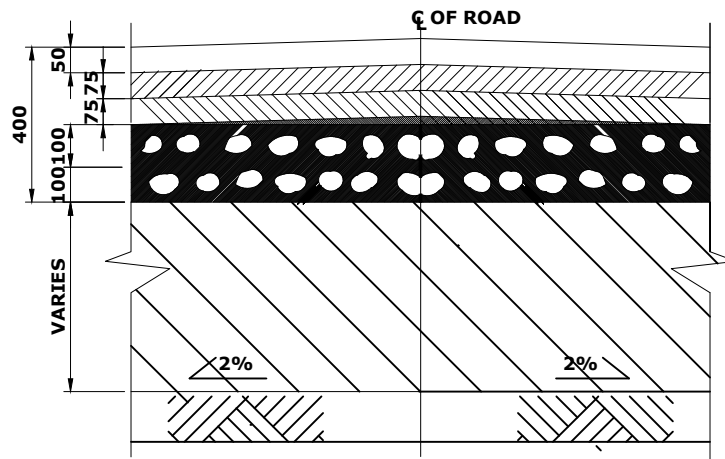
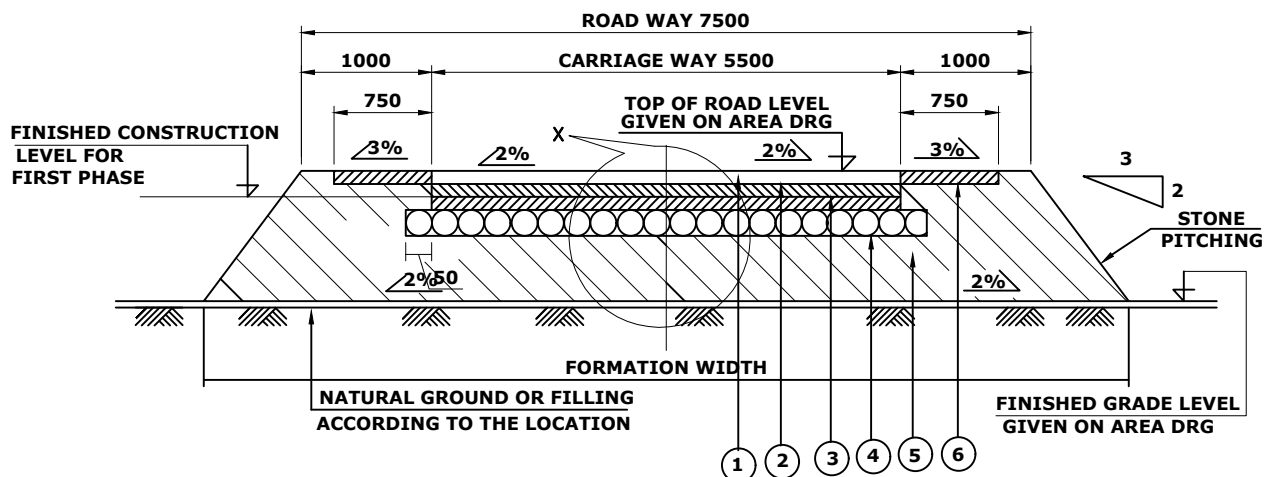
VCS-STD-CS-6010

03

A4

SHEET NO.

2 OF 3



DETAIL - X

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD DRAWING FOR
CROSS SECTION OF ROAD
(9.0 M WIDE)

STANDARD DRAWING NO.

REV.

SIZE

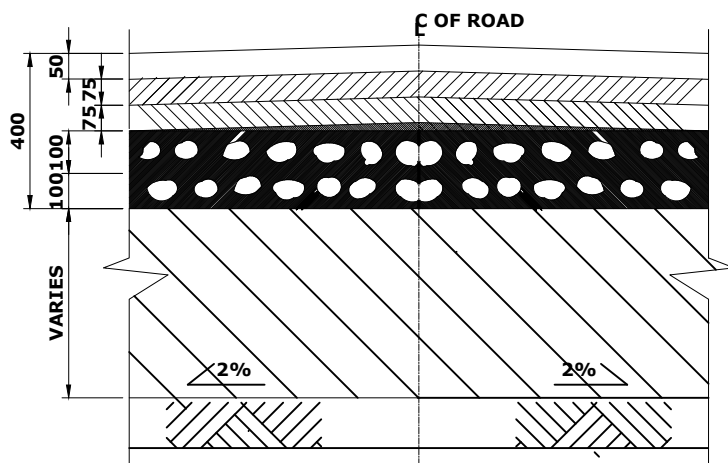
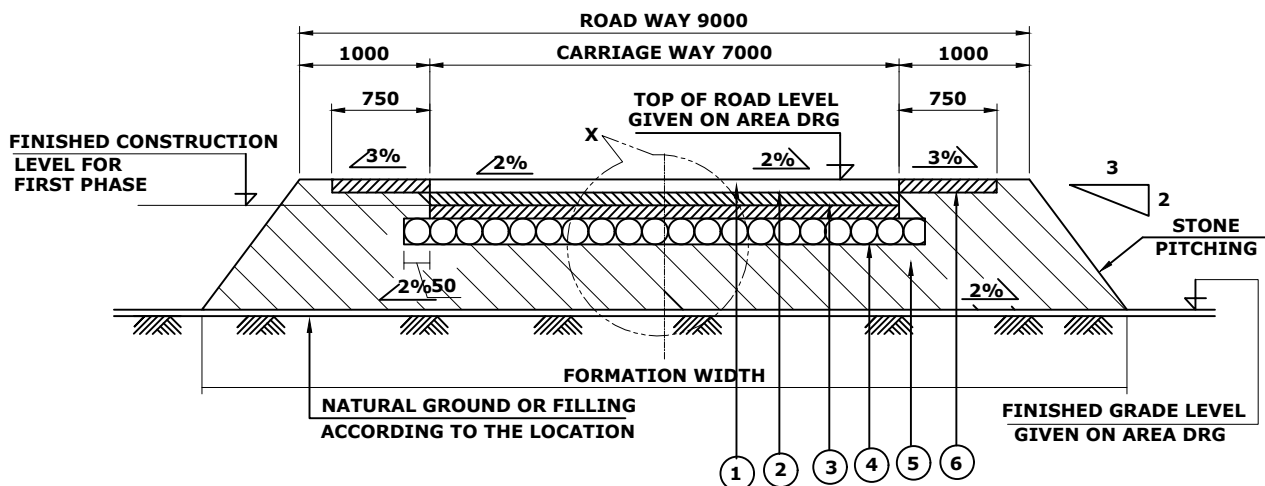
VCS-STD-CS-6010

03

A4

SHEET NO.

3 OF 3



DETAIL - X

			<i>MN</i>	<i>GDS</i>	<i>HK</i>	<i>WG</i>
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD DRAWING FOR
MANHOLE(SWS)
TYPE-1
FOR DEPTH <1M.(Ø<300)

STANDARD DRAWING NO.

VCS-STD-CS-6012

SHEET NO.

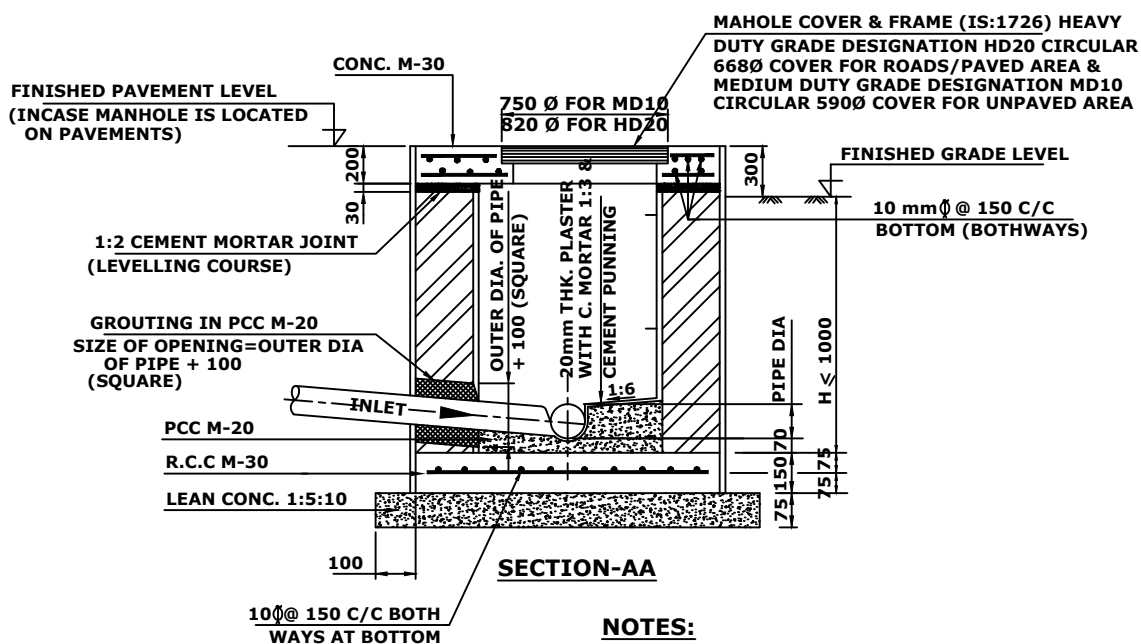
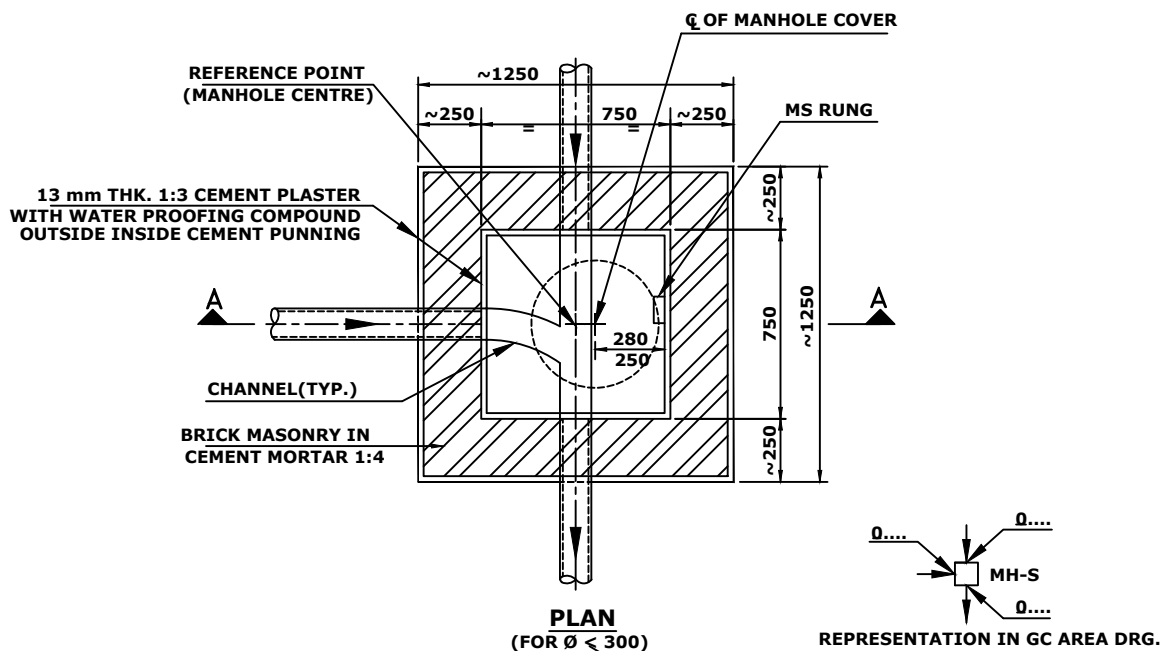
1 OF 1

REV.

03

SIZE

A4



NOTES:

1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE.
2. ALL REINFORCEMENT SHALL BE OF GRADE Fe415 CONFORMING TO IS:1786.
3. EXACT THICKNESS OF BRICK MASONRY SHALL BE ACCORDING TO SIZE OF LOCALLY AVAILABLE BRICKS.
4. FOR AGGRESSIVE SOIL CONCRETE GRADE M-35 SHALL BE PROVIDED

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD DRAWING FOR
MANHOLE TYPE-2
(SANITARY WASTE SYSTEM)
FOR DEPTH < 2 (Ø < 500)

STANDARD DRAWING NO.

VCS-STD-CS-6013

SHEET NO.

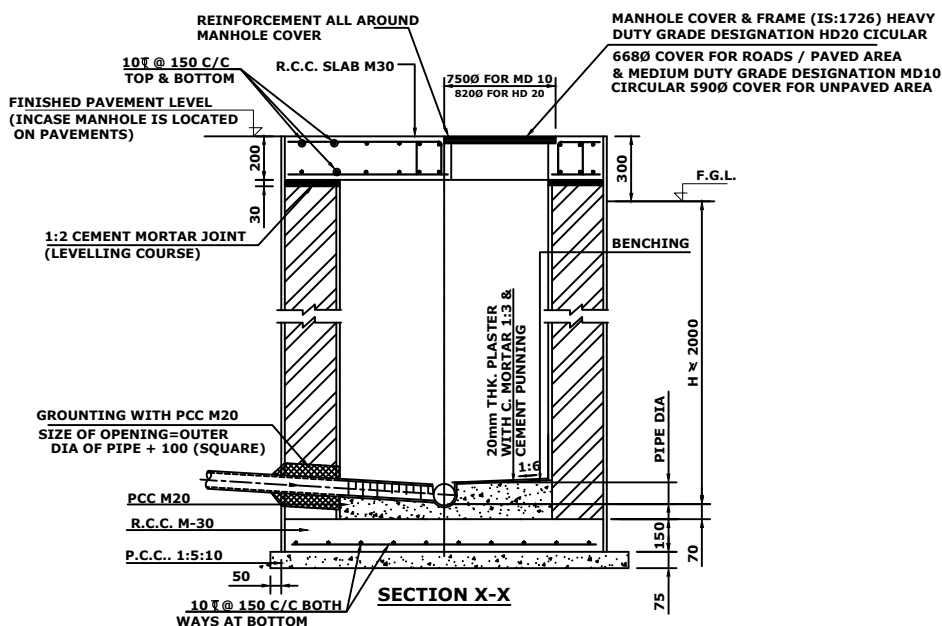
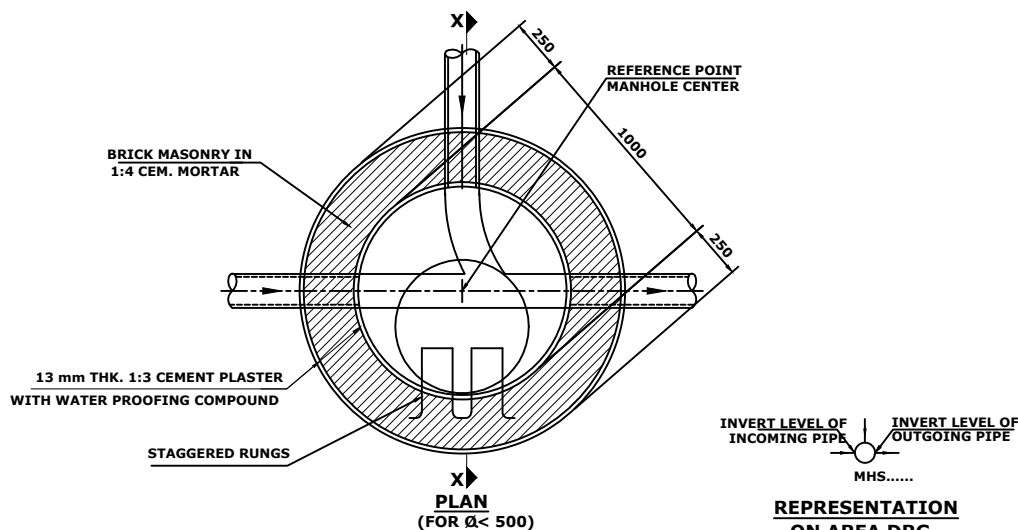
1 OF 1

REV.

03

SIZE

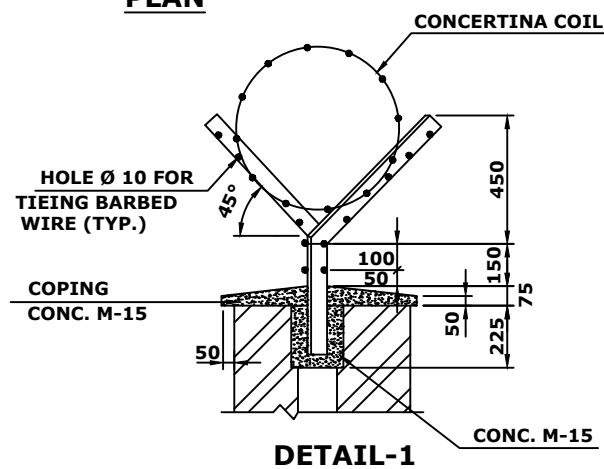
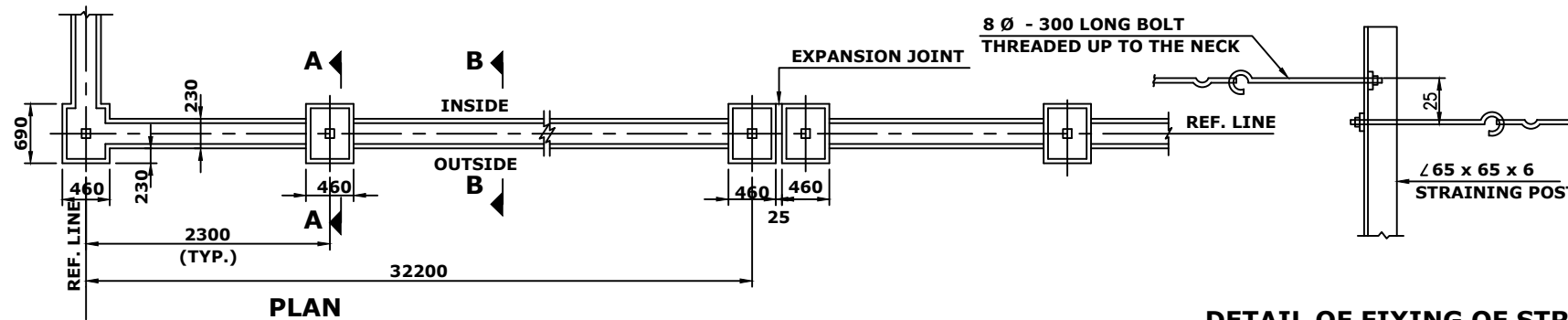
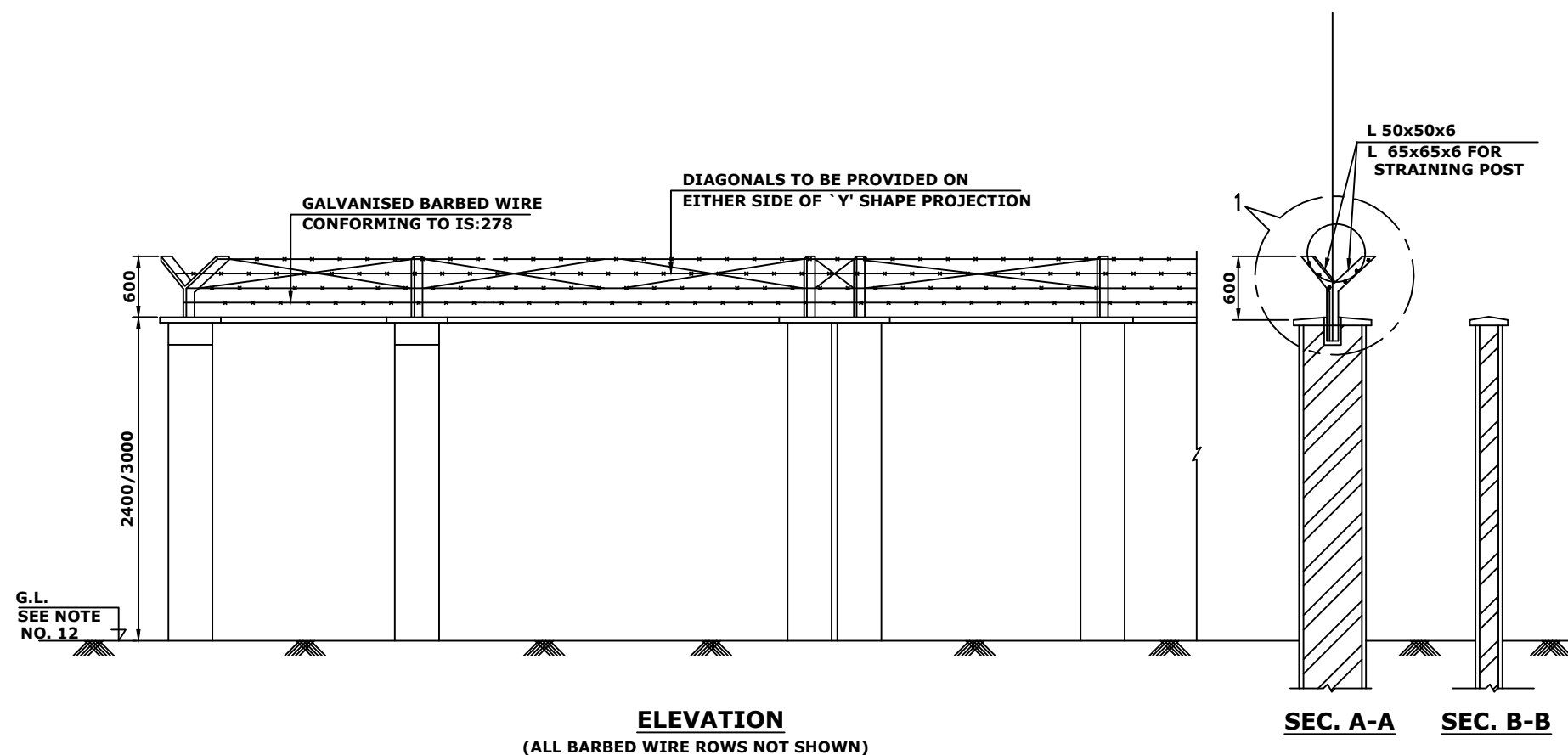
A4



NOTE;

1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE
2. ALL REINFORCEMENT SHALL BE OF GRADE Fe 415 (MIN.) CONFORMING TO IS:1786
3. BAR BENDING SHALL CONFORM TO IS:2502.
4. TOP SLAB SHALL BE CAST-IN-SITU AND REINFORCEMENT ON WALL SIDE OF MANHOLE OPENING SHALL BE ADJUSTED AT SITE.
5. THE BRICKS SHALL CONFORM TO IS:1077 (CLASS 5.0 MINIMUM).
6. EXACT THICKNESS OF BRICK MASONRY WALL SHALL BE AS PER LOCATION AVAILABLE BRICK (HERE WALL THICKNESS HAS BEEN GIVEN AS PER BRICKS SIZE 250x125x75).
7. FOR AGGRESSIVE SOIL CONCRETE GRADE M-35 SHALL BE PROVIDE.

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



DETAIL OF FIXING OF STRAINING BOLT WITH STRAINING POST

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. CEMENT MORTAR FOR BRICK MASONRY AND PLASTER SHALL BE 1:6 (1 CEMENT : 6 SAND)
3. PLASTER SHALL BE 13 mm THK. ON EVEN SURFACE AND 16 THK. ON UNEVEN SURFACE.
4. POCKETS FOR ANGLE IRON MEMBERS SHALL BE 150x150 IN PLAN AND OF 3 BRICK COURSE IN DEPTH AND SHALL BE GROUTED WITH CONC. M-15
5. GALVANISED BARBED WIRE SHALL CONFORM TO IS:278.
6. STRAINING BOLT SHALL BE PROVIDED AT EVERY 90M APPX.
7. EXPANSION JOINTS SHALL PROVIDE A CONTINUOUS VERTICAL SEPERATION THROUGH THE FULL THICKNESS OF MASONRY WALL EXTENDING FROM TOP OF WALL TO BASE CONCRETE.
8. NECESSARY STEPS SHALL BE GIVEN IN THE HEIGHT OF THE WALL SO THAT THE HEIGHT OF WALL IS NOT LESS THAN 3050 MM ABOVE G.L. AT ANY POINT.
9. EARTH AVAILABLE FROM THE EXCAVATION OF FOUNDATION SHALL BE FILLED 2.5 M ON EITHER SIDE TO THE FINISHED GRADE LEVEL AND COMPACTED WITH PROPER SLOPE FOR DRAINAGE OF WATER AWAY FROM THE WALL.
10. WEEP HOLES SHALL BE PROVIDED IN THE COMPOUND WALL WHEREVER REQUIRED AT SUITABLE LOCATION DIRECTED BY ENGINEER-IN CHARGE.
11. FOR FOUNDATION DETAILS REFER RELEVANT STRL. DRG.
12. (G.L.) GRADE LEVEL MEANS F.G.L. OR N.G.L. ADJACENT TO THE COMPOUND WALL ON EITHER SIDE AS APPLICABLE. THE HEIGHT OF COMPOUND WALL (2400 / 3000) SHALL BE GOVERNED FROM THE HIGHER GRADE LEVEL AT INSIDE OR OUTSIDE THE COMPOUND WALL.



VCS QUALITY SERVICES
PRIVATE LIMITED

BRICK MASONRY
COMPOUND WALL

REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY	SHEET NO.	1 OF 1	REV.	SIZE
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG	VCS-STD-CS-6015	1 OF 1	03	A3
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK				



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD DRAWING FOR BRICK FOOTPATH

STANDARD DRAWING NO.

VCS-STD-CS-6017

SHEET NO.

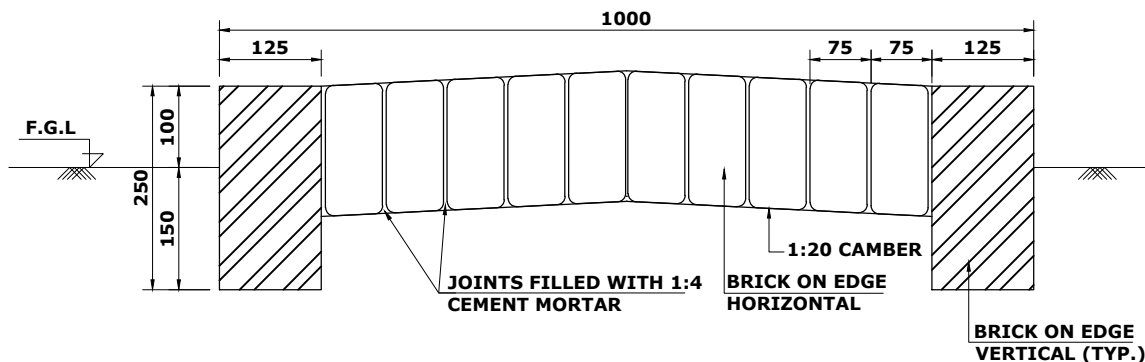
1 OF 1

REV.

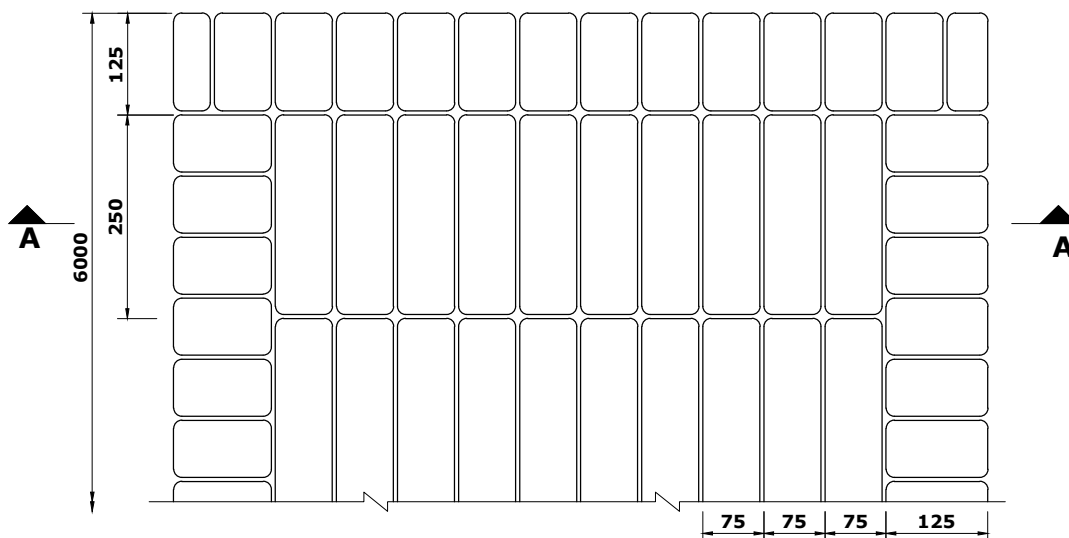
03

SIZE

A4



SECTION A-A



PLAN

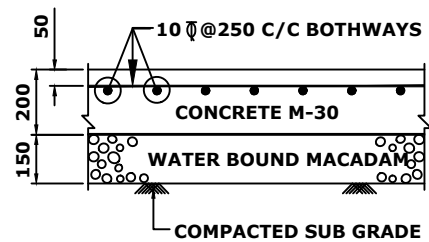
NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. AFTER EVERY 6000 LENGTH OF FOOTPATH A BREAK OF 100 mm WIDTH SHALL BE LEFT UNPAVED TO ALLOW THE SURFACE DRAINAGE.

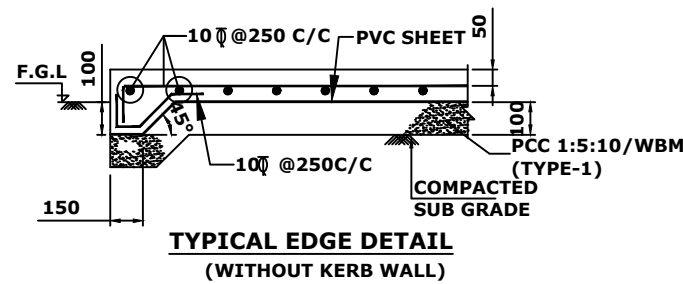
LEGEND:-

F.G.L. = FINISH GRADE LEVEL

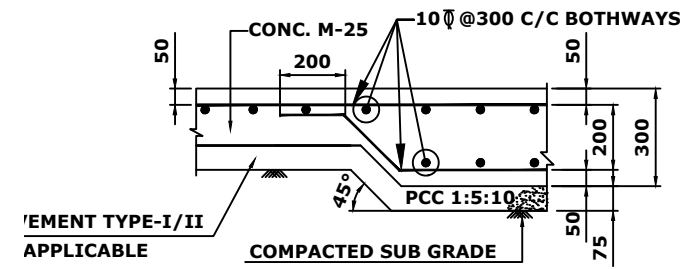
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



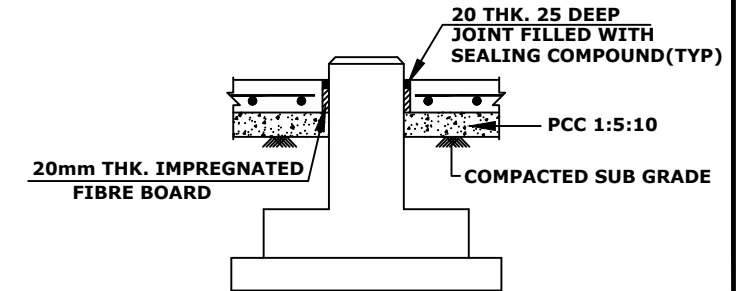
TYPE - I
(FOR VEHICULAR MOVEMENT AREA)



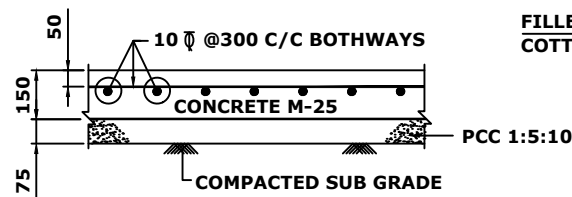
TYPICAL EDGE DETAIL
(WITHOUT KERB WALL)



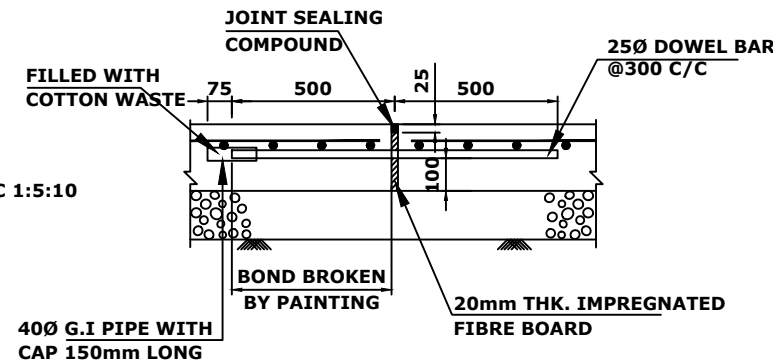
X-SECTION OF THICKENED PAVEMENT
(SEE NOTE 14)



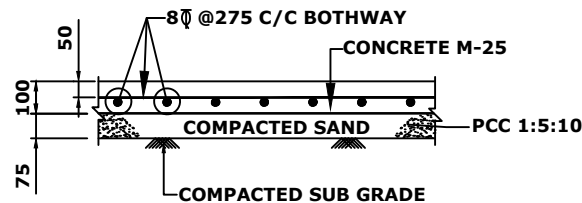
TYPICAL DETAIL OF JOINT SEALING
AROUND FOUNDATION



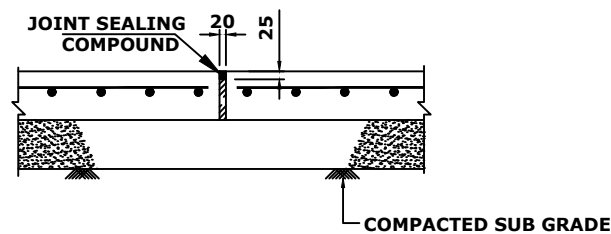
TYPE - II
(FOR UNIT PAVEMENT)



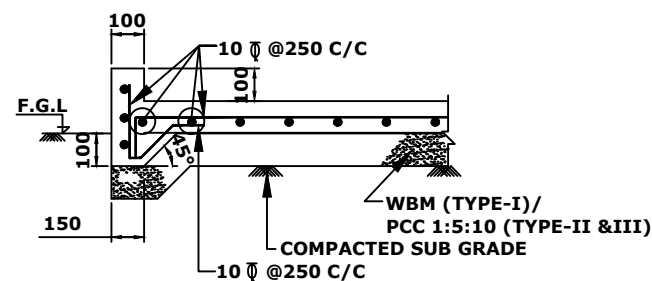
DETAIL OF EXPANSION JOINT
(FOR TYPE -I PAVEMENT)



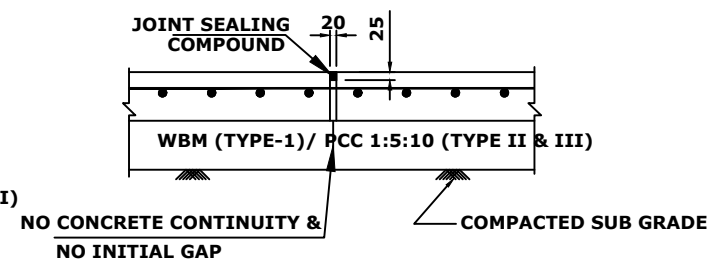
TYPE - III
(FOR OFFSITE PUMP STATION)



DETAIL OF EXPANSION JOINT
(FOR TYPE -II & III PAVEMENT)



TYPICAL EDGE DETAIL
(WITH KERB WALL)



DETAIL OF CONSTRUCTION JOINT
(SEE NOTE 13)

NOTES:-

- ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
- CONCRETE SHALL BE CONFIRM TO IS:456.
- Ø DENOTED HIGH YIELD DEFORMED BARS OF GRADE Fe415 (MIN.) CONFIRMING TO IS:1786. UNLESS OTHERWISE SPECIFIED.
- JOINT SEALING COMPOUND IN PAVING AND AROUND EQUIPMENT FOUNDATIONS SHALL CONFIRM TO IS:1834 TYPE-B.
- EXPANSION AND SEALING JOINT FILLER MATERIAL SHALL BE FILLERS OF BITUMEN PREFORMED FIBRES IMPREGNATED FIBRE, CONFIRMING TO IS:1838, PART-1.
- CONCRETE PAVING SHALL BE SLOPED STEEPEST TO 1:100 UNLESS OTHERWISE SHOWN IN DETAIL ENGINEERING DRAWING. SLOPE OF THE SUB GRADE SHALL BE PREPARED TO MATCH WITH SLOPE OF PAVEMENT.
- SUB GRADE BELOW PAVEMENT SHALL BE THOROUGHLY COMPACTED TO 95% OF LAB DRY DENSITY AS PER IS:2720, PART VIII.
- CAST IN-SITU CONCRETE FOR PAVEMENT SHALL BE LAID IN ALTERNATE PANELS OF SIZES AS DEFINED IN THIS STANDARD DRAWING HOWEVER, THE PANEL SIZE SHALL BE ADJUSTED AROUND COLUMNS & FOUNDATION
- EXPANSION JOINTS SHALL BE SPACED AT 14.0M (MAX.)FOR TYPE-I PAVEMENT & 13M C/C (MAX.)FOR TYPE-II PAVEMENTS.
- EXPANSION JOINTS SHALL BE SPACED AT 15 M C/C & CONSTRUCTION JOINS SHALL BE SPACED AT 7.5M C/C (MAXIMUM) FOR TYPE-III PAVEMENTS.
- THIS STANDARD NOT VALID FOR CAUSTIC HANDLING AREAS.
- LIMITATION OF SINGLE AXLE LOAD ON RCC PAVEMENT:
FOR TYPE-I PAVEMENT : MAX. UPTO 12.0 TONNE
FOR TYPE-II PAVEMENT : MAX. UPTO 6.0 TONNE
(FOR SMALL VEHICLES LIKE FORK LIFT)
- CONSTRUCTION JOINTS MAY BE PROVIDED IN CASE PANEL SIZE IS LESS THAN THE REQUIRMENT OF EXPANSION SUIT SITE REQUIREMENTS.
- FOR PIPE SUPPORT DETAILS COMING IN THICKENED PAVEMENT AREA REFER RELEVANT PIPING GAD / PIPING STANDARDS.

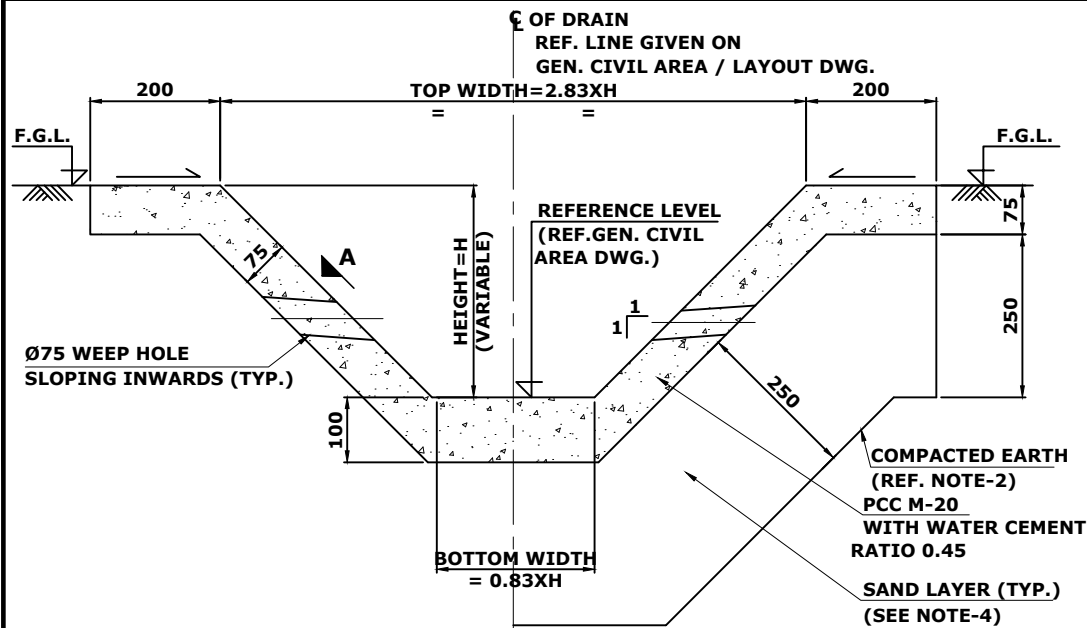
GEOTECHNICAL RECOMMENDATION SHALL BE FOLLOWED FOR SUBGRADE TREATMENT FOR PAVEMENTS IN BLACK COTTON SOIL AREAS/JOB SPECIFIC REQUIREMENT



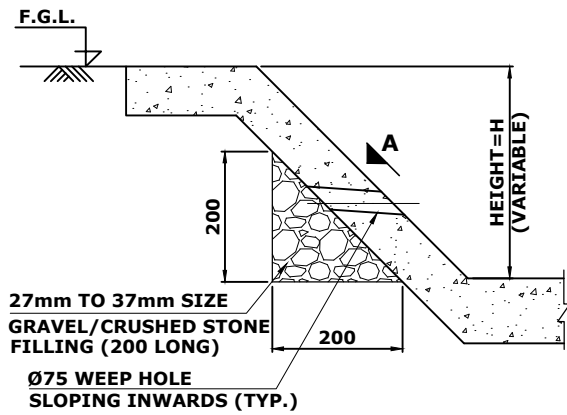
VCS QUALITY SERVICES
PRIVATE LIMITED

RCC PAVEMENT DETAILS

							STANDARD DRAWING NO.		REV.	SIZE
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG				
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK	VCS-STD-CS-6018		03	A3
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY	SHEET NO.	1 OF 1		



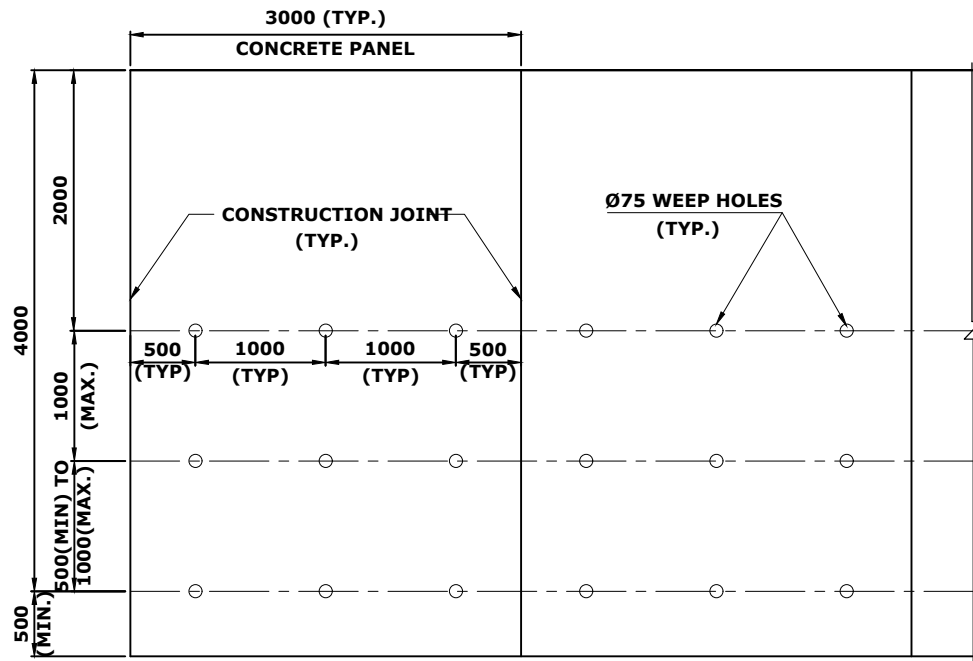
TRAPEZOIDAL DRAIN



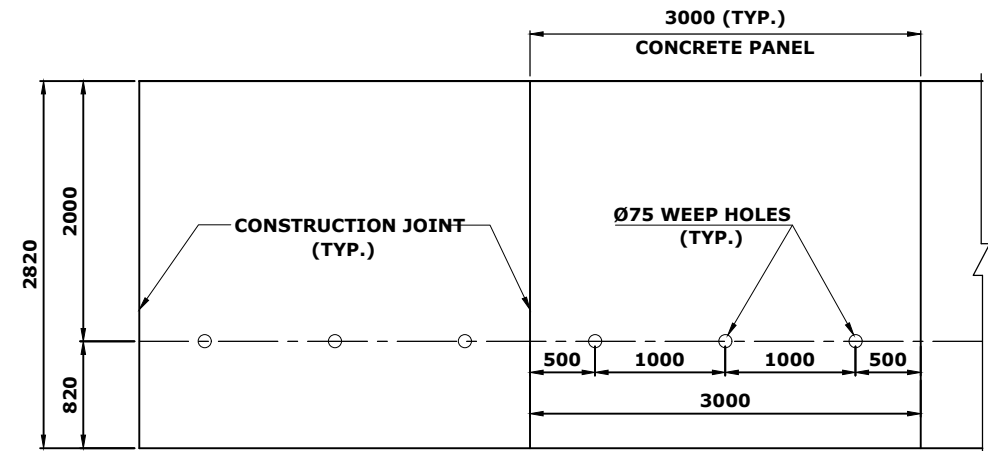
DETAIL OF WEEP HOLE

NOTES:

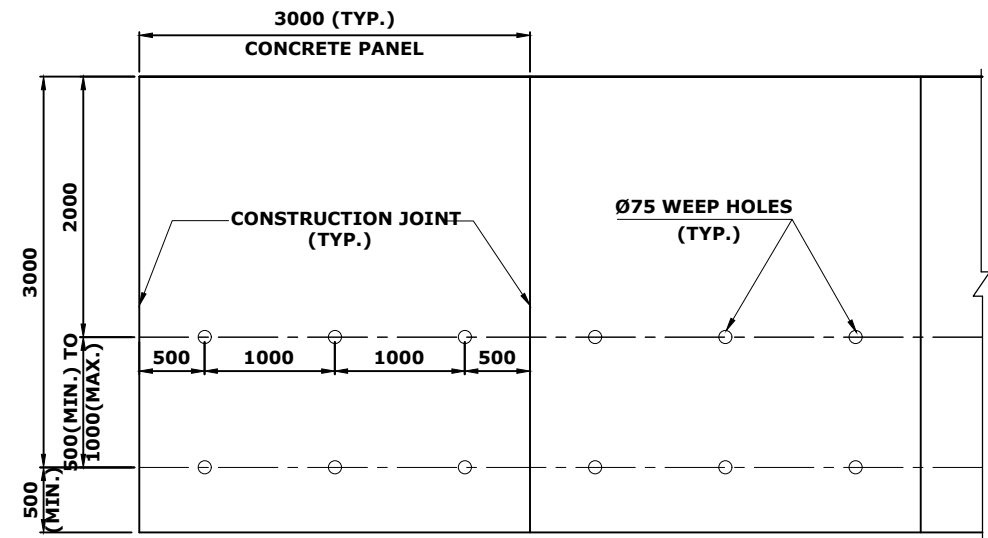
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
2. CONCRETE LINING SHALL BE DONE AFTER THE SIDES OF DRAIN ARE CUT, COMPACTED TO 90% OF MAX. LABORATORY DRY DENSITY AND DRESSED TO THE REQUIRED SLOPE.
3. CONCRETING ON THE SIDE SLOPES SHALL BE DONE IN PANELS OF 3.0 METER LENGTH.
4. WHEREVER CONCRETE TRAPEZOIDAL DRAIN IS LAID IN EXPANSIVE/ BLACK COTTON SOIL, A LAYER OF 250 mm THICK SAND SHALL BE PROVIDED BELOW AND AROUND THE SIDE OF DRAIN.
5. NO WEEP HOLES SHALL BE PROVIDED UPTO 1.5M HEIGHT (H) i.e. 2.0 (APPROX.) INCLINED PART OF THE DRAIN FROM FGL TO ELIMINATE POLLUTION IN THE DRAIN DUE TO CONTAMINATED SUB-SURFACE FLOW.
6. THE VIEW OF INCLINED PART OF DRAIN ARE SHOWN HERE AS A GUIDELINE FOR THE LOCATION OF WEEP HOLES AND FOR THE PANELS OF CONCRETING. HOWEVER, FOR DEPTHS OTHER THAN SHOWN HERE, THE GUIDELINE SHALL REMAIN SAME.



VIEW-A (H=>2.5M TO 3.0M)
(INCLINED PART OF THE DRAIN)



VIEW-A (H=2.0M)
(INCLINED PART OF THE DRAIN)



VIEW-A (H=>2.0M TO 2.50M)
(INCLINED PART OF THE DRAIN)

 VCS QUALITY SERVICES PRIVATE LIMITED Energising Quality	CONCRETE TRAPEZOIDAL STORM WATER DRAIN (HEIGHT (H)<3.0M)								STANDARD DRAWING NO.		REV.	
		03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG	VCS-STD-CS-6019		03	A3
		02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK				
		REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY	SHEET NO.	1 OF 1		



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD TYP.DETAILS OF CABLE TRENCH

STANDARD DRAWING NO.

VCS-STD-CS-6031

SHEET NO.

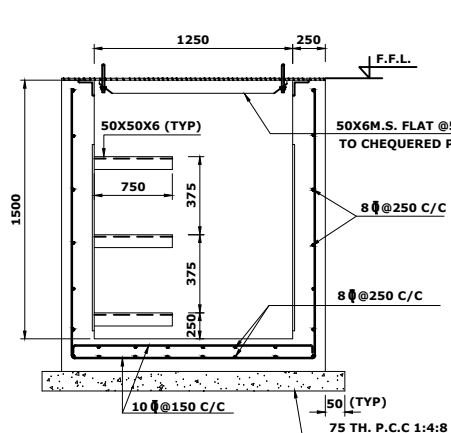
1 OF 1

REV.

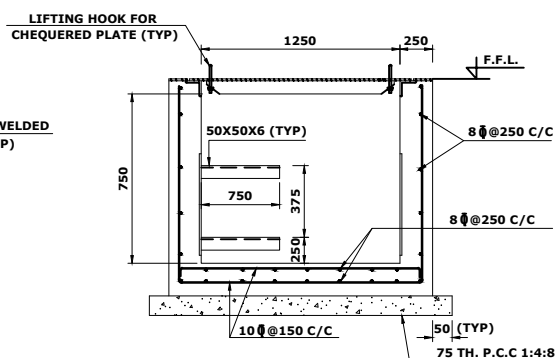
03

SIZE

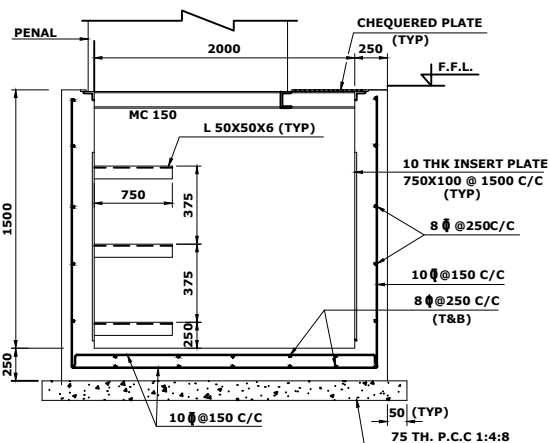
A4



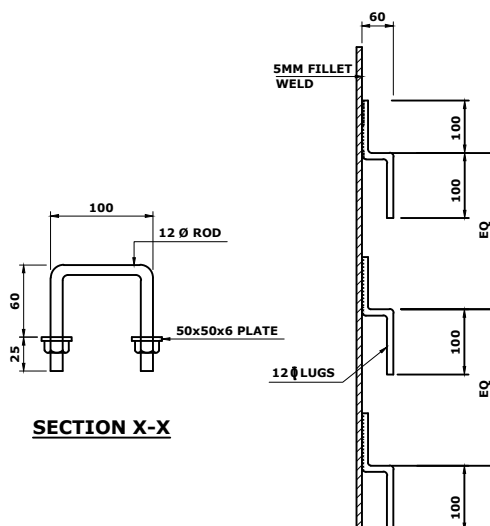
R/F DETAIL OF CABLE TRENCH SECTION



R/F DETAIL OF CABLE TRENCH SECTION

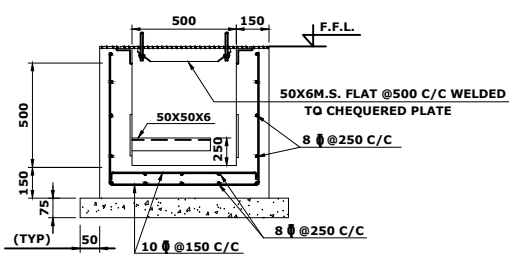


SUPPORTING PANELS

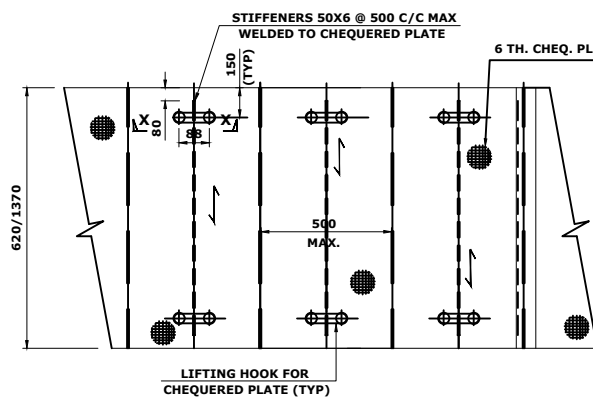


SECTION X-X

TYP. DETAIL OF INSERT PLATE



R/F DETAIL OF CABLE TRENCH SECTION



DETAIL OF CHEQUERED PLATE

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

R.C.C FLOORING DETAILS

STANDARD DRAWING NO.

VCS-STD-CS-6032

SHEET NO.

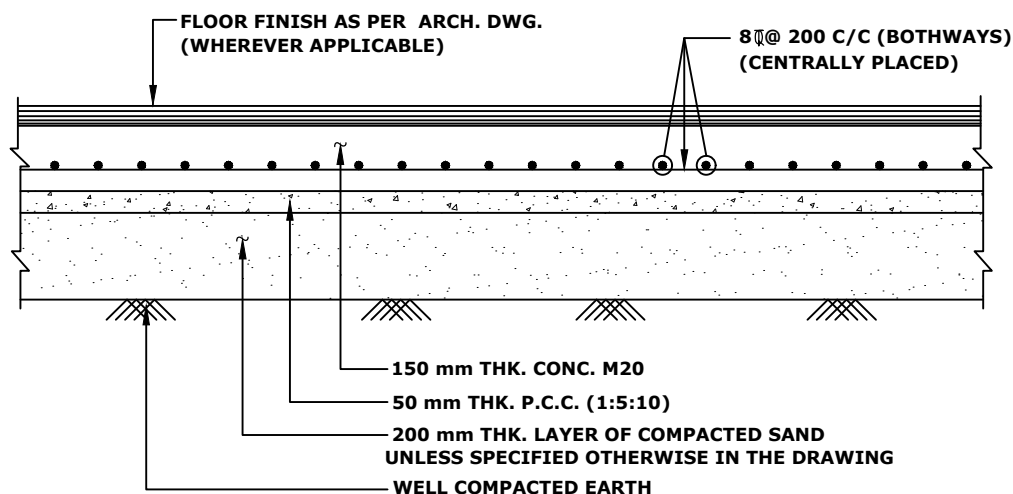
1 OF 2

REV.

03

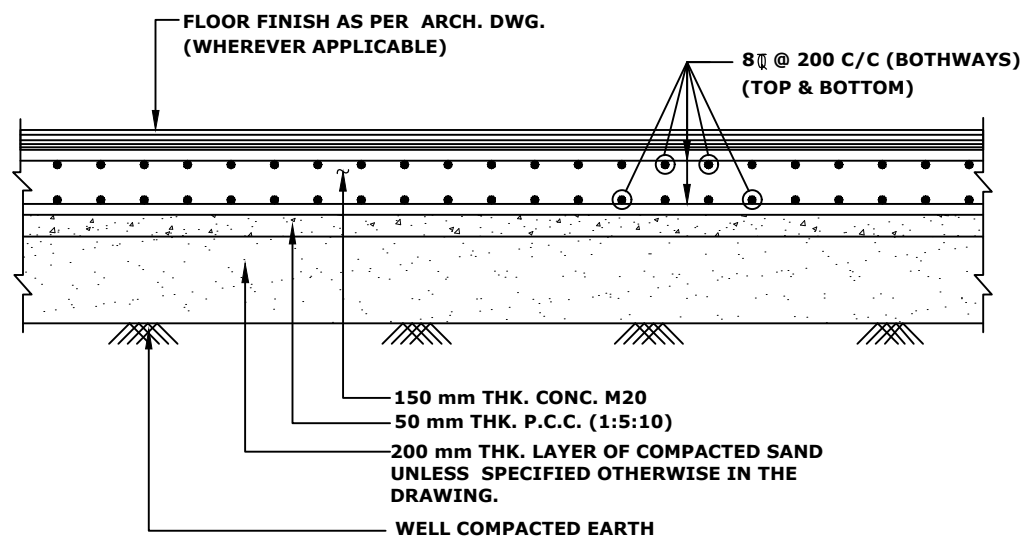
SIZE

A4



TYPE-I

(FOR PLANT BUILDINGS, SUB-STATION, CONTROL ROOM, PUMP HOUSE,
UTILITY COMPRESSOR HOUSE, PARKING AREA, STORE &
PORCH)



TYPE-II

(FOR WAREHOUSE, WORKSHOP, CEMENT GODOWN, FIRE STATION
& PROCESS COMPRESSOR HOUSE)

			<i>MN</i>	<i>GDS</i>	<i>HK</i>	<i>WG</i>
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

R.C.C FLOORING DETAILS

STANDARD DRAWING NO.

VCS-STD-CS-6032

SHEET NO.

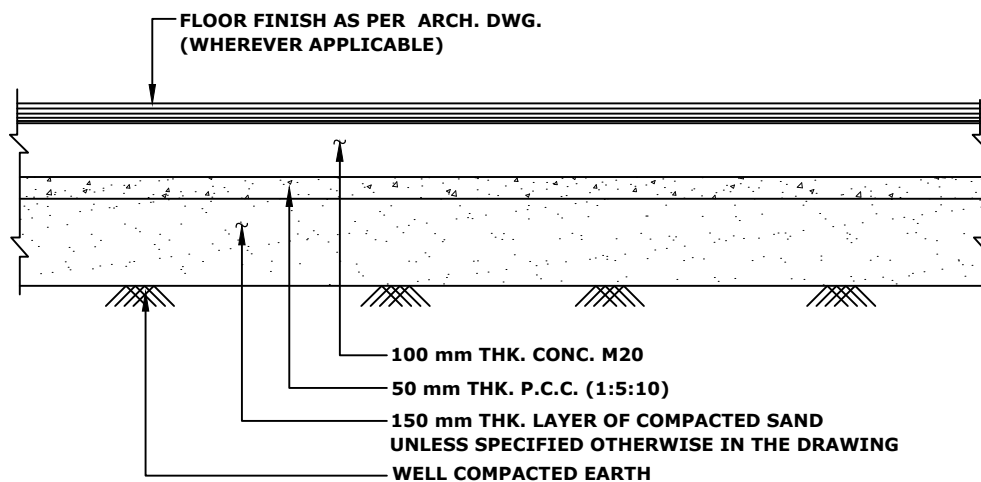
2 OF 2

REV.

03

SIZE

A4



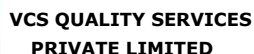
TYPE-III

(FOR NON-PLANT BUILDINGS, ADMINISTRATION,
LABORATORY, CANTEEN, TIME OFFICE, SITE OFFICE ETC.,)

NOTES:-

1. ALL DIMENSIONS ARE IN mm
2. STRUCTURAL CONCRETE SLAB SHALL BE CAST IN ALTERNATE PANELS AND NO DIMENSION OF THE PANEL SHALL EXCEED 4.5 m

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



STANDARD FOR HANDRAIL ON STEEL PLATFORM

STANDARD DRAWING NO.

REV.

SIZE

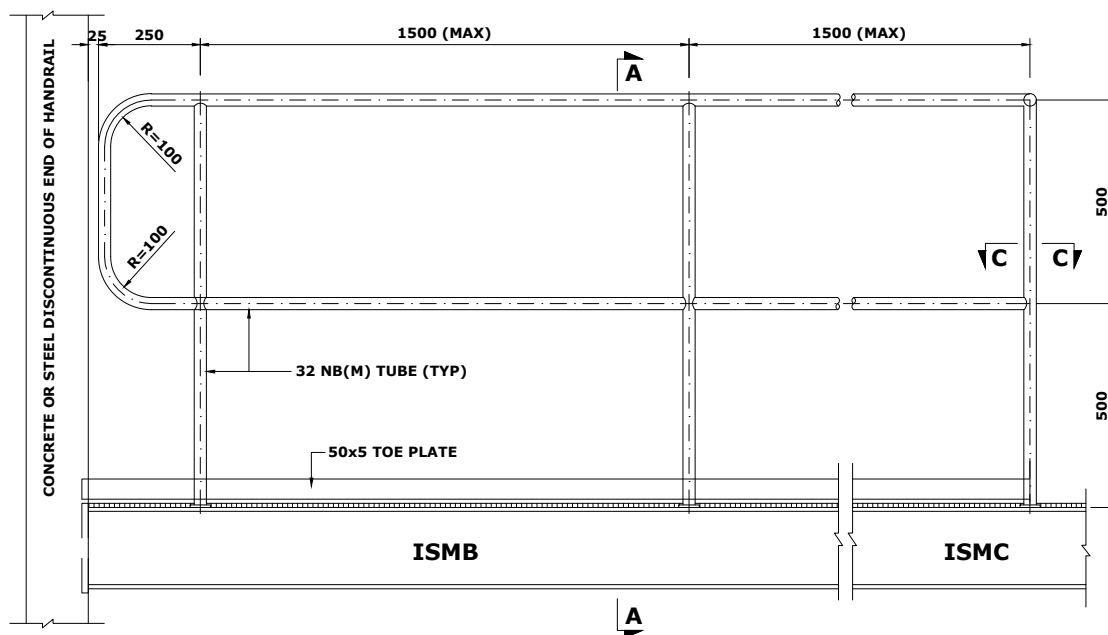
VCS-STD-CS-6033

03

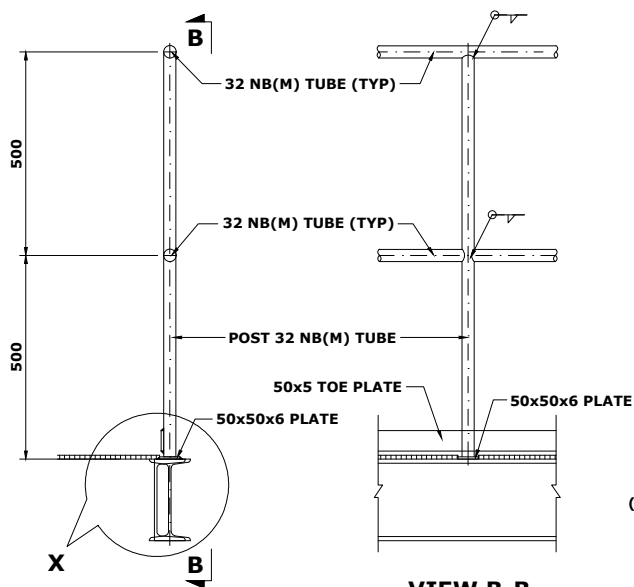
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SHEET NO.

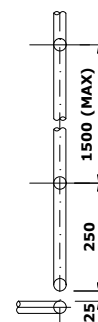
1 OF 1



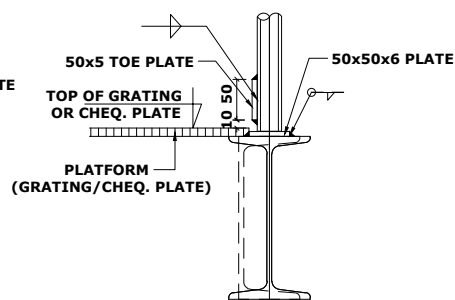
HORIZONTAL HANDRAIL ON STEEL PLATFORM



SECTION A-A



VIEW C-C
(AT CORNER)



DETAIL X

						
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD
FOR
SLIDING T- SUPPORT

STANDARD DRAWING NO.

VCS-STD-CS-6034

SHEET NO.

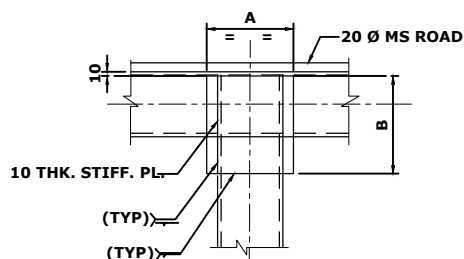
1 OF 2

REV.

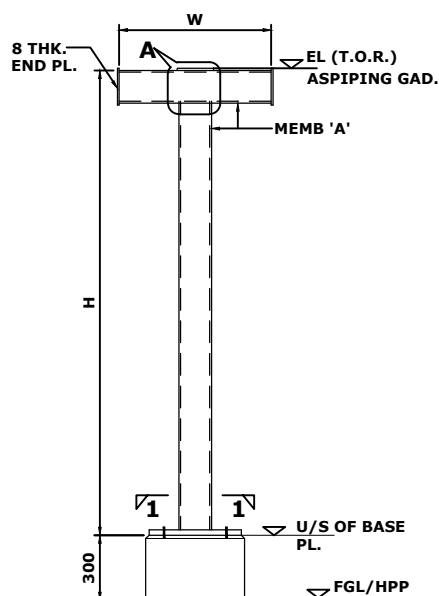
03

SIZE

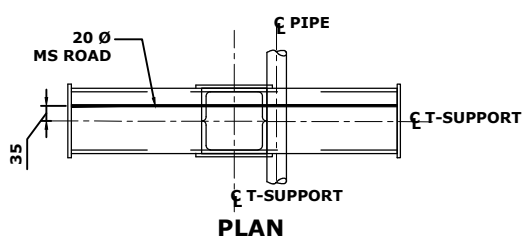
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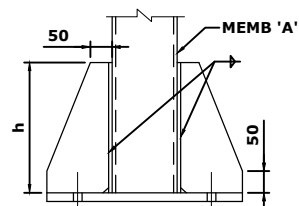
DETAIL - A



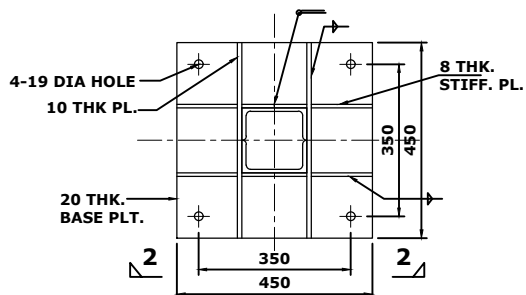
ELEVATION



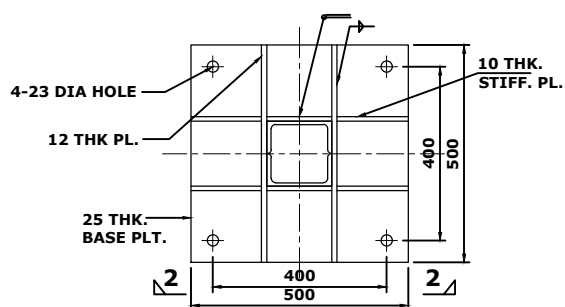
PLAN



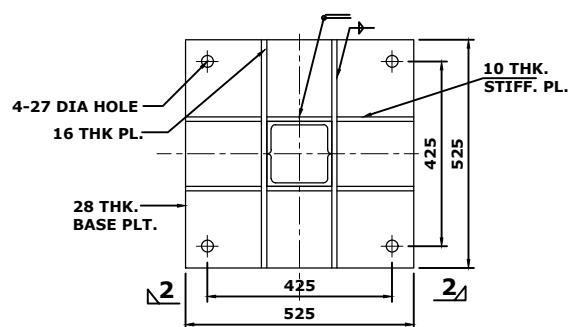
VIEW 2-2



VIEW 1-1
(BASE PLATE TYPE I)



VIEW 1-1
(BASE PLATE TYPE II)



VIEW 1-1
(BASE PLATE TYPE III)

S. NO.	T-SUPPT. MKD.	WIDTH 'W'	HEIGHT 'H'	MEMB 'A'	BASE PLATE TYPE	h	CONN. PLATE		APPX. TY IN KG
							A	B	
1	TS1	UP TO 750	UP TO 2000	ISMC 150	I	200	200	225	150
2	TS2	UP TO 750	2000<H<3000	ISMC 200	II	275	250	300	260
3	TS3	UP TO 750	3000<H<4000	ISMC 250	III	325	300	350	410
4	TS4	750<W<1500	UP TO 1500	ISMC 150	I	200	200	225	160
5	TS5	750<W<1500	1500<H<2300	ISMC 200	II	275	250	300	260
6	TS6	750<W<1500	2300<H<3000	ISMC 250	III	325	300	350	400

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD
FOR
SLIDING T- SUPPORT

STANDARD DRAWING NO.

VCS-STD-CS-6034

SHEET NO.

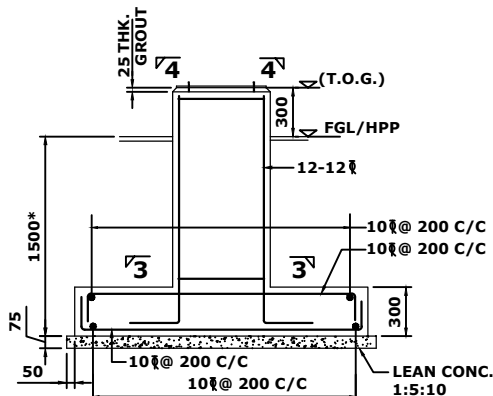
2 OF 2

REV.

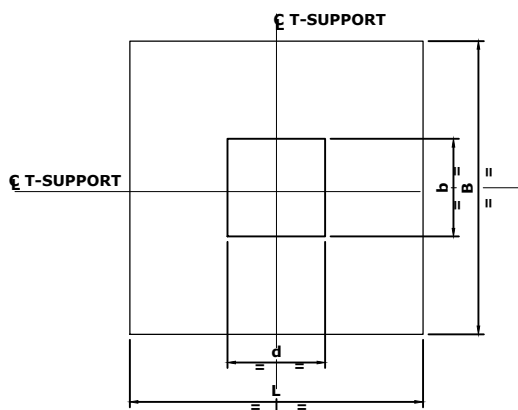
03

SIZE

A4



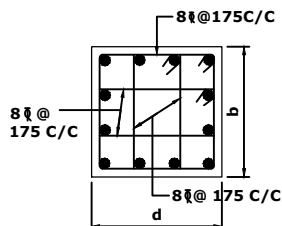
ELEVATION



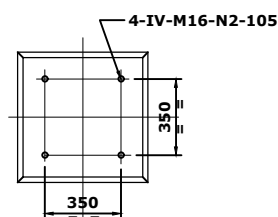
FDN. PLAN

NOTES :-

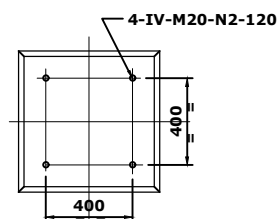
1. FOLLOWING LOADS HAVE BEEN CONSIDERED IN DESIGNEN:
 - a) VERTICAL LOAD =1.0 MT FOR 750 WIDTH
=2.0 MT FOR 1500 WIDTH
 - b) WIND INTENSITY =150 Kg/sqm
 - c) WIND ON 18" PIPE HAS BEEN CONSIDERED
 - d) PIPE FRICTION COEFFICIENT IN BOTH DIRECTION = 0.30



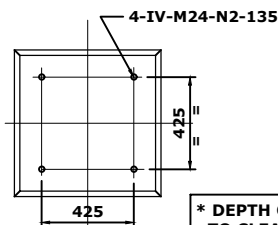
SECTION 3-3



VIEW -4-4
(FOR SUPPORT TS1 & TS4)



VIEW -4-4
(FOR SUPPORT TS2 & TS5)



VIEW -4-4
(FOR SUPPORT TS3 & TS6)

* DEPTH OF FDN. CAN BE INCREASED TO CLEAR U/G PIPING IF ANY.

S. NO.	T-SUPPT. MKD.	PED SIZE		FDN SIZE		QTY IN m ³	5.0<S.B.C<10.0 T/sqm		QTY IN m ³	10.0<S.B.C<15.0 T/sqm		QTY IN m ³	S.B.C>15.0 T/sqm		QTY IN m ³
		d	b	L	B		L	B		L	B		L	B	
1	TS1	600	600	1800	1800	1.51	1600	1600	1.31	1500	1500	1.22			
2	TS2	650	650	2000	2000	1.83	1750	1750	1.55	1600	1600	1.40			
3	TS3	675	675	2250	2250	2.20	1800	1800	1.66	1800	1800	1.66			
4	TS4	600	600	2000	2000	1.74	1750	1750	1.46	1600	1600	1.31			
5	TS5	650	650	2250	2250	2.15	1800	1800	1.60	1700	1700	1.50			
6	TS6	675	675	2250	2250	2.20	1900	1900	1.77	1900	1900	1.77			

03	10.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	02.12.19	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY

 VCS QUALITY SERVICES PRIVATE LIMITED Emerging Quality	SMALL OPERATING PLATFORMS ON GRADE/RCC ELEVATION STRUCTURE	STANDARD DRAWING NO.		REV.	SIZE
		VCS-STD-CS-6035		03	A4
		SHEET NO.	1 OF 3		

NOTES:-

1. THIS STANDARD COVERS DETAILS OF OPERATING PLATFORM ON GRADE, OR ON ELEVATED R.C.C. STRUCTURE FOR A MAXIMUM HEIGHT OF 2300mm ABOVE FGL AND/OR 2150mm ABOVE FFL.
2. ALL DIMENSIONS ARE IN MILLIMETERS.
3. STRUCTURAL STEEL SHALL CONFORM TO IS:2062 GRADE-A.
4. GRADE OF CONCRETE SHALL BE AS MENTIONED IN GENERAL NOTES FOR CONCRETE WORKS FOR THE PROJECT.
5. R/F BARS SHALL BE COLD WORKED STEEL HIGH STRENGTH DEFORMED BARS OF GRADE Fe415 CONFORMING TO IS:1786.
6. CONCRETE & STEEL WORKS SHALL BE AS PER GENERAL NOTES OF THE PROJECT.
7. THE LOCATION AND ORIENTATION OF PLATFORMS SHALL BE AS PER PIPING GAD.
8. IF NOT GALVANIZED GRATING SHALL BE WELDED ALONG THE LINE OF SUPPORT. GALVANIZED GRATING SHALL BE CLAMPED.
9. UP TO H> 2000 HANDRAIL SHALL BE TYPE-IV HANDRAIL FOR OTHER PLATFORMS SHALL BE TYPE-VII. TOP RAIL OF HANDRAIL SHALL BE 32 NB (M) PIPE.
10. ALL GUSSET PLATES SHALL BE 8mm THICK, UNLESS NOTED OTHERWISE.
11. ALL CONNECTIONS SHALL BE WELDED USING 6mm THICK FILLET WELDS. CONNECTIONS AT CORNER LOCATIONS SHALL BE WITH SUITABLE CLEAT ANGLE.
12. FOUNDATIONS SHOWN IN THIS STANDARD ARE VALID UP TO S.B.C. OF 5.00 T/M² AT FOUNDATION LEVEL.
13. CONSTRUCTION JOINTS IN PAVEMENT SHALL BE SUITABLY LOCATED AT SITE IN CASE THICKNESS PAVEMENT IS ADOPTED FOR PLATFORM FOUNDATIONS.
14. GROUT SHALL BE 1:2 CEMENT SAND MORTAR TYPE.

						
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

SMALL OPERATING PLATFORMS ON GRADE/RCC ELEVATION STRUCTURE

STANDARD DRAWING NO.

VCS-STD-CS-6035

SHEET NO.

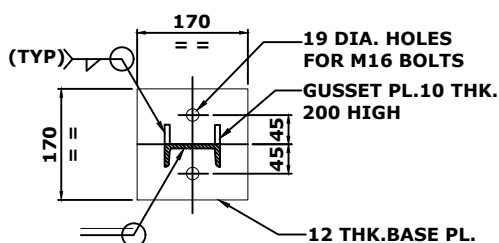
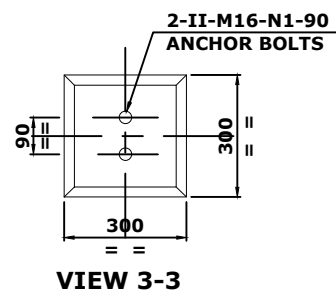
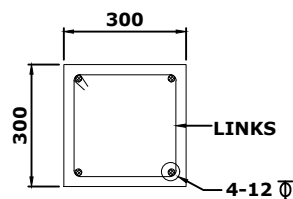
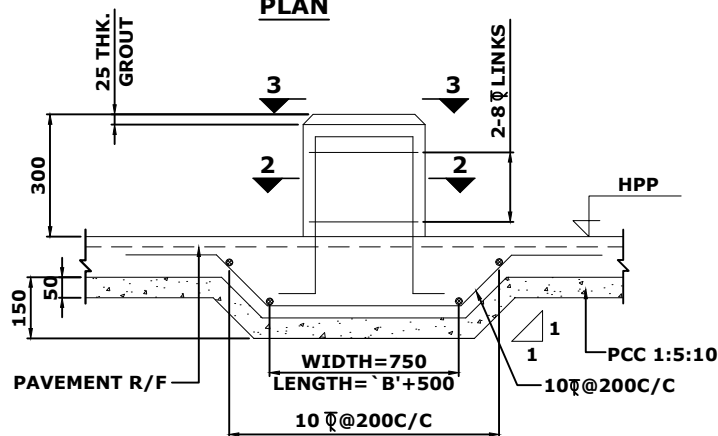
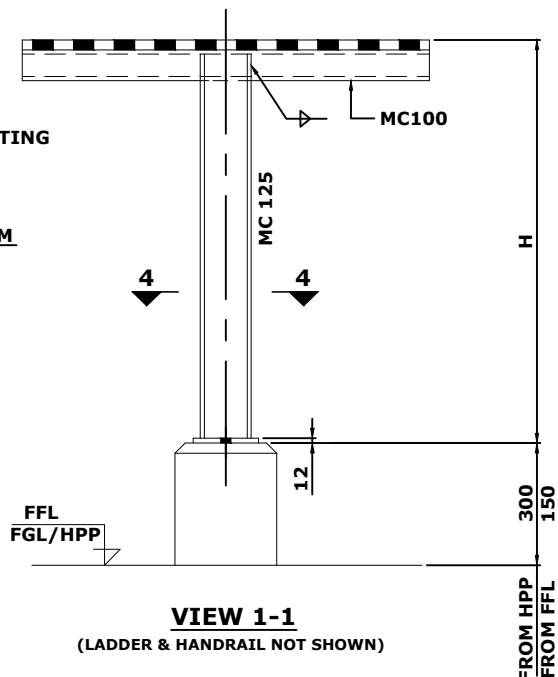
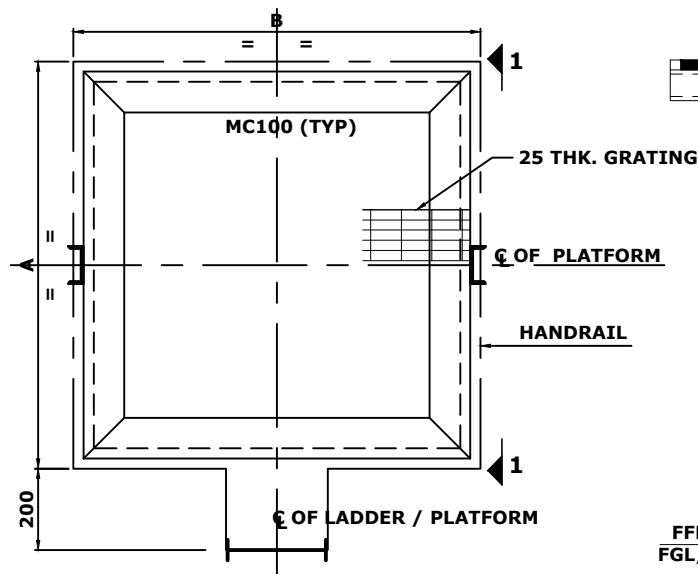
2 OF 3

REV.

03

SIZE

A4



750 < A < 1000
750 < B < 1000
750 < H < 1000

TYP.DETAILS OF PLATFORMS

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

SMALL OPERATING
PLATFORMS
ON GRADE/RCC ELEVATION
STRUCTURE

STANDARD DRAWING NO.

VCS-STD-CS-6035

SHEET NO.

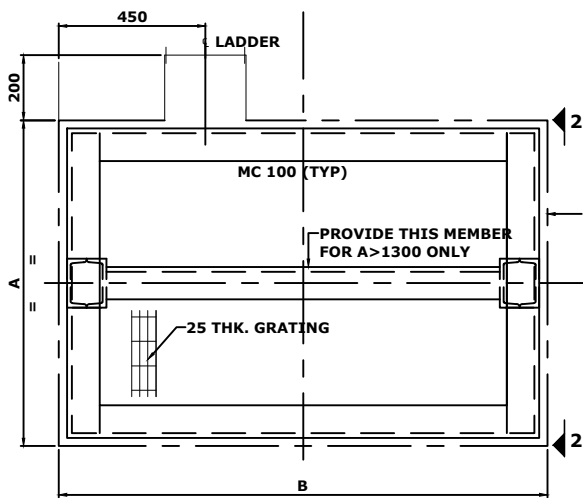
3 OF 3

REV.

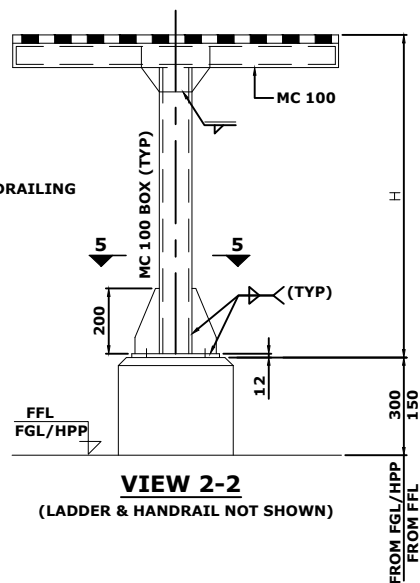
03

SIZE

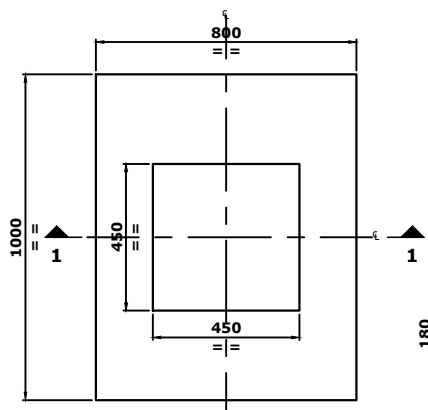
A4



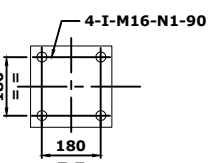
PLAN



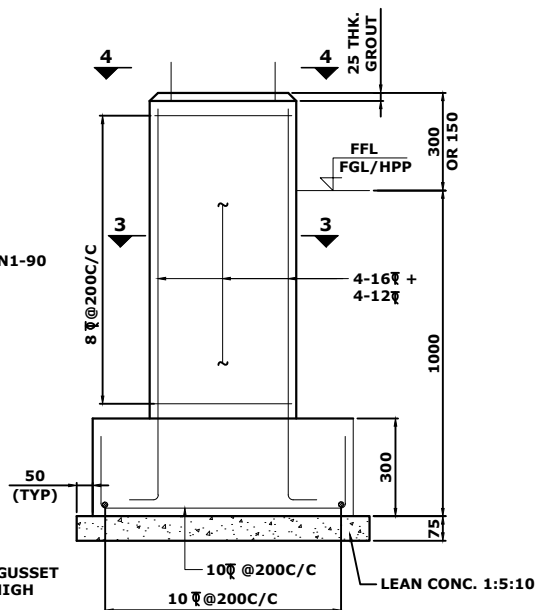
VIEW 2-2
(LADDER & HANDRAIL NOT SHOWN)



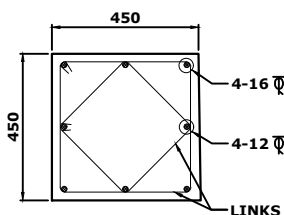
DETAIL OF FOUNDATION
(20 NOS.REQD. THUS)



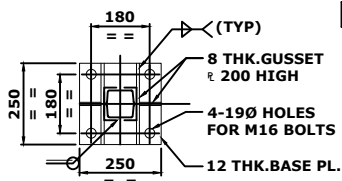
VIEW 4-4



SECTION 1-1



SECTION 3-3



VIEW 5-5

1000 < A < 1500
1000 < B < 2500
1000 < H < 2000

TYP.DETAILS OF PLATFORMS FOR

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD GRATING DETAILS

STANDARD DRAWING NO.

VCS-STD-CS-6036

SHEET NO.

1 OF 3

REV.

03

SIZE

A4

NOTES:-

1. THIS STANDARD No VPC-STD-CS-6036 GIVES DESIGN AND DETAILS OF GRATING.
2. THE TYPE OF GRATING TO BE USED SHALL BE CALLED OUT ON THE DESIGN DRAWING.
3. THE TYPE OF GRATING TO BE USED SHALL BE CALLED OUT ON THE DESIGN DRAWING.
4. MATERIAL FOR THE GRATING (M.S. ROUNDS / M.S. FLATS) SHALL CONFORM TO IS:2026 GR-A. COMMERCIAL QUALITY MATERIAL WILL BE ALLOWED ONLY AFTER ASCERTAINING ITS WELDABILITY / STRENGTH.
5. THE NET WORKING LOADS ARE BASED ON A LIMITING VERTICAL DEFLECTION OF SPAN/200 OR 6mm WHICHEVER IS LESS.
6. THE PANEL WIDTH OF 1056 SHOWN ON THE SUBSEQUENT SHEETS IS INDICATIVE. IT MAY BE INCREASED OR DECREASED AS REQUIRED TO SUIT THE GEOMETRY OF THE PLATFORM AND CONVENIENCE OF HANDLING.
7. MAIN / SECONDARY MEMBERS OF THE GRATING SHALL BE PLACED AS PER THE SPACINGS. HOWEVER IF THE SIZE OF THE GRATING IS NOT IN MULTIPLES OF THE SPACING. ADJUSTMENT SHALL BE MADE AT THE ENDS ONLY.
8. THE GRATING WEIGHTS ARE COMPUTED FOR A PANEL SIZE OF 1056 X 1000.
9. REMOVABLE GRATING PANEL SHALL BE FIXED WITH THE SUPPORTING MEMBERS BY CLAMPS ONLY.
10. UNSUPPORTED EDGES OF ADJACENT GRATING PANELS SHALL BE CONNECTED BY TACK WELD OR U-CLAMPS MADE OUT OF 25X3 THK. M.S. FLATS WITH M-6 BOLTS AT BOTTOM. MINIMUM TWO TACK WELDS OR TWO CLAMPS PER PANEL SHALL BE PROVIDED.
11. GRATINGS SHALL NOT BE USED FOR SUPPORTING THE PIPES DIRECTLY. ADDITIONAL MEMBER MC100 SHALL BE PROVIDED UNDER THE GRATING FOR SUPPORTING THE PIPE HAVING A MAXIMUM LOAD OF 500kg. THIS MEMBER SHALL SPAN IN SAME DIRECTION AS GRATING.
12. FOR GRATING PANELS WITH CUTOUTS / OPENINGS; STRENGTHENING SHALL BE CARRIED OUT AS PER THE DETAILS GIVEN ON SHEET 3 OF 3.

NET SAFE WORKING LOADS FOR GRATING

L	500	600	700	800	900	1000	1100	1250	1400
d	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	
w	> 2000				1515	1105	830	540	345
p	1475	1225	1050	915	810	670	550	400	275

SYMBOLS :-

L = EFFECTIVE SPAN IN mm
d = VERTICAL DEFLECTION IN mm
p = UNIFORMLY DISTRIBUTED LINEAR LOAD IN kg/m AT MID SPAN ALONG PANEL WIDTH.
↔ = GRATING SPAN

b = BEARING WIDTH IN mm
w = UDL IN kg/m²

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD GRATING DETAILS

STANDARD DRAWING NO.

VCS-STD-CS-6036

SHEET NO.

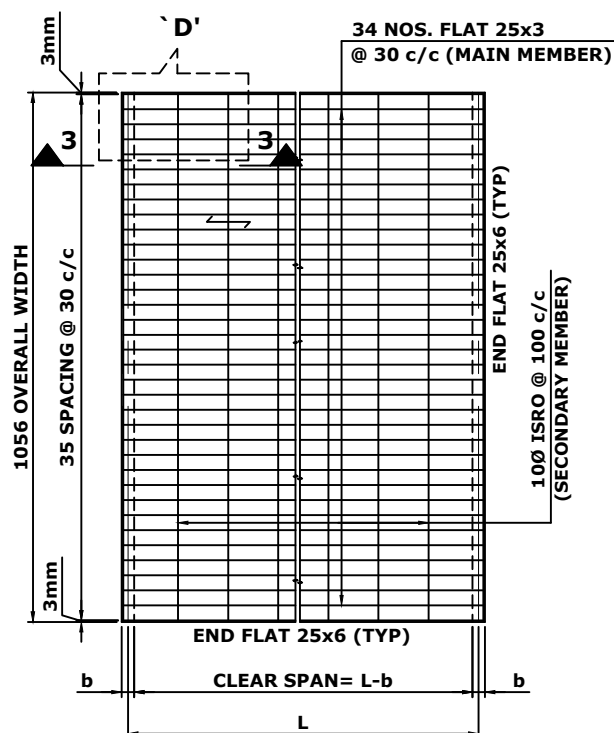
2 OF 3

REV.

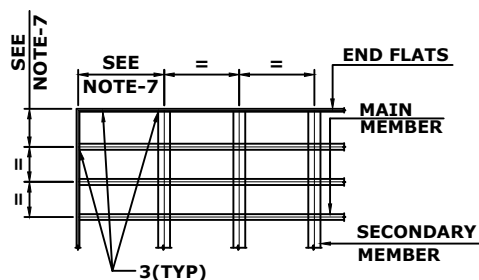
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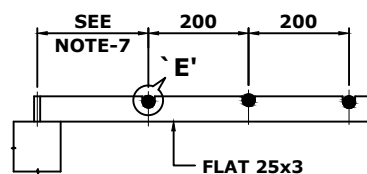
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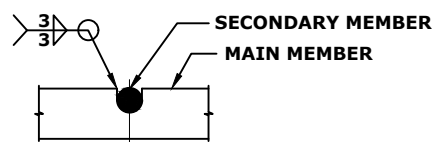
PLAN



DETAIL - 'D'



SECTION 3-3



DETAIL - 'E'

GRATING

WEIGHT OF GRATING IN kg/m2				PROPERTIES WIDTH - 1056			APPLICATION	NOTES
25X6	25X3	100 ISRO	TOTAL	Lxx cm4	Zxx cm3	MR kgm	EQUIPMENT PLATFORM STAIRCASE PUMP HOUSE CROSS OVER	REFER SHT. 1 OF 3
4.6	18.8	5.4	28.8	14.84	11.87	195.94		

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG	
02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK	
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY	



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD GRATING DETAILS

STANDARD DRAWING NO.

VCS-STD-CS-6036

SHEET NO.

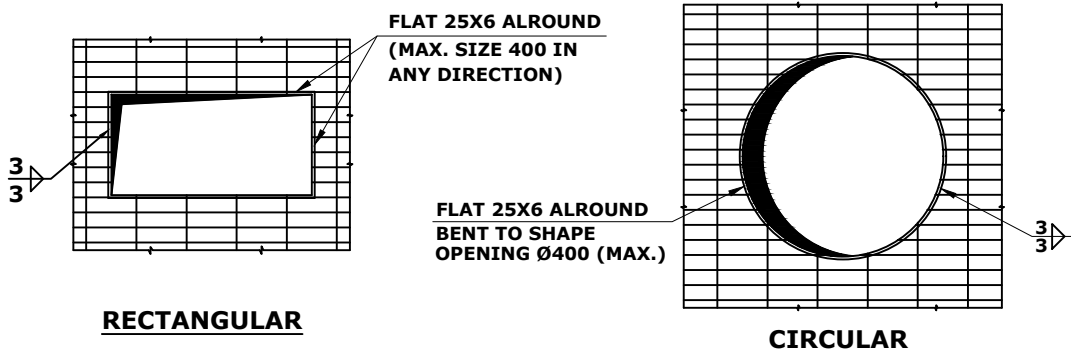
3 OF 3

REV.

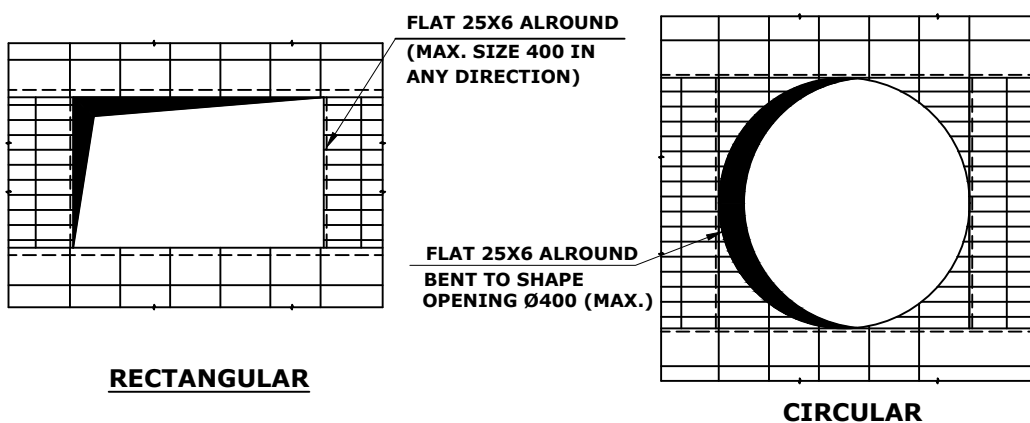
03

SIZE

A4

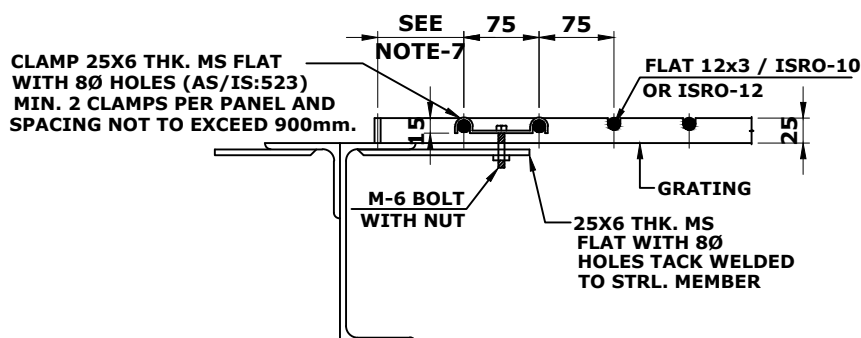


(MAXIMUM SIZE OF OPENING 400 mm)



(SIZE OF OPENING GREATER THAN 400 mm)

TYPICAL DETAIL OF GRATING STRENGTHENING AT OPENINGS



FIXING DETAIL FOR REMOVABLE GRATING PANELS WITH CLAMPS

(SEE NOTE - 9)

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY

 VCS QUALITY SERVICES PRIVATE LIMITED	PIPE SLEEPER CROSSOVER	STANDARD DRAWING NO.		REV.	SIZE
		VCS-STD-CS-6037		03	A4
		SHEET NO.	1 OF 3		

NOTES :-

1. ALL DIMENSIONS ARE IN MILLIMETERS
2. THE LOADING CONSIDER ARE :-
 - a) LIVE LOAD = 2.0 KN/m^2 ON CROSSOVER
 - b) SELF WEIGHT OF MEMBER INCLUDING GRATINGS
3. ALL STRUCTURE STEEL SHALL CONFORM TO IS: 2062 GRADE-A
4. GRADE OF CONCRETE SHELL BE AS MENTIONED IN GENERAL NOTES FOR CONCRETE WORKS, FOR THE PROJECT
5. R/F BARS SHELL BE COLD WORKED STEEL HIGH STRENGTH DEFORMED BARS OF GRADE Fe 415 (MIN.) CONFORMING TO IS: 1786
6. CONCRETE AND STEEL WORK SHALL BE AS PER GENERAL NOTES FOR THE PROJECT.
7. LOCATION AND ORIENTATION OF PLATFORMS SHALL BE AS PER PIPING GAD.
8. STAIRCASE DETAIL AS PER VPC-STD-CS-6047.
9. STAIRCASE ON EACH SIDE OF CROSSOVER SHALL HAVE INCLINATION OF 41° TO HORIZONTAL, WITH RISERS NOT EXCEEDING 200mm.
10. GRATING SHALL BE AS PER VPC-STD-CS-6036.
11. UPTO > 2000 HANDRAIL SHALL BE AS PER VPC-STD-CS-6033.
12. GUSSET PLATES SHALL BE 8mm. THICK UNLESS NOTED OTHERWISE.
13. ANCHOR BOLTS SHALL BE AS PER VPC-STD-CS-6054.
14. PIPE SLEEPERS HAVE BEEN ASSUMED TO BE 500mm. (MAXIMUM) ABOVE GRADE AND WITH A MAXIMUM LENGTH OF 5000mm SYMMETRICALLY LOCATED WITH RESPECT TO CENTRE LINE THUS REQUIRING SINGLE SPAN CROSSOVERS.

						
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

PIPE SLEEPER
CROSSOVER

STANDARD DRAWING NO.

VCS-STD-CS-6037

SHEET NO.

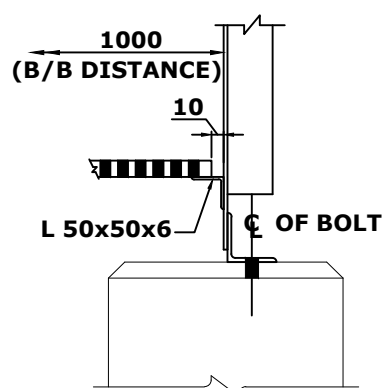
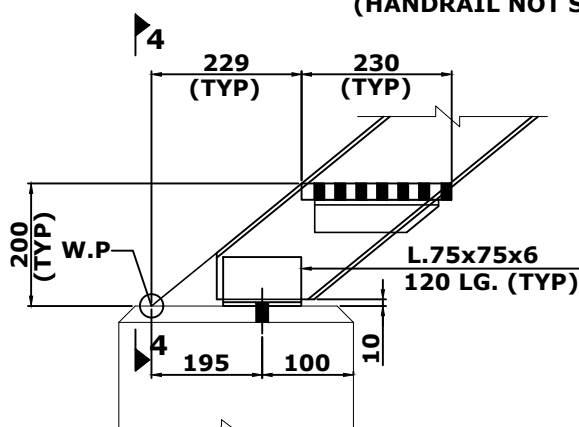
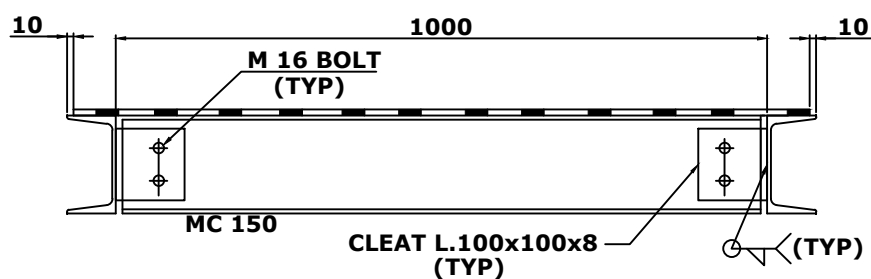
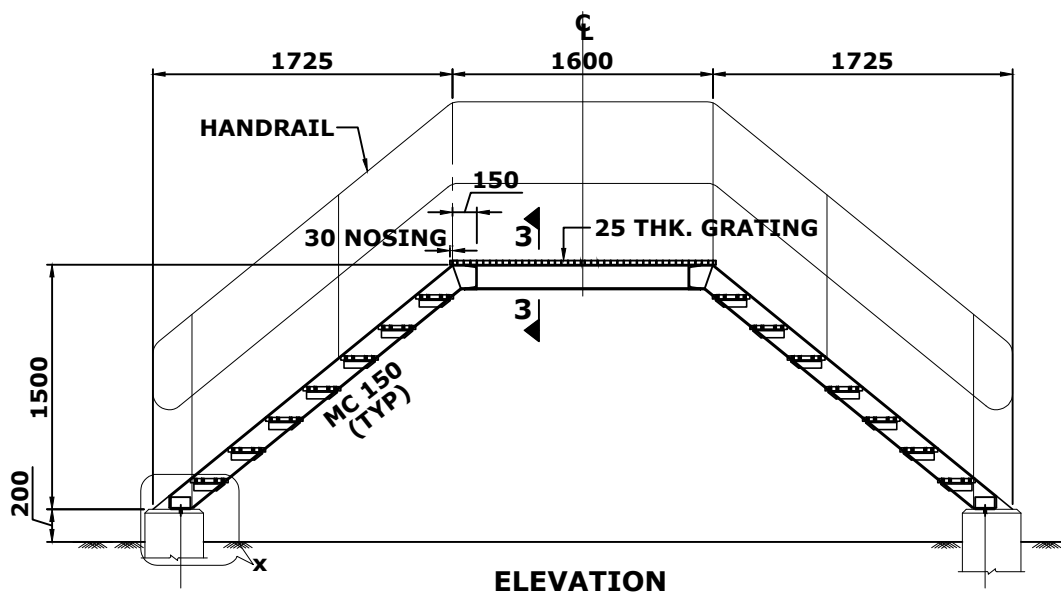
2 OF 3

REV.

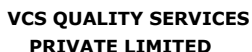
03

SIZE

A4



03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



PIPE SLEEPER CROSSOVER

STANDARD DRAWING NO.

REV.

SIZE

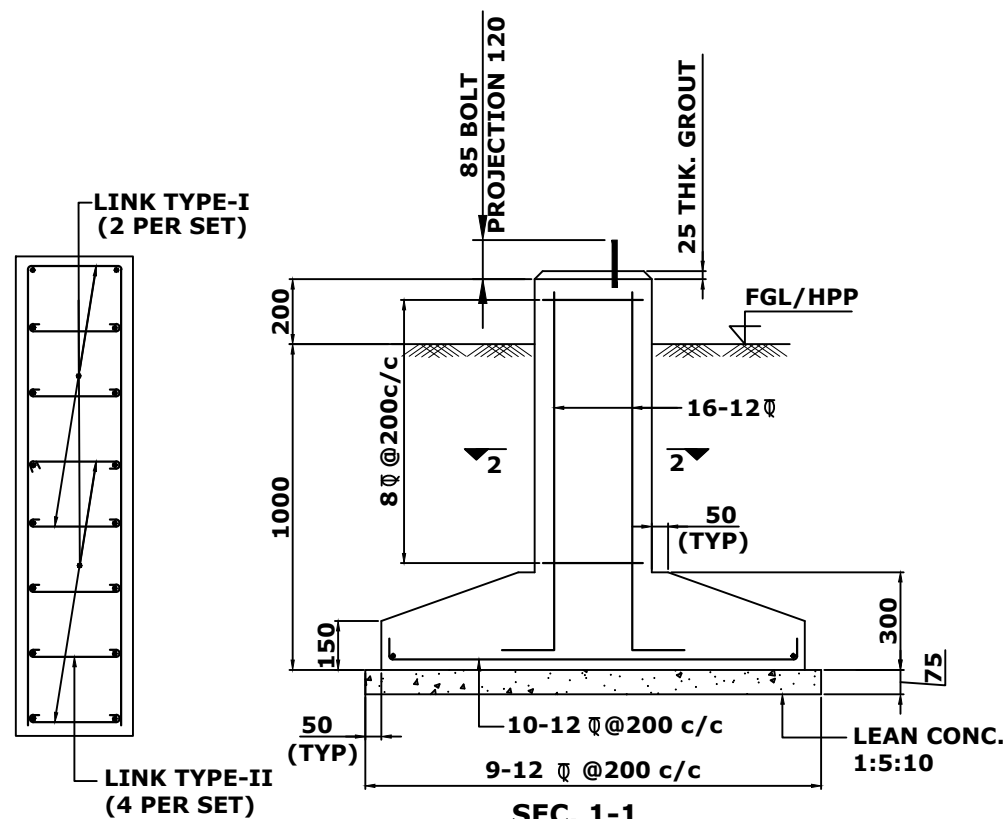
VCS-STD-CS-6037

03

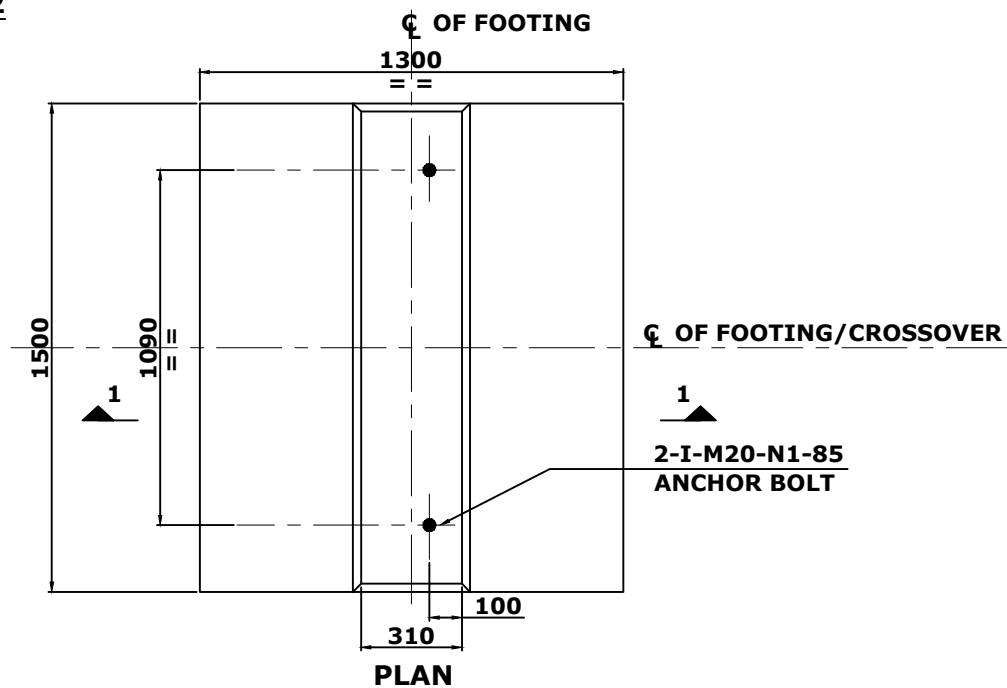
A4

SHEET NO.

3 OF 3



SEC. 2-2



						
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD
FOR
MISCELLANEOUS DETAILS

STANDARD DRAWING NO.

VCS-STD-CS-6038

SHEET NO.

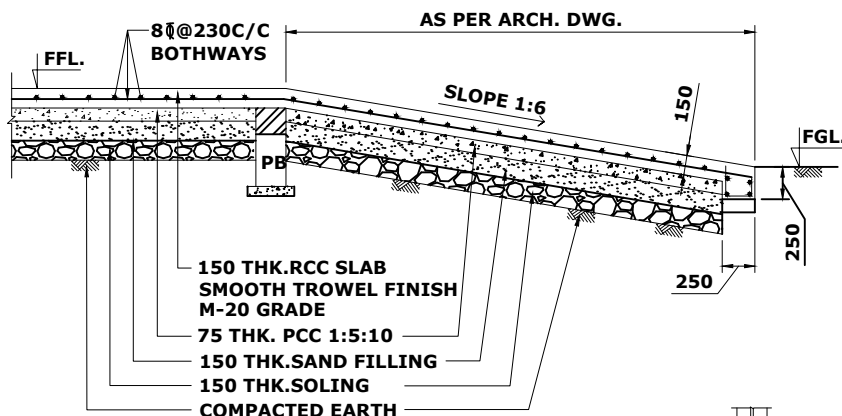
1 OF 1

REV.

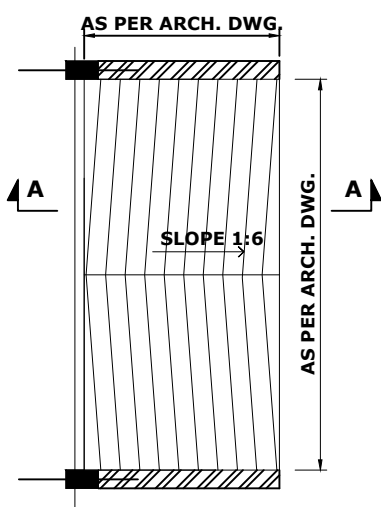
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SIZE

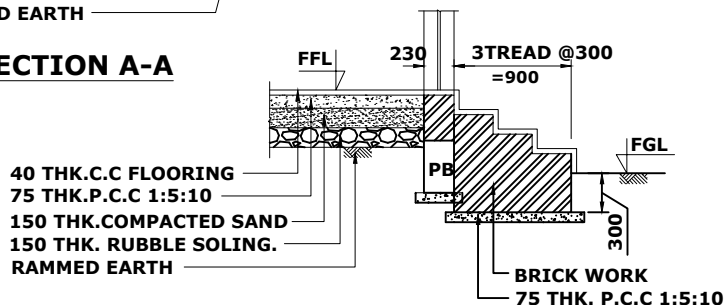
A4



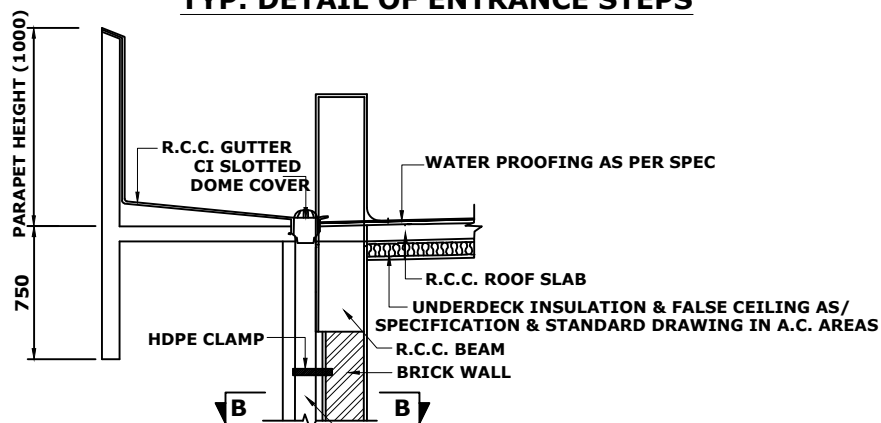
SECTION A-A



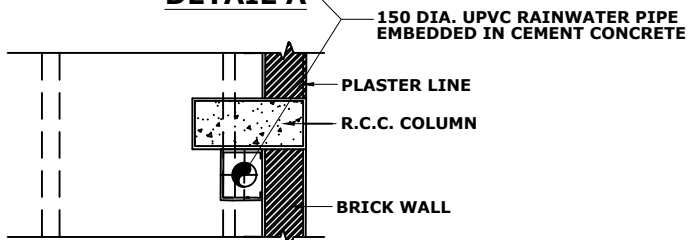
PLAN OF RAMP



TYP. DETAIL OF ENTRANCE STEPS



DETAIL A



**SECTION B-B
TYP. DETAIL OF RAIN DOWNTAKE**

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

DETAILS OF STEEL LADDER

STANDARD DRAWING NO.

REV.

SIZE

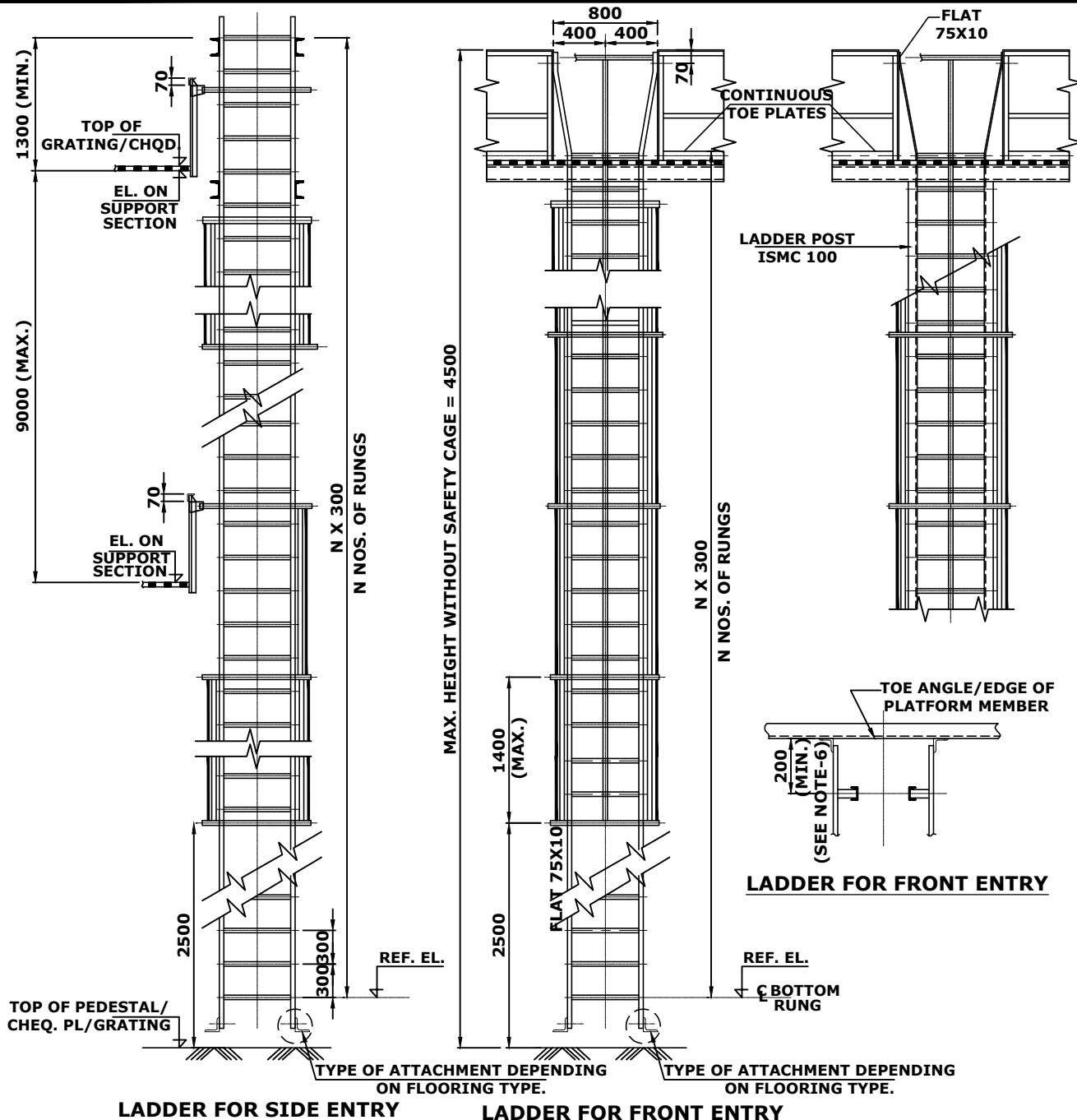
VCS-STD-CS-6039

03

A4

SHEET NO.

1 OF 3



03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

DETAILS OF STEEL LADDER

STANDARD DRAWING NO.

REV.

SIZE

VCS-STD-CS-6039

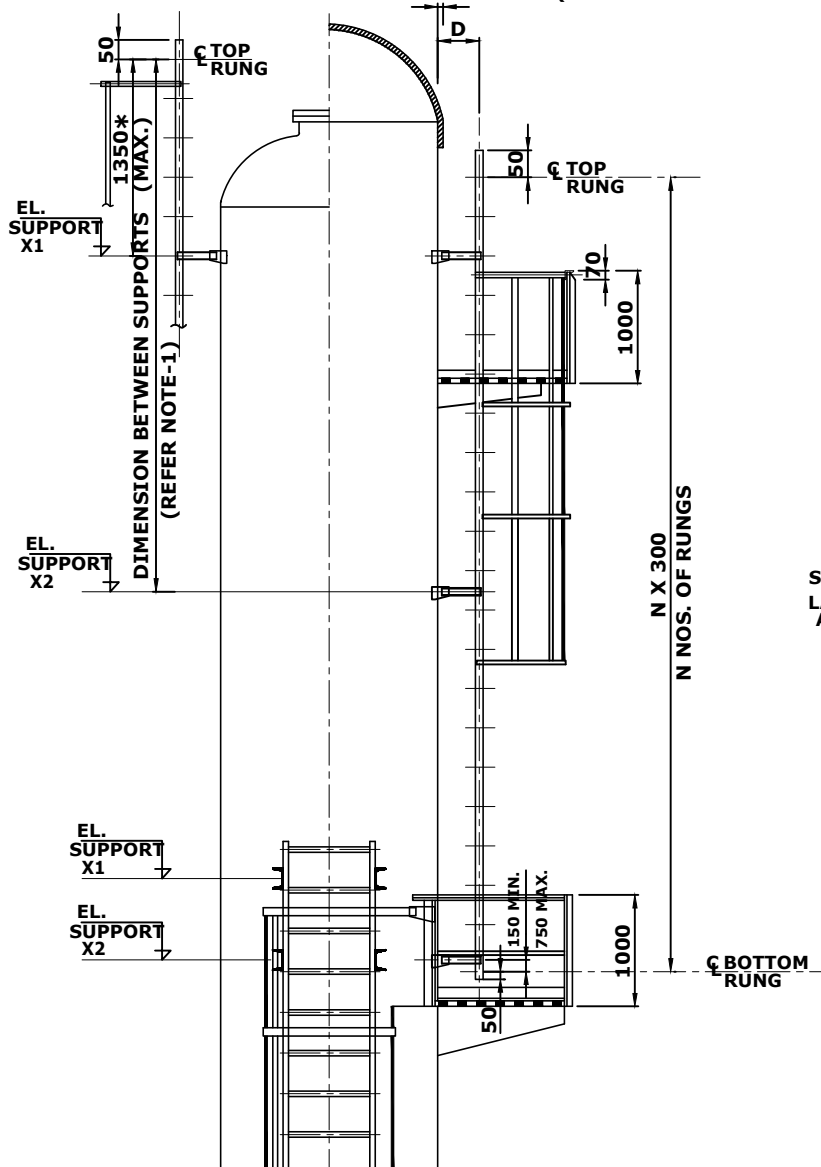
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A4

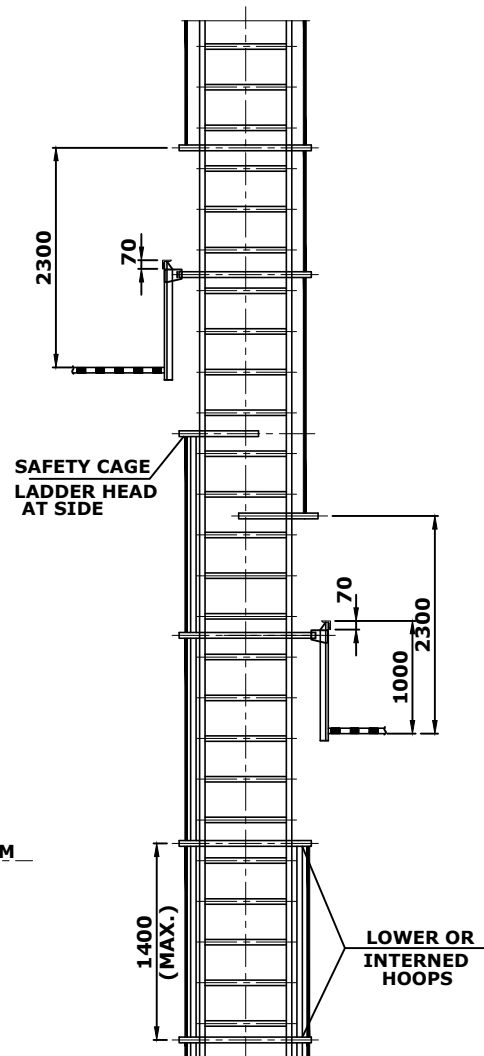
SHEET NO.

2 OF 3

`e' INSULATION THICKNESS (50 mm UNLESS NOTED OTHERWISE)



LADDER FOR SIDE ENTRY



LADDER FOR SIDE ENTRY

VESSEL DIA (mm)	DISTANCE `D' (mm)
UPTO 800	200 + e
> 800 ≤ 3200	260 + e
> 3200 < 8000	275 + e

*MC100 SHALL BE ADOPTED FOR DISTANCE MORE THAN 1350 UPTO 2000

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

DETAILS OF STEEL LADDER

STANDARD DRAWING NO.

VCS-STD-CS-6039

SHEET NO.

3 OF 3

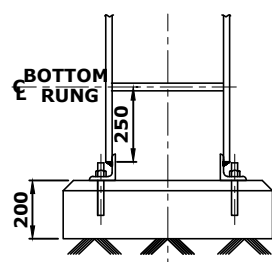
REV.

03

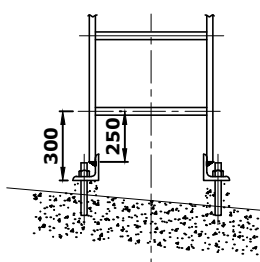
SIZE

A4

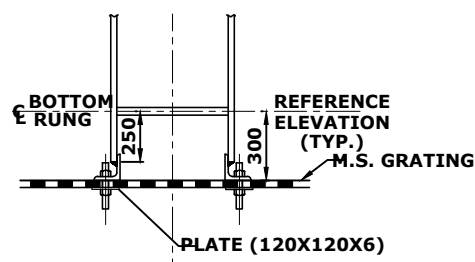
TYPE OF ATTACHMENT	NATURE OF SUPPORT SECTION	REMARKS
A1, A2	SITE WITHOUT PAVING	
B1, B2	CONCRETE FLOOR	A1, B1, C1, D1 : FIXED TYPE
C1, C2, D1, D2	CHEQUERED PLATE / GRATING FLOORING	A2, B2, C2, D2 : SLIDING TYPE



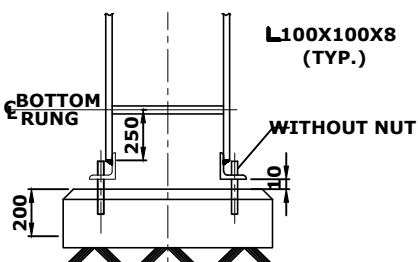
TYPE - A1



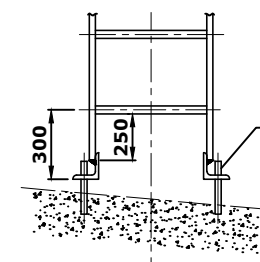
TYPE - B1



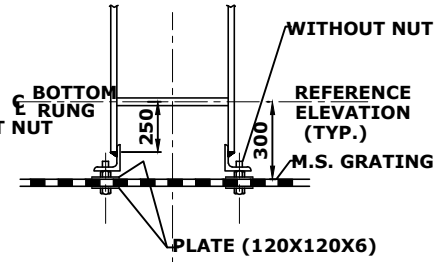
TYPE - C1



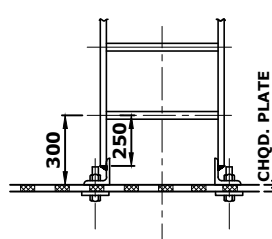
TYPE - A2



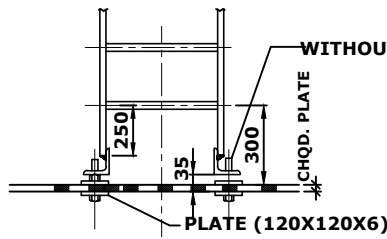
TYPE - B2



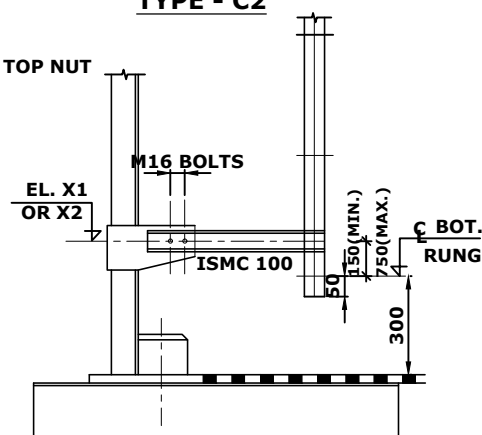
TYPE - C2



TYPE - D1



TYPE - D2

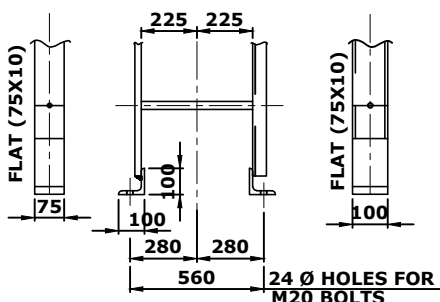


TYPE - E
(FREE)

NOTE :-

IN CASE OF TOWERS BOTTOM RUNG SHALL
BE 300 mm FROM FGL /HPP

TYPE OF ATTACHMENT AT BASE



LADDER BOTTOM DETAILS

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY

 VCS QUALITY SERVICES PRIVATE LIMITED	METAL INSERT PLATES	STANDARD DRAWING NO.		REV.	SIZE
		VCS-STD-CS-6040		03	A4
		SHEET NO.	1 OF 7		

GENERAL NOTES:-

- ALL LUGS SHALL BE OF HIGH STRENGTH DEFORMED BARS OF
GRADE Fe415 CONFORMING TO IS:1786 (WITH GUARANTEED WELDABILITY)
AND SHALL BE CONNECTED TO METAL INSERT PLATES BY 6 mm FILLET
WELDS AS SHOWN IN SKETCHES.
- METAL INSERT PLATES SHALL BE CONFORMING TO IS:2062 (GR-A).
- METAL INSERT PLATES MARKED ON DRAWING REFER AS UNDER

IP -(A) @ (C)

IP = INSERT PLATE

A = TYPE OF INSERT PLATE

C = ELEVATION OF INSERT PLATE (TOP EDGE)

e.g IP-R9a @ EL.110.300 MEANS INSERT TYPE R9a AT EL.110.300.
- METAL INSERT PLATES SHALL BE KEPT FLUSH WITH CONCRETE SURFACE.
- THE LONGER SIDE OF METAL INSERT PLATE SHALL BE KEPT VERTICAL
UNLESS SHOWN OTHERWISE.
- METAL INSERT PLATE ON COLUMN OR BEAM SHALL BE KEPT SYMMETRICAL
ABOUT C_G OF COLUMN OR BEAM, UNLESS SHOWN OTHERWISE.

						
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	RK	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

METAL INSERT PLATES (LUG BENDING DETAILS)

STANDARD DRAWING NO.

VCS-STD-CS-6040

SHEET NO.

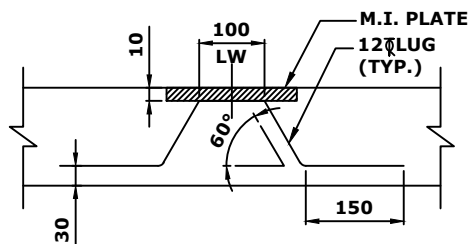
2 OF 7

REV.

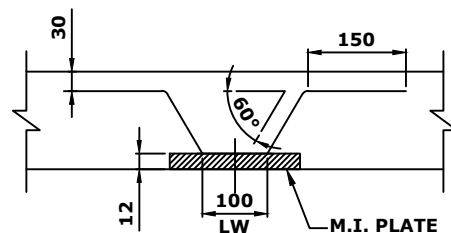
03

SIZE

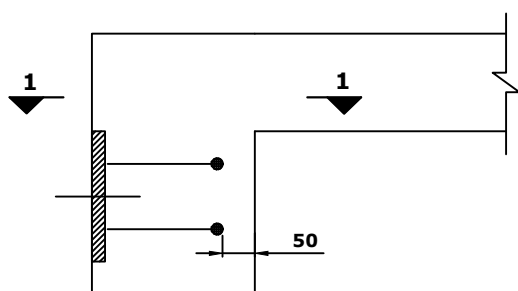
A4



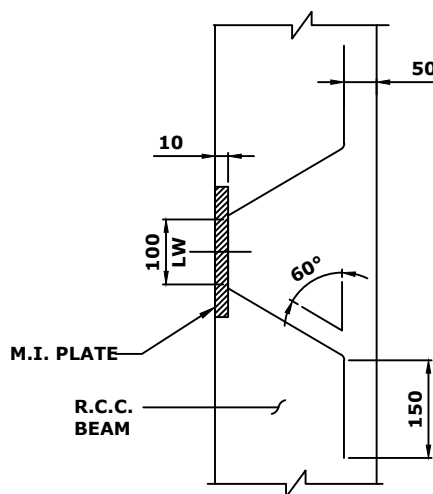
**METAL INSERT DETAIL
ON TOP OF SLAB**



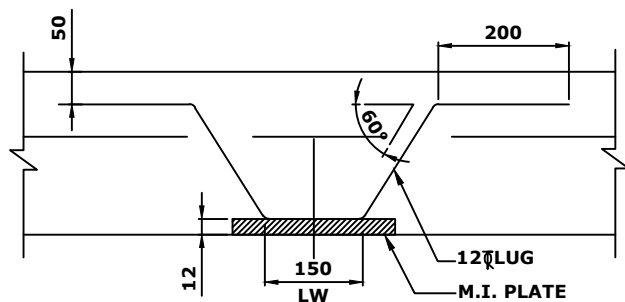
**METAL INSERT DETAIL
ON BOTTOM OF SLAB**



**METAL INSERT DETAIL
ON SIDE OF BEAM**

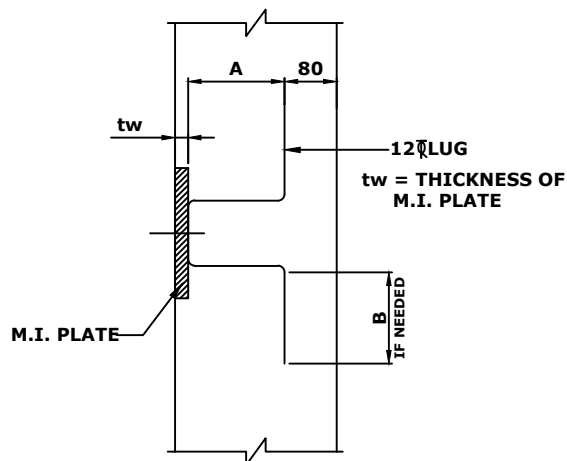


VIEW 1-1



**METAL INSERT DETAIL
ON BOTTOM OF BEAM**

(FOR ALTERNATE DETAIL REF. SHT. 7 OF 7)



**METAL INSERT DETAIL
ON COLUMNS**

A+B = LUG EMBEDMENT REQUIRED
AS PER SHT. 4,5,6 OF 7

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

METAL INSERT PLATES

STANDARD DRAWING NO.

VCS-STD-CS-6040

SHEET NO.

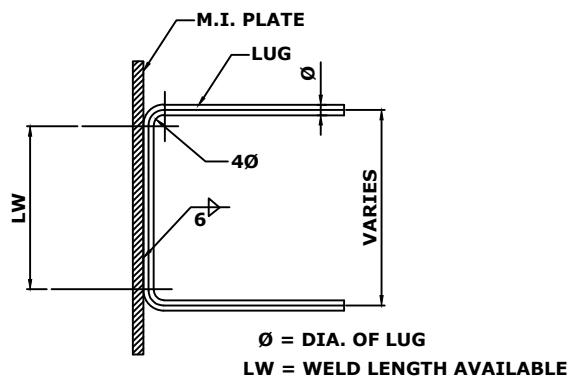
3 OF 7

REV.

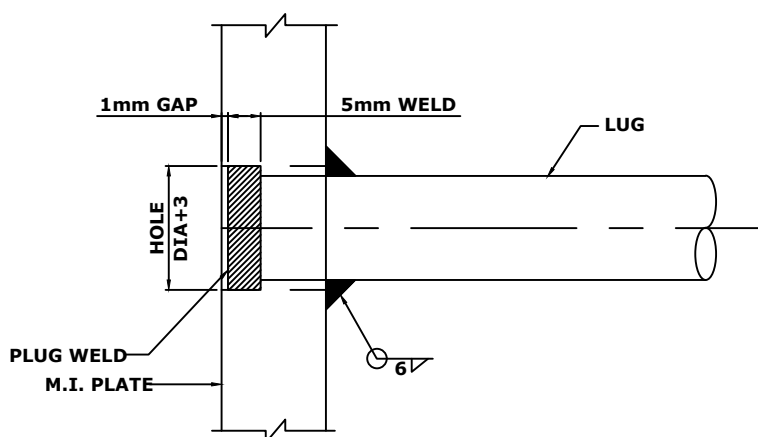
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SIZE

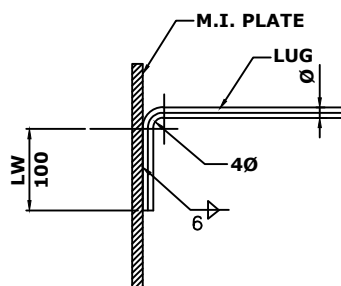
A4



BENDING DIMENSIONS FOR 12mm & 16mm LUGS (FOR SPACING OF LUGS ≥ 190) (NOT APPLICABLE FOR S1, S2 & R1)



WELD DETAIL OF 12mm & 16mm LUGS WITH M.I. PLATE (FOR SPACING OF LUGS < 190) (VALID FOR S1, S2 & R1)



BENDING DIMENSIONS FOR 12mm & 16mm LUGS (VALID FOR R9, R10, R12, R13, R14, PS11 & PS12)

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

METAL INSERT PLATES
(S/R DESIGNATES)

STANDARD DRAWING NO.

VCS-STD-CS-6040

SHEET NO.

4 OF 7

REV.

03

SIZE

A4

S. NO.	TYPE OF INSERT	DIA OF LUGS	THK. OF INSERT	DETAILS OF INSERT PLATE		S. NO.	TYPE OF INSERT	DIA OF LUGS	THK. OF INSERT	DETAILS OF INSERT PLATE	
				PLAN	CROSS SECTION					PLAN	CROSS SECTION
1.	S1a	12	12			7.	S7a	12	12		
	S1b	16	16				S7b	16	16		
2.	S2a	12	12			8.	R1a	12	12		
	S2b	16	16				R1b	16	16		
3.	S3a	12	12			9.	R2a	12	12		
	S3b	16	16				R2b	16	16		
4.	S4a	12	12			10.	R3a	12	12		
	S4b	16	16				R3b	16	16		
5.	S5a	12	12			11.	R4a	12	12		
	S5b	16	16				R4b	16	16		
6.	S6a	12	12			12.	R5a	12	12		
	S6b	16	16				R5b	16	16		

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

METAL INSERT PLATES
(R DESIGNATES)

STANDARD DRAWING NO.

VCS-STD-CS-6040

SHEET NO.

5 OF 7

REV.

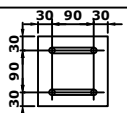
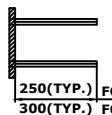
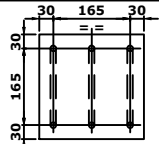
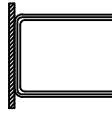
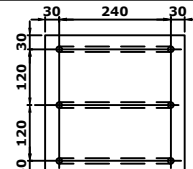
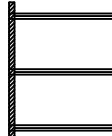
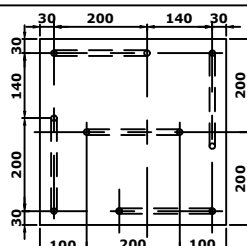
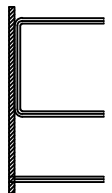
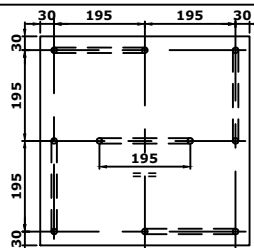
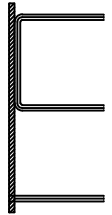
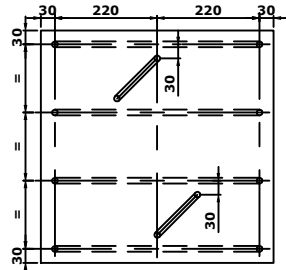
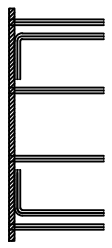
03

SIZE

A4

S. NO.	TYPE OF INSERT	DIA OF LUGS	THK. OF INSERT	DETAILS OF INSERT PLATE		S. NO.	TYPE OF INSERT	DIA OF LUGS	THK. OF INSERT	DETAILS OF INSERT PLATE	
				PLAN	CROSS SECTION					PLAN	CROSS SECTION
13.	R6a	12	12			18.	R11a	12	12		
	R6b	16	16				R11b	16	16		
14.	R7a	12	12			19.	R12a	12	12		
	R7b	16	16				R12b	16	16		
15.	R8a	12	12			20.	R13a	12	12		
	R8b	16	16				R13b	16	16		
16.	R9a	12	12			21.	R14a	12	12		
	R9b	16	16				R14b	16	16		
17.	R10a	12	12								
	R10b	16	16								

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY

 VCS QUALITY SERVICES PRIVATE LIMITED				METAL INSERT PLATES (PS DESIGNATES)		STANDARD DRAWING NO.		REV.	SIZE
						VCS-STD-CS-6040		03	A4
						SHEET NO.	6 OF 7		
S. NO.	TYPE OF INSERT	DIA OF LUGS	THK. OF INSERT	DETAILS OF INSERT PLATE					
				PLAN	CROSS SECTION				
1.	PS1	12	12	 SIZE 150x150					
	PS2	16	16						
2.	PS3	12	12	 SIZE 225x225					
	PS4	16	16						
3.	PS5	12	12	 SIZE 300x300					
	PS6	16	16						
4.	PS7	12	12	 SIZE 400x400					
	PS8	16	16						
5.	PS9	12	12	 SIZE 450x450					
	PS10	16	16						
6.	PS11	12	12	 SIZE 500x500					
	PS12	16	16						
03	03.02.22	RE-ISSUED AS STANDARD			MN	GDS	HK	WG	
02	30.01.20	RE-ISSUED AS STANDARD			YS	GDS	RKB	SK	
REV NO.	DATE	PURPOSE			PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY	



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD FOR DETAIL
OF METAL INSERT PLATES
(PS DESIGNATES)

STANDARD DRAWING NO.

VCS-STD-CS-6040

SHEET NO.

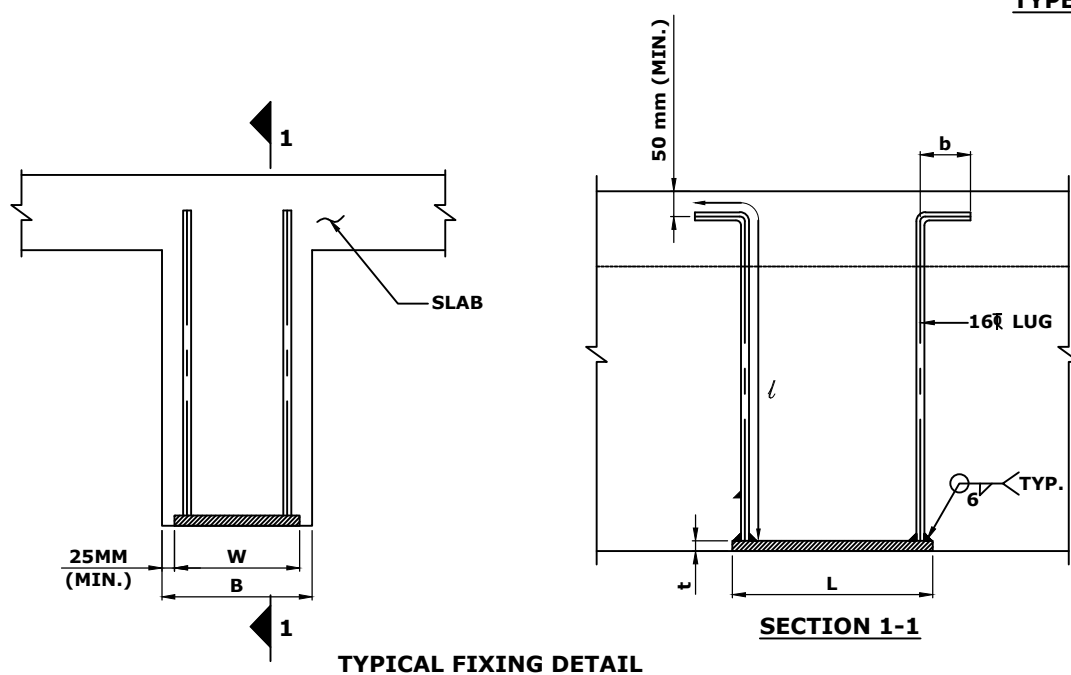
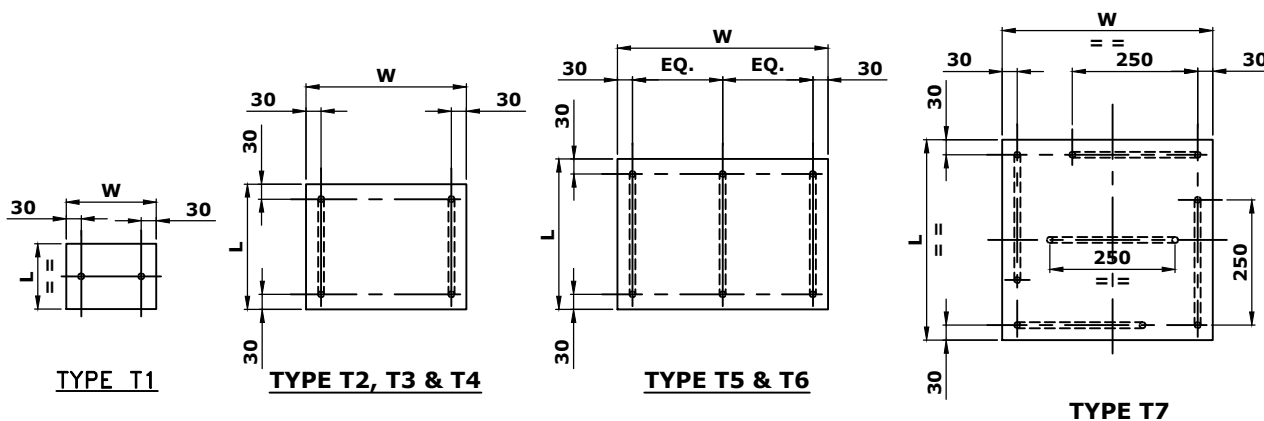
7 OF 7

REV.

03

SIZE

A4



S.NO.	TYPE OF INSERT	WIDTH OF BEAM 'B' (mm)	MAXIMUM WIDTH OF PLATE 'W' (mm)	LENGTH OF PLATE 'L' (mm)	MAXIMUM 'b' (mm)	THICKNESS OF PLATE 't' (mm)	TOTAL ANCHORAGE LENGTH 'l' (mm)
1.	T1	230	180	180	110	16	350
2.	T2	300	220	250	110	20	350
3.	T3	350	270	250	110	20	350
4.	T4	400	320	250	110	20	350
5.	T5	450	370	300	110	32	350
6.	T6	500	420	300	110	32	350
7.	T7	500	420	400	110	32	350

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD FOR DETAIL OF CANTILEVER PIPE SUPPORT

STANDARD DRAWING NO.

VCS-STD-CS-6041

SHEET NO.

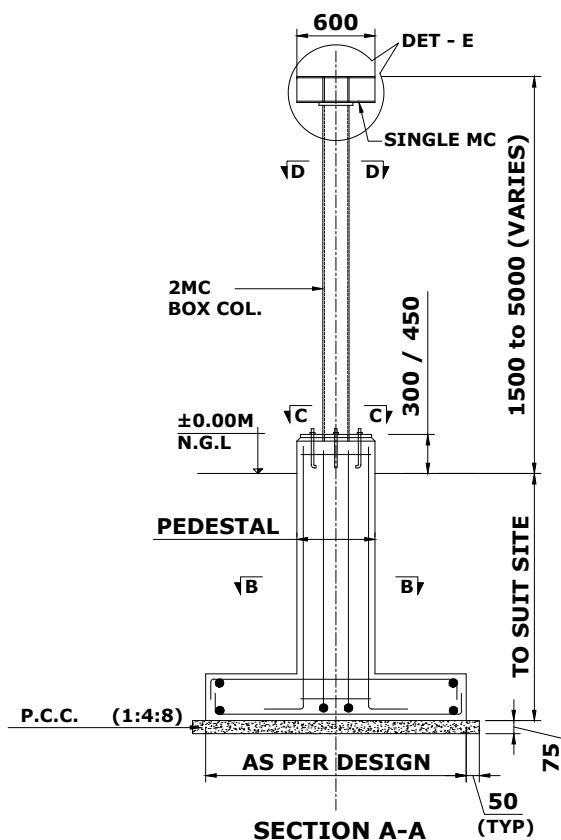
1 OF 1

REV.

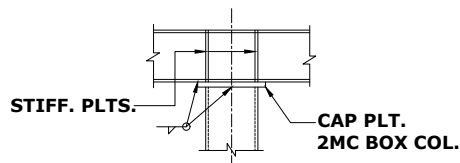
03

SIZE

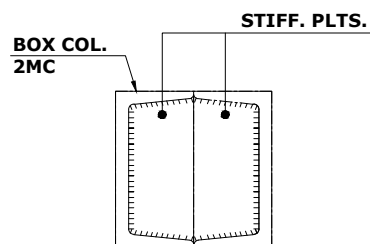
A4



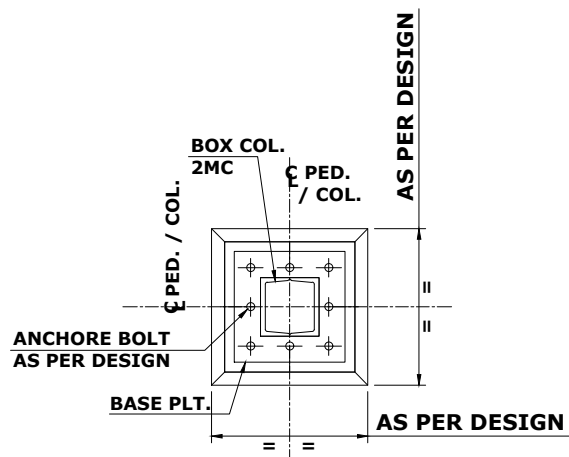
SECTION A-A



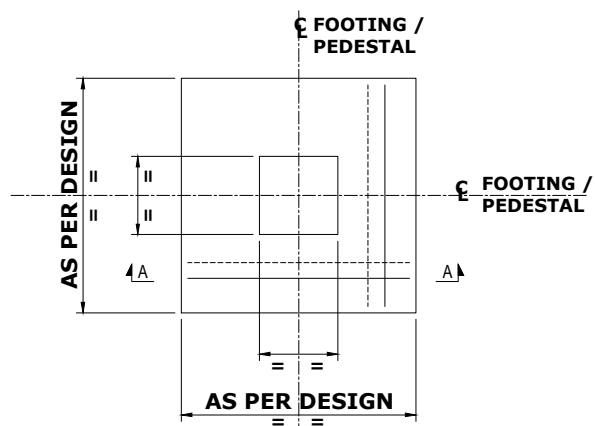
DETAIL - E



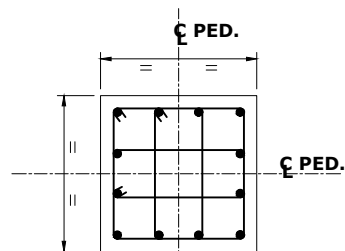
SECTION D-D



VIEW C-C



FOUNDATION PLAN



SECTION B-B

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD FOR DETAIL
OF PEDESTAL FOR STAIR / LADDER

STANDARD DRAWING NO.

VCS-STD-CS-6043

SHEET NO.

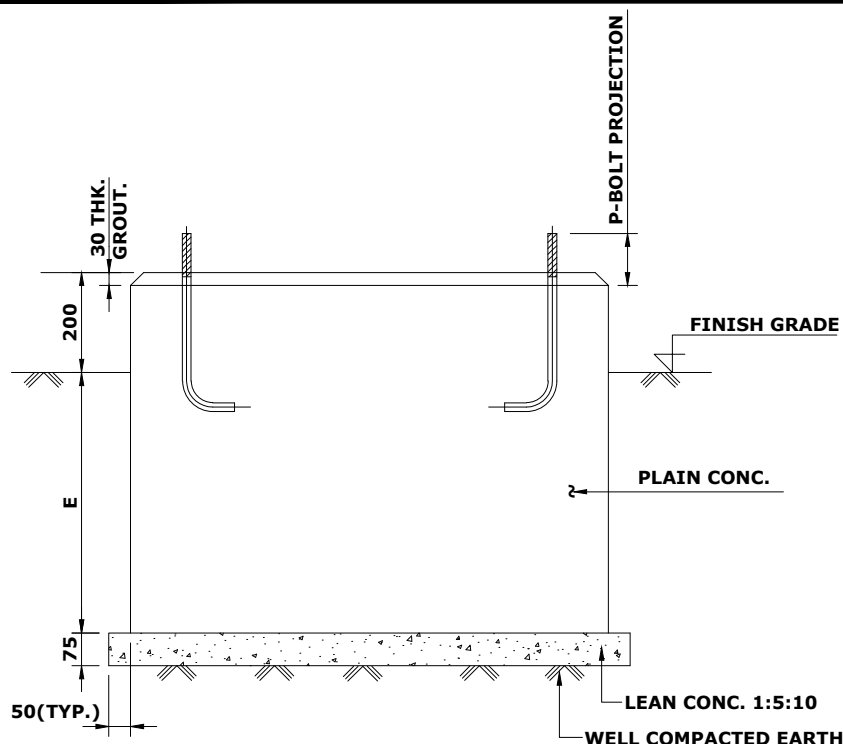
1 OF 1

REV.

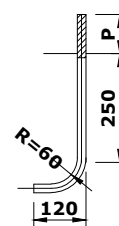
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SIZE

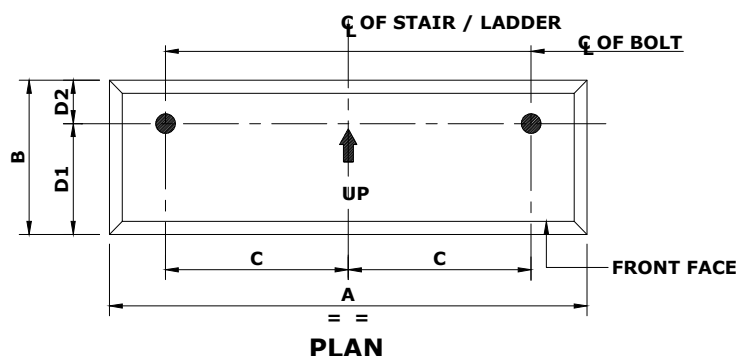
A4



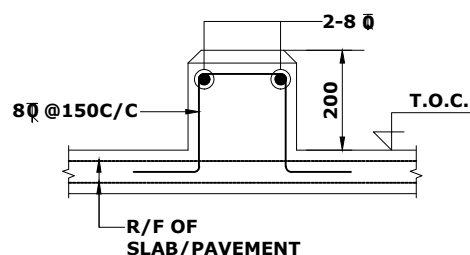
PEDESTAL FOR UNPAVED AREA



DETAIL OF L-BOLT



PLAN



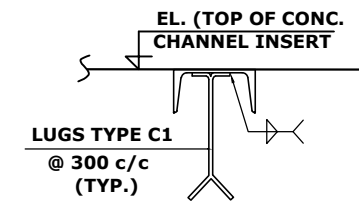
PEDESTAL ON CONC.
PAVEMENT/R.C.C.SLAB

S.NO.	ITEM	WIDTH	A	B	C	D1	D2	P	E	NUT	REMARKS
1	LADDER	450	750	300	280	200	100	90	500	SINGLE	
2	STAIR	750	1100	310	421	160	150	90	600	SINGLE	FOR STRINGER BEAM MC150
3	STAIR	750	1100	355	421	255	100	90	600	SINGLE	FOR STRINGER BEAM MC200

NOTES :-

1. IN CASE OF PEDESTAL OVER PILE CAP/RCC FOUNDATION, DIMENSION E TO SUIT ACCORDINGLY BUT NOT TO EXCEED VALUES GIVEN IN ABOVE TABLE.
2. CONCRETE GRADE SHALL BE AS PER GENERAL NOTES OF THE PROJECT BUT NOT LOWER THEN M25.
3. M20 L-BOLT AS PER DETAIL GIVEN ABOVE SHALL BE PROVIDED.
4. BOLTS SHALL BE TURNED FROM MILD STEEL BARS CONFORMING TO IS:2062 GRADE-A.
5. HEXAGONAL NUTS AND WASHERS SHALL CONFORM TO IS:1363 AND IS:3138.
6. THREADING SHALL BE COARSE AND CONFORM TO IS:1367 AND IS 4218.

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



 VCS QUALITY SERVICES PRIVATE LIMITED 	STANDARD FOR DETAIL OF BLOCK FOUNDATION FOR TRANSFORMERS (UPTO 2000kVA RATING)								STANDARD DRAWING NO.	REV.	SIZE
		3	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG			
		2	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK	SHEET NO.	1 OF 1	
		REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY			



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD FOR DETAIL
OF M.S. RUNGS FOR CONC. STRUCTURES

STANDARD DRAWING NO.

VCS-STD-CS-6046

SHEET NO.

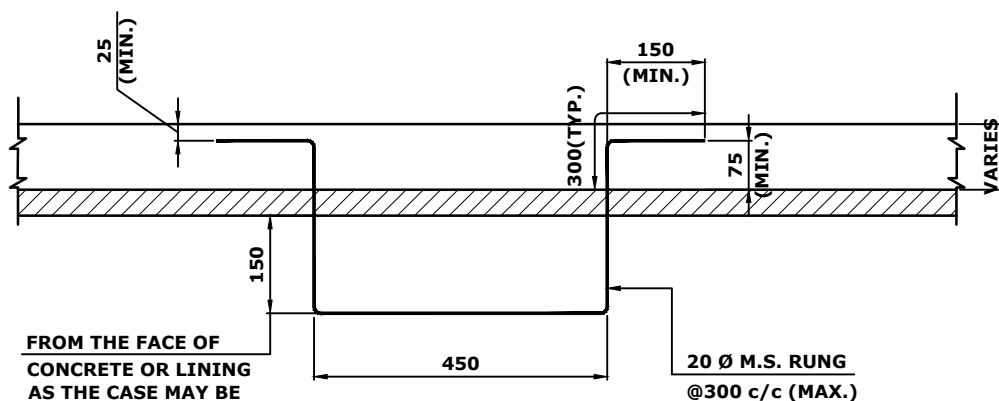
1 OF 1

REV.

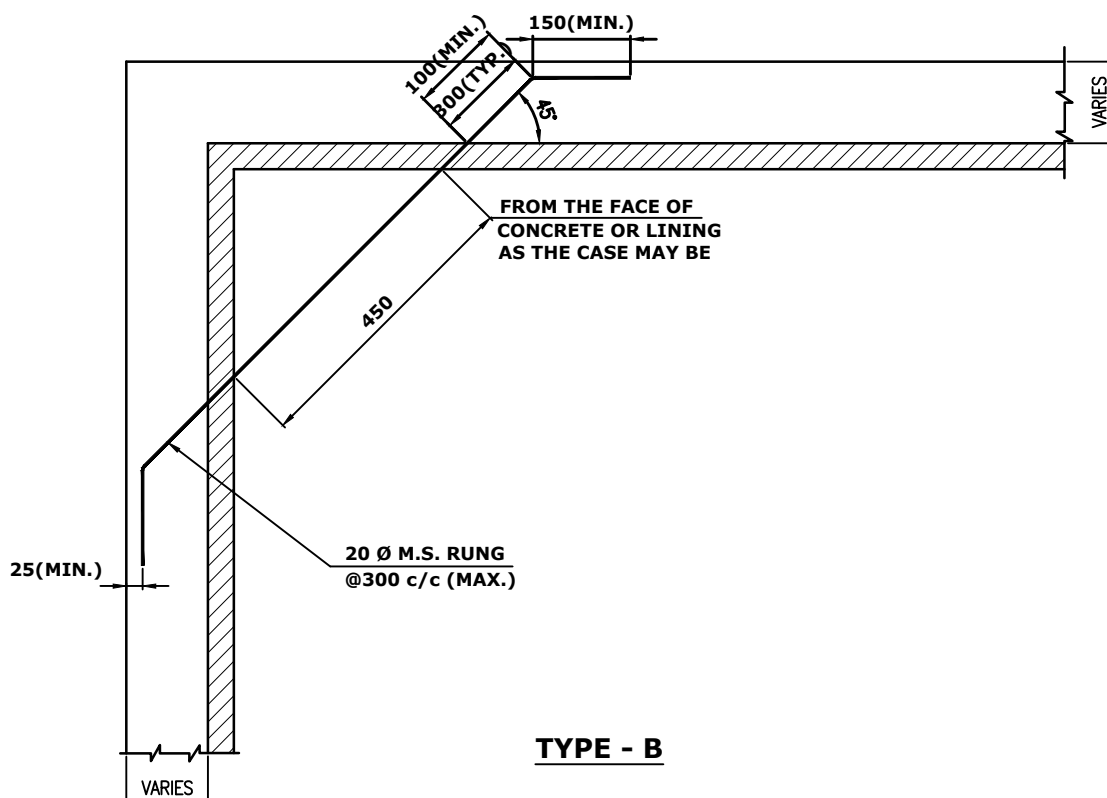
03

SIZE

A4



TYPE - A



TYPE - B

NOTES :-

1. ALL DIMENSIONS ARE IN mm.
2. FIRST RUNG SHALL BE AT 300mm FROM TOP.

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD FOR DETAIL
OF REINFORCEMENT AT CIRCULAR
CUT-OUT IN SLAB

STANDARD DRAWING NO.

VCS-STD-CS-6048

SHEET NO.

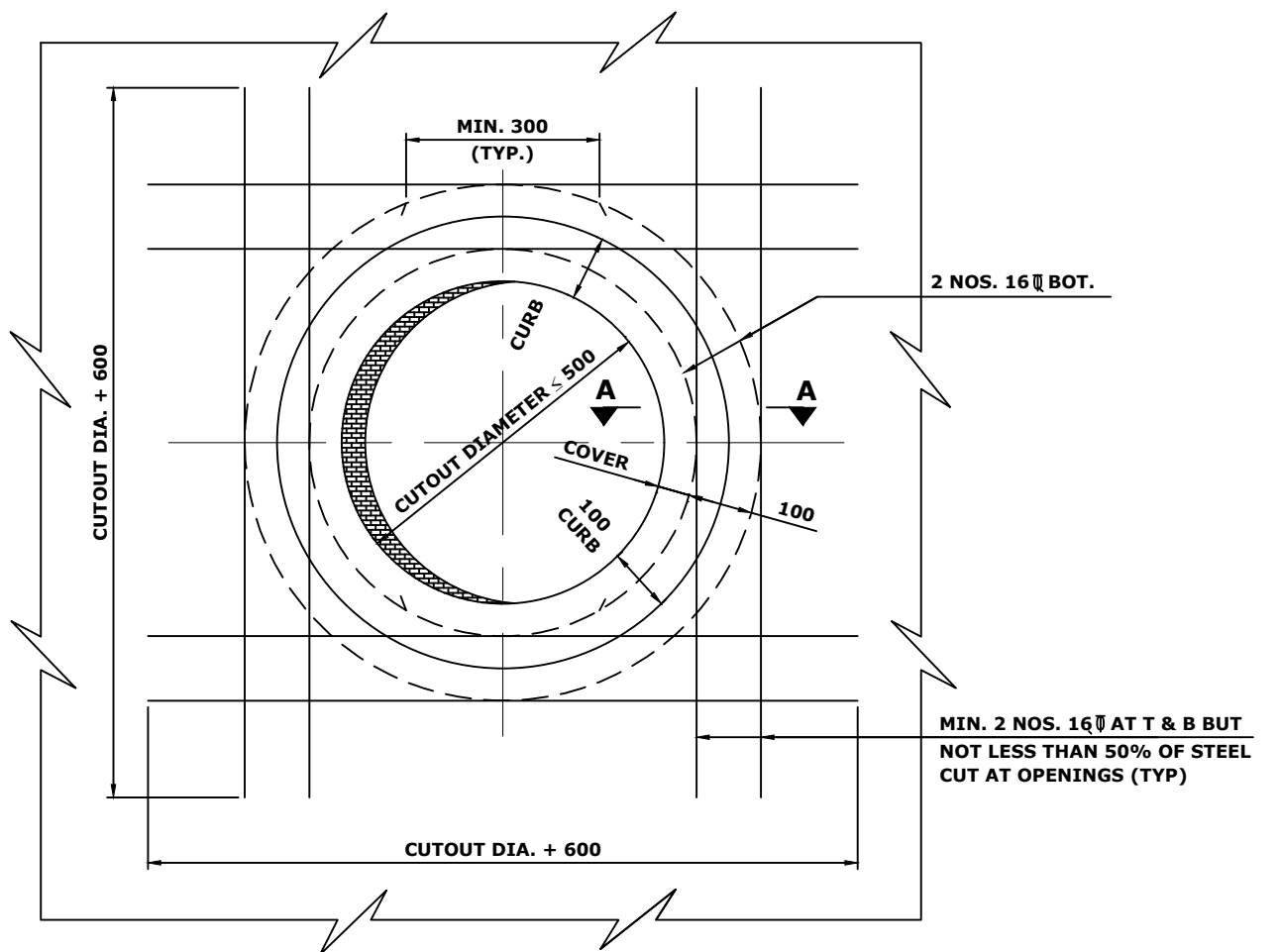
1 OF 1

REV.

03

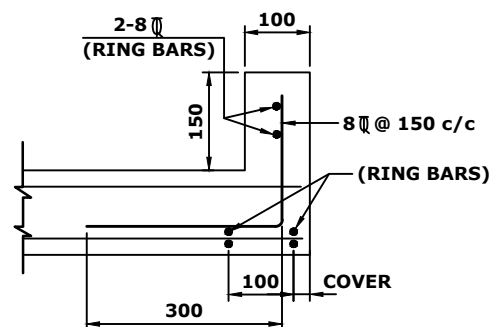
SIZE

A4



2 NOS. 16 $\varnothing$ BOT.

MIN. 2 NOS. 16 $\varnothing$ AT T & B BUT
NOT LESS THAN 50% OF STEEL
CUT AT OPENINGS (TYP)



SECTION: A-A

NOTES :-

1. ALL DIMENSIONS ARE IN mm.
2. ALL THE BARS SHALL BE EFFECTIVELY TIED WITH THE MAIN REINFORCEMENT BARS CUT OR SPLAYED NEAR THE OPENING AS PER THE DIRECTION OF THE ENGINEER-IN-CHARGE.
3. THIS DETAIL APPLIES TO SLABS UP TO 200 THK.
4. OMIT CURB WHERE SPECIFICALLY STATED ON DRAWINGS.

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD FOR DETAIL
OF REINFORCEMENT AT SQ. / RECT.
CUT-OUT IN SLAB

STANDARD DRAWING NO.

VCS-STD-CS-6049

SHEET NO.

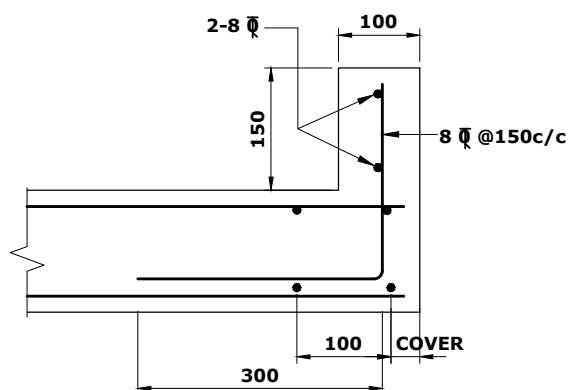
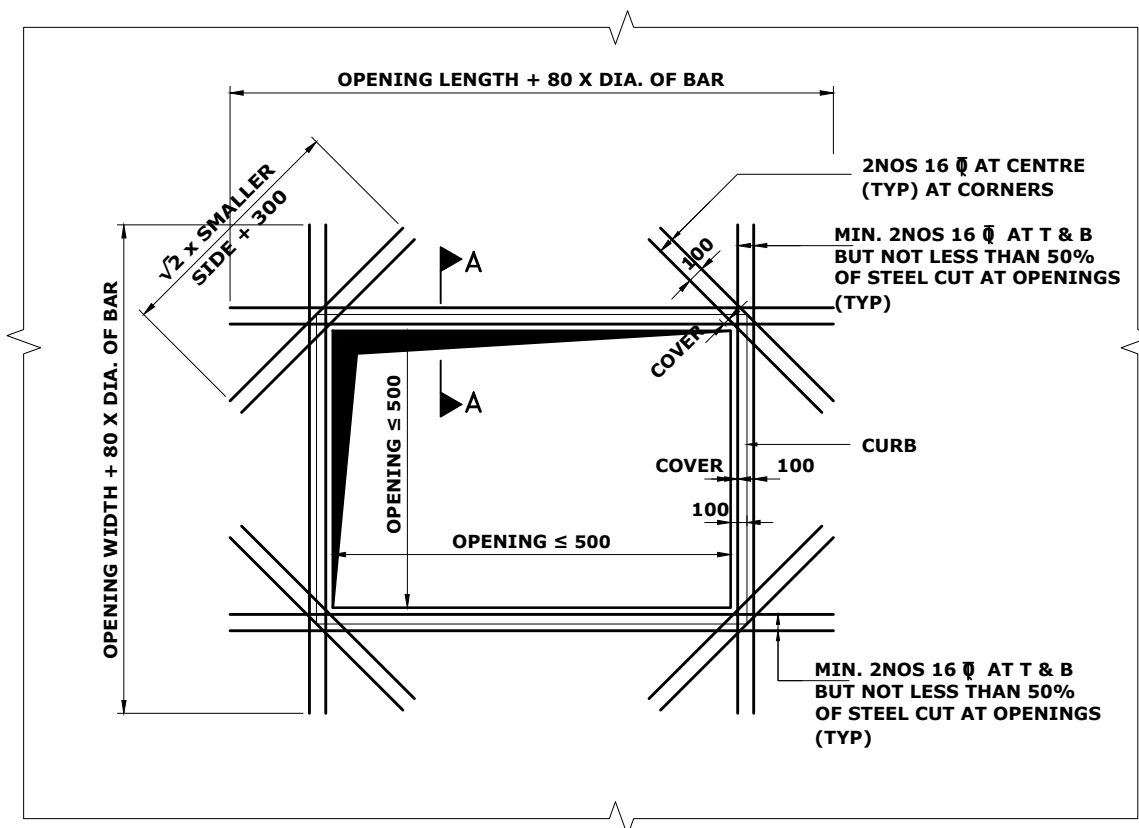
1 OF 1

REV.

03

SIZE

A4



SECTION: A-A

NOTES:-

1. ALL DIMENSIONS ARE IN mm.
2. EXTRA BARS MAY BE OMITTED IF A BEAM IS PROVIDED AT THE RELEVANT EDGE.
3. CORNER BAR MAY BE OMITTED IF TWO BEAMS MEET AT THE RELEVANT CORNER.
4. ALL THE BARS MENTIONED ABOVE SHALL BE EFFECTIVELY TIED WITH THE MAIN REINFORCEMENT BARS CUT OR SPLAYED NEAR OPENING AS DIRECTED BY ENGINEER-IN-CHARGE.
5. OMIT CURB WHERE SPECIFICALLY STATED ON DRAWING.
6. THIS DETAIL APPLIES TO SLABS UPTO 200 THK.

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD FOR DETAIL OF LUGS

STANDARD DRAWING NO.

VCS-STD-CS-6050

SHEET NO.

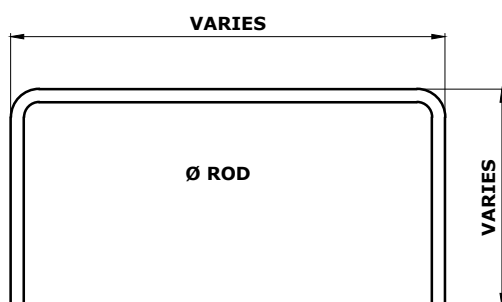
1 OF 1

REV.

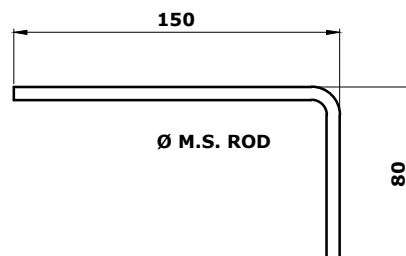
03

SIZE

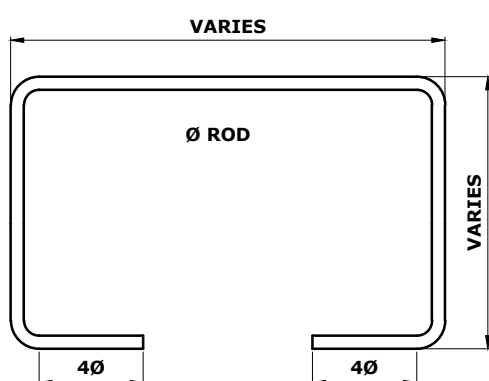
A4



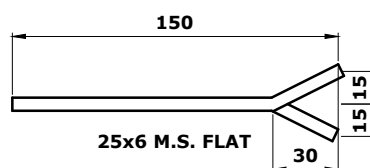
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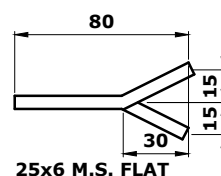
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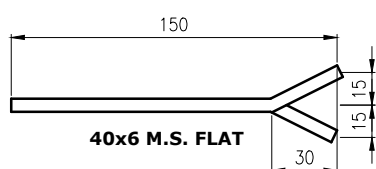
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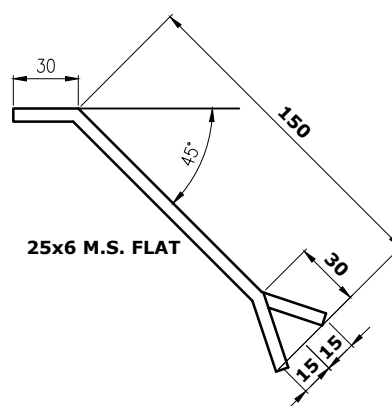
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TYPE-`C3`

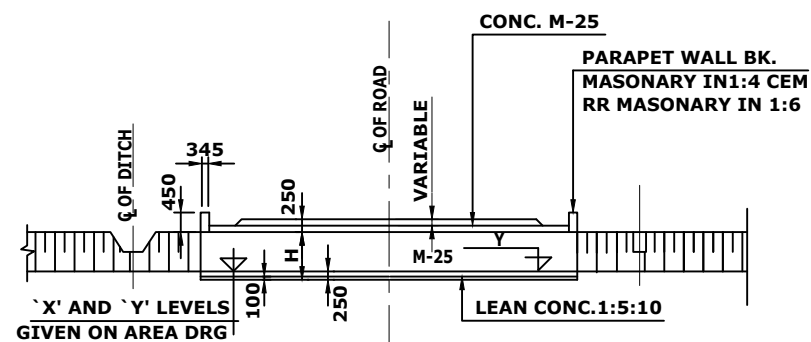


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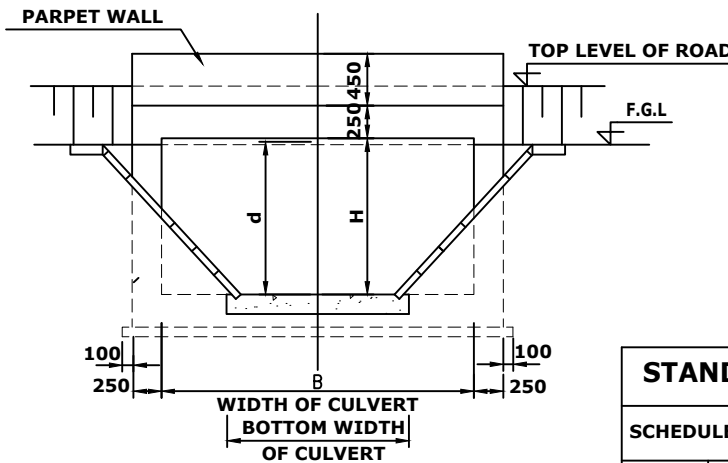


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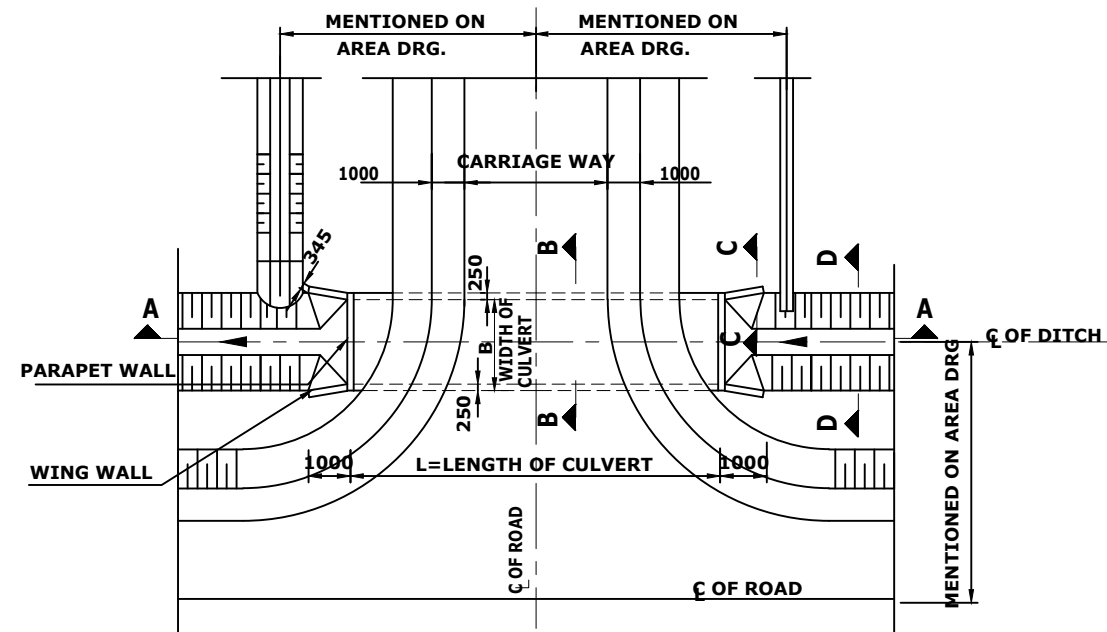
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



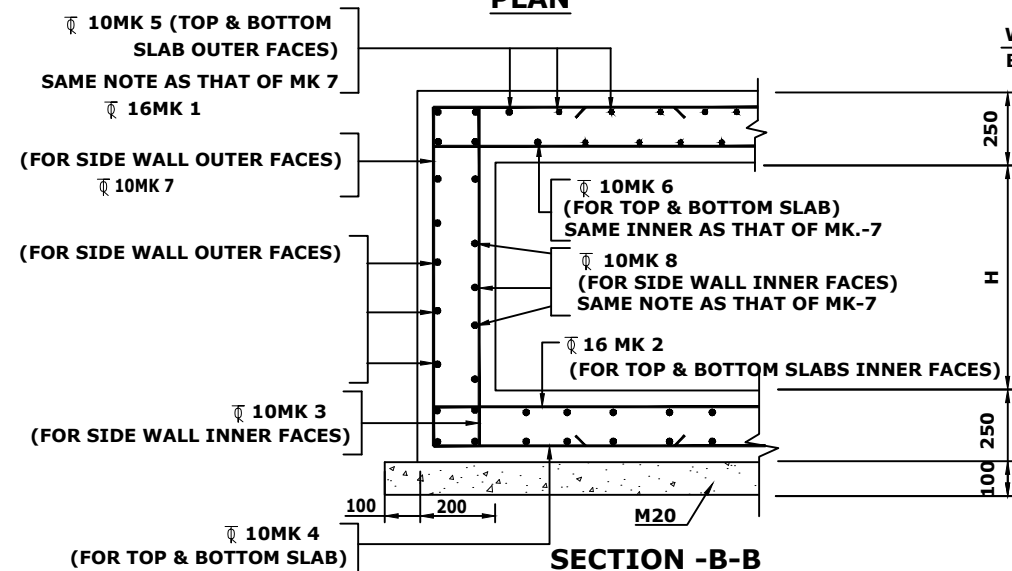
SECTION A-A



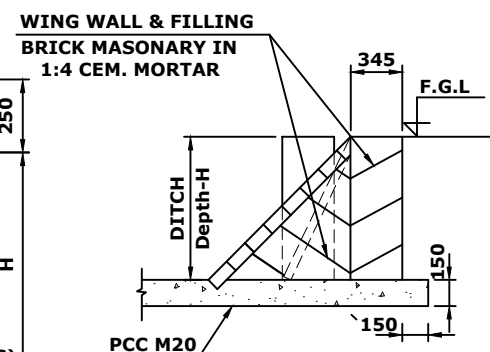
SECTION D-D



PLAN



SECTION -B-B



SECTION C-C

NOTES:-
BARS OF VARYING DIMENSIONS FOR DIFFERENT CULVERTS DEPENDING UPON THE LENGTH OF CULVERT.

NOTES:-

1. ALL DIMENSIONS ARE IN MM EXCEPT LEVELS WHICH ARE IN METRES.
2. BOX CULVERT ARE DESIGNED FOR I.R.C CLASS 'A' & CLASS 'AA' LOADING.
3. ALL REINFORCEMENT SHOWN THUS SHALL BE OF COLD TWISTED DEFORMED BARS CONFORMING TO IS 1786-LATEST.
4. BARS BENDING SHALL CONOIRM TO IS:2502
5. REINFORCEMENT CONCRETE SHALL BE M:25 CONFORMING TO IS : 456 LATEST
6. ALL BRICK WORK SHALL BE IN 1:4 CEMENT MORTAR AS PER IS : 2212
7. OVERLAP FOR BARS SHALL BE 50D AND SHALL BE STAGGERED.
8. FOR AGGRESSIVE SOIL PCC M20 AND RCC M35 SHALL BE USED.

STANDARD DIMENSIONS OF BOX CULVERT WITH BILLS OF MATERIAL

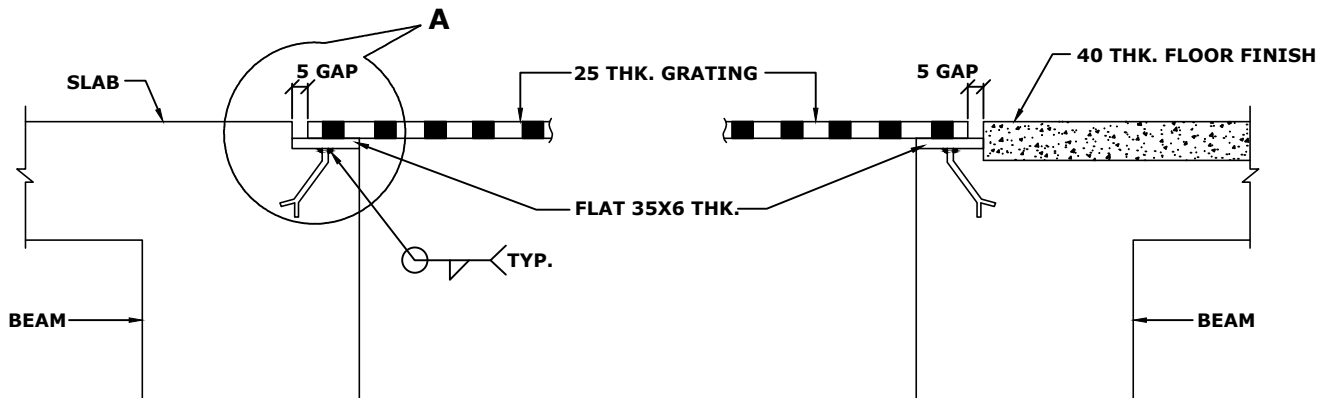
SCHEDULE OF CULVERT		PER METRE LENGTH OF CULVERT			WING WALL & PARAPET PER CULVERT		
TYPE	WIDTH DEPTH (BXH)	WEIGHT OF REINFORCEMENT	CONC. 1:5:10	CONC. M-25	CONC. 1:4:8	BK.WALL IN 1:4 MORTAR	1:3 CEM PLASTER -TER 13mm THK.
I	1700X850	16 0.1T 10 0.066T	0.21M ³	1.53M ³	0.25M ³	2.44M ³	10.70M ³
II	2000X1000	16 0.16T 15 0.071T	0.27M ³	1.75M ³	0.25M ³	2.77M ³	14.22M ³
III	2200X1100	16 0.129T 10 0.078T	0.291M ³	1.90M ³	0.25M ³	3.0M ³	15.18M ³
IV	2600X1300	16 0.144T 10 0.089T	0.33M ³	2.20M ³	0.25M ³	3.44M ³	17.10M ³

REINFORCEMENT BENDING SCHEDULE

MARK	TYPE OF CULVERT	STEEL DIA & SPACING	BENDING SCHEDULE		CUT LENGTH
			A	B	
MK-1	I	Ø16 150C/C	1250	725	2704
	II	Ø16 125C/C	1400	850	3004
	III	Ø16 100C/C	1500	930	3264
	IV	Ø16 100C/C	1700	1070	3744
MK-2	I	Ø16 150C/C	2100		2100
	II	Ø16 125C/C	2400		2400
	III	Ø16 100C/C	2600		2600
	IV	Ø16 100C/C	3000		3000
MK-3	I	Ø10 200C/C	1250		1250
	II	Ø10 200C/C	1400		1400
	III	Ø10 200C/C	1500		1500
	IV	Ø10 200C/C	1700		1700
MK-4	I	Ø10 200C/C	2100		2100
	II	Ø10 200C/C	2400		2400
	III	Ø10 200C/C	2600		2600
	IV	Ø10 200C/C	3000		3000
MK-5	I	Ø10 200C/C	BARS OF VARYING LENGTH		
MK-6	II	Ø10 100C/C			
MK-7	III	Ø10 100C/C			
MK-8	IV	Ø10 200C/C			

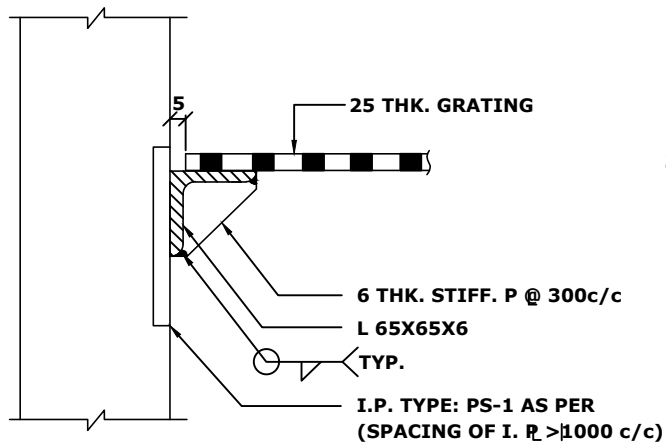
VCS QUALITY SERVICES PRIVATE LIMITED STANDARD FOR DETAIL OF BOX CULVERT TYPE- I,II,III & IV	3	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG	STANDARD DRAWING NO.		REV.	SIZE
	2	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK	VCS-STD-CS-6051		3	A3
	REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY	SHEET NO.	1 OF 1		

 VCS QUALITY SERVICES PRIVATE LIMITED Emerging Quality	STANDARD FOR DETAIL OF TYPICAL GRATING SPORT.	STANDARD DRAWING NO.		REV.	SIZE
		VCS-STD-CS-6052		03	A4
		SHEET NO.	1 OF 1		

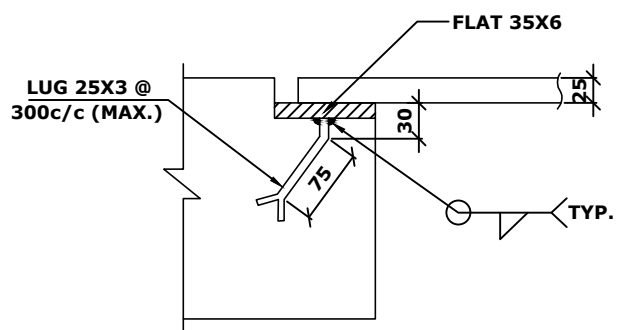


**GRATING SUPPORT OVER BEAM
WITHOUT FLOOR FINISH**

**GRATING SUPPORT OVER BEAM
WITH FLOOR FINISH**



GRATING SUPPORT ON WALL/COLUMN



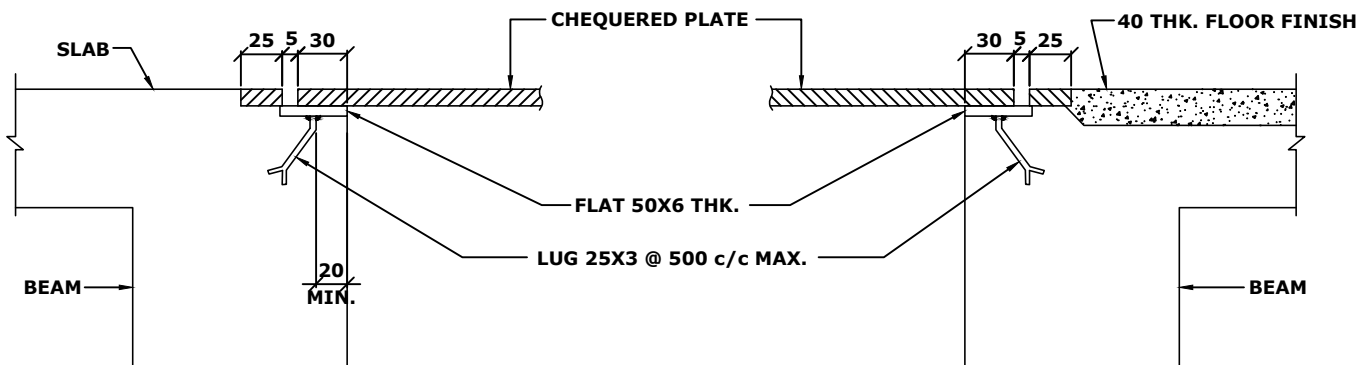
DETAIL 'A'

NOTES:

1. M.S. LUGS SHALL BE SUITABLY BENT IF CONCRETE THICKNESS IS LESS THAN THE LENGTH OF LUGS OR LUGS INTERFERE WITH R/F BARS.
2. ALL DIMENSIONS ARE IN mm.

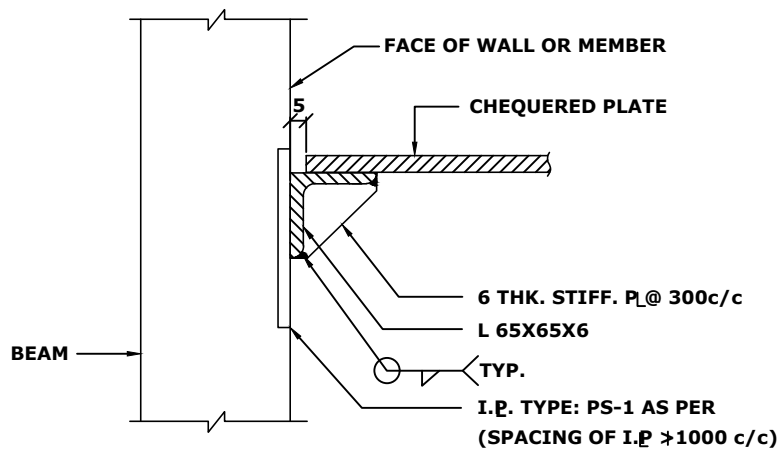
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02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY

 VCS QUALITY SERVICES PRIVATE LIMITED	STANDARD FOR DETAIL TYPICAL CHEQUERED PLATE SUPPORT.	STANDARD DRAWING NO.		REV.	SIZE
		VCS-STD-CS-6053		03	A4
		SHEET NO.	1 OF 1		



**CHQD. PL SUPPORT OVER BEAM
WITHOUT FLOOR FINISH**

**CHQD. PL SUPPORT OVER BEAM
WITH FLOOR FINISH**



GRATING SUPPORT ON WALL/COLUMN

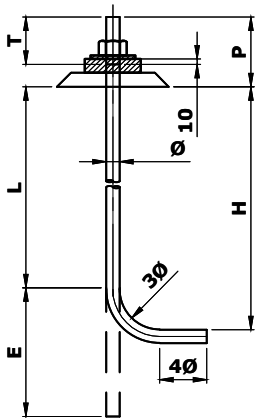
NOTES:

1. M.S. LUGS SHALL BE SUITABLY BENT IF CONCRETE THICKNESS IS LESS THAN THE LENGTH OF LUGS OR LUGS INTERFERE WITH R/F BARS.
2. ALL DIMENSIONS ARE IN mm.

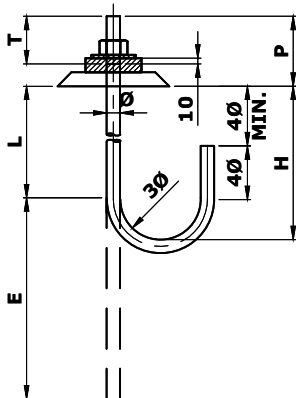
						
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY

 VCS QUALITY SERVICES PRIVATE LIMITED	M.S. ANCHOR BOLT ASSEMBLIES				STANDARD DRAWING NO.		REV.	SIZE
					VCS-STD-CS-6054		03	A4
					SHEET NO.	1 OF 4		

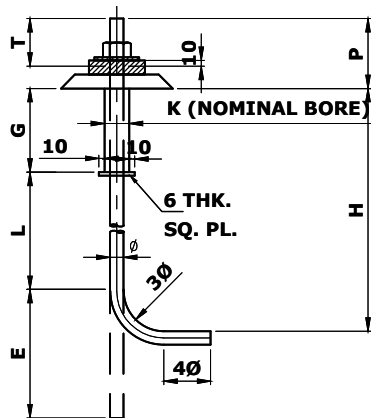
GRADE OF CONC.	BOLT TYPE	DIMENSIONS MM		BOLT DIA (Ø) IN MM											
				10	12	16	18	20	22	24	27	30	33	36	39
M25	I & III	L		200	250	400	400	450	550	550	650	700	800	850	950
		E		95	115	155	170	190	210	230	255	285	315	345	370
		H	TYPE-I	230	286	448	454	510	616	622	731	790	899	958	1067
			TYPE-III	380	436	598	604	810	916	922	1181	1240	1349	1408	1517
	II & IV	L		150	150	250	250	300	350	350	450	500	550	600	650
		E		150	180	240	270	300	330	360	405	450	495	540	585
		H	TYPE-II	180	186	298	304	360	416	422	531	590	649	708	767
			TYPE-IV	330	336	440	454	660	716	722	981	1040	1099	1158	1217
M30	I & III	L		180	220	315	335	390	445	470	550	600	680	735	815
		E		95	115	155	170	190	210	230	255	285	315	345	370
		H	TYPE-I	210	260	365	390	450	515	545	635	690	780	845	935
			TYPE-III	360	410	515	540	750	815	845	1085	1140	1230	1295	1385
	II & IV	L		150	150	200	200	250	275	300	350	375	425	450	500
		E		150	180	240	270	300	330	360	405	450	495	540	585
		H	TYPE-II	180	190	250	255	310	345	375	435	465	525	560	620
			TYPE-IV	330	340	400	405	610	645	675	885	915	975	1010	1070



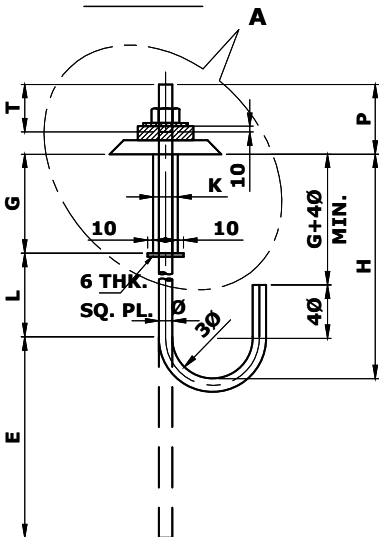
TYPE-I



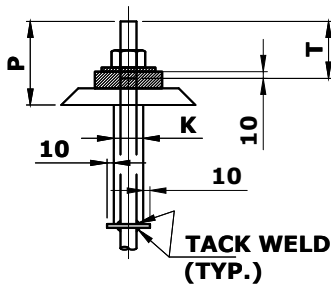
TYPE-II



TYPE-III



TYPE-IV



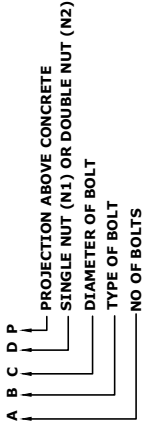
**DETAIL-A
(TYP.)**

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY

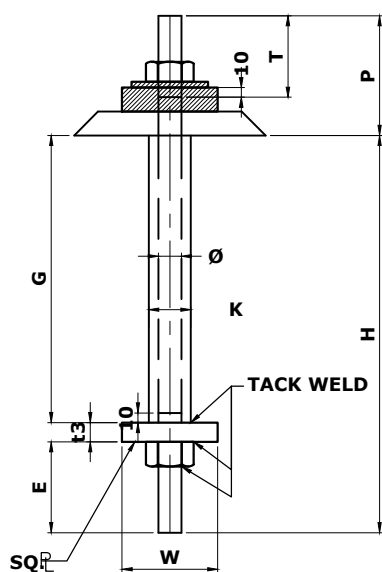
GRADE OF CONC.	BOLT TYPE	DIMENSIONS MM		BOLT DIA (Ø) IN MM																							
				10	12	16	18	20	22	24	27	30	33	36	39	42	45	48	52	56	60	64	68	72			
M25&M30	III & IV	SLEEVE	G	150	150	150	150	300	300	300	300	450	450	450	450	450											
			K	50	50	50	50	50	80	80	80	80	80	80	100												
	I TO IV IX & XII	THREADED (T) LENGTH	SINGLE NUT	40	45	55	60	60	65	70	75	80	90	95	100												
			DOUBLE NUT	50	60	70	75	80	90	95	105	110	120	130	140												
M25	V		G	150	150	150	200	300	300	300	300	450	450	450	450	550	600	650	700	750	800	900	900	1000	1050		
			H	210	222	234	291	398	410	417	580	585	598	608	772	786	841	905	975	1035	1150	1171	1281	1350			
			W	80	80	90	100	100	130	130	140	150	170	180	200	210	220	230	260	270	290	320	330	350			
		t3		10	12	16	16	20	20	25	25	25	28	32	36	36	36	40	45	45	50	56	56	63			
				L					350	400	400	500	550	600	750	950	1050	1200	1100	1350	1500	1750	1900	2100	2300		
				L											350	400	450	500	550	600	650	700	750	800	900		
	VIII		C												160	200	200	240	240	240	260	280	280	280			
		V		G	150	150	150	200	300	300	300	300	450	450	450	450	500	550	600	650	750	800	800	900	1000		
	V & VI		W		H	210	225	235	290	400	410	415	580	585	600	610	675	690	745	805	875	985	1050	1075	1185	1300	
					10	12	16	16	20	20	25	25	25	28	32	36	36	36	40	45	45	50	56	56	63		
M30		VII		L						275	325	325	375	425	500	600	750	850	975	1000	1075	1225	1375	1525	1675	1850	
	VIII				L										300	350	400	450	500	550	600	650	700	750	800		
					C													125	160	160	160	185	200	240	240	240	240

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY

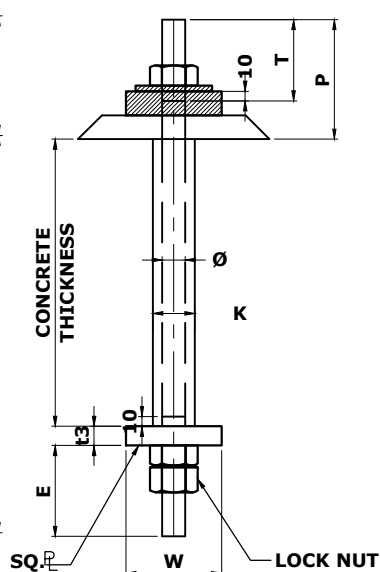
GRADE OF CONC.	BOLT TYPE	DIMENSIONS		BOLT DIA (Ø) IN MM																							
		MM		10	12	16	18	20	22	24	27	30	33	36	39	42	45	48	52	56	60	64	68	72			
M25&M30	V & VI	E		50	60	70	75	80	90	95	105	110	120	130	140	150	155	165	180	190	200	215	225	240			
	V , VI ,	K		50	50	50	50	50	80	80	80	80	80	80	100	100	100	100	125	125	125	150	150	150			
	VII & VIII	THREADED (T)	SINGLE NUT	40	45	55	60	60	65	70	75	80	90	95	100	105	110	120	125	135	140	150	160	165			
		LENGTH	DOUBLE NUT	50	60	70	75	80	90	95	105	110	120	130	140	150	155	165	180	190	200	215	225	240			
	VII	t3						16	16	16	16	16	16	16	16	16	16	20	20	20	20	20	20	20			
	VIII	t3													16	20	20	25	25	28	32	32	32	32			
	VII & VIII	G		150	150	150	150	300	300	300	450	450	450	450	450	450	450	450	450	450	600	600	600	600			
	IX	L		80	100	150	170	200																			
	M25	XII	L		185	220	310	335	385	435	460	535	590	660	720												
L				150	150	200	225	250	275	300	350	375	425	450													
M30																											

- NOTES : -
1. BOLTS SHALL BE MARKED ON THE DRAWING AS UNDER :
- 
- e.g. 6-IV-M27-N1-200
2. BOLTS SHALL BE TURNED FROM M.S. ROUNDS CONFORMING TO IS:2062 GR-A.
3. NUTS AND WASHERS SHALL CONFORM TO IS:1363 AND IS:3138.
4. THREADED SHALL BE COARSE CONFORMING TO IS:1367 AND IS:4218
5. ANCHOR BOLTS SHALL BE SET ACCURATELY AND HELD IN POSITION BY TEMPLATE BEFORE CONCRETING.
6. 6 THK SQ. PLATE AT THE BOTTOM OF SLEEVE SHALL BE TACK WELDED WITH BOLTS AND SLEEVE FOR BOLT TYPE III, IV, VII AND VIII.
7. SLEEVE SHALL BE M.S. TUBES (MEDIUM) AS PER IS:1239.
8. REFER DESIGN DRAWINGS FOR PROJECTION (P) OF BOLT ABOVE TOP OF ROUGH CONCRETE AND NUMBER (A) OF BOLTS.
9. ANCHOR BOLTS SHALL BE TEMPERED BEFORE MACHINING IF MADE BY FORGING. THE FORGING TEMPERATURE SHALL BE ABOVE 900° C BUT LOWER THAN SUPER HEATING TEMPERATURE.

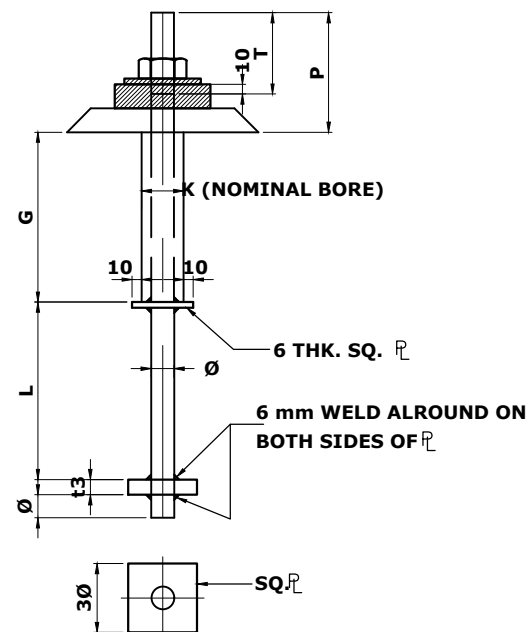
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



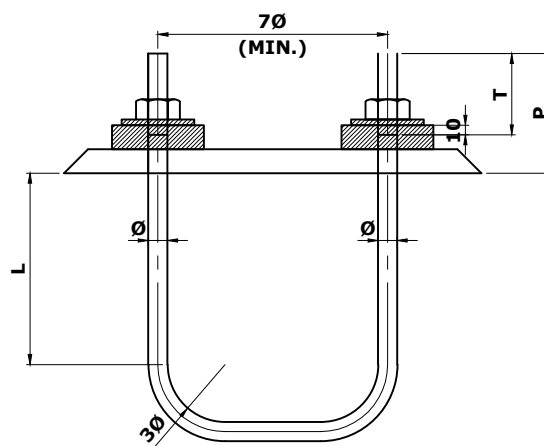
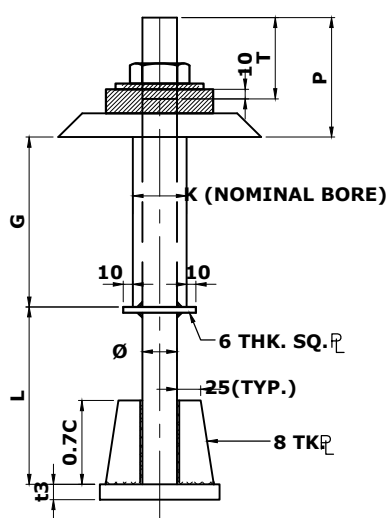
TYPE-V



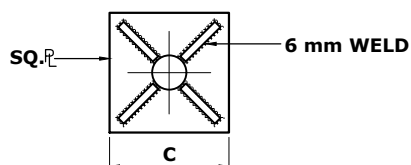
TYPE-VI



TYPE-VII



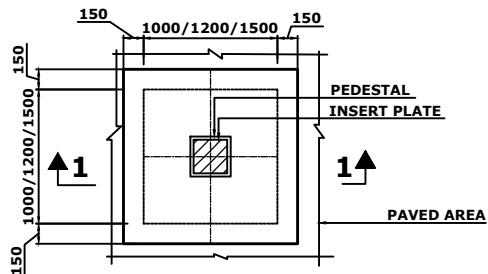
TYPE-IX



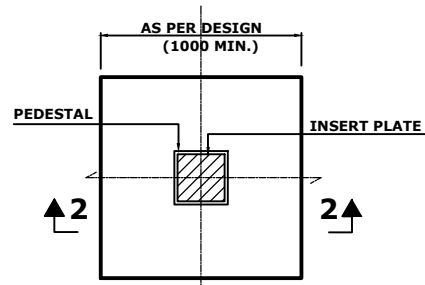
TYPE-VIII

						
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY

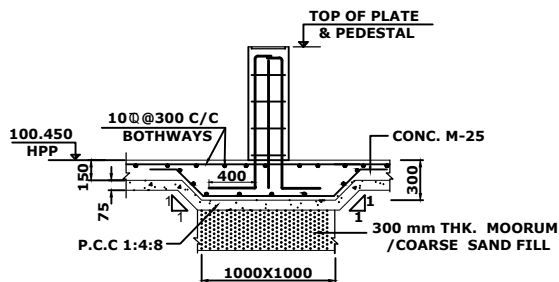
 VCS QUALITY SERVICES PRIVATE LIMITED	STANDARD FOR DETAIL OF RCC PIPE SUPPORT	STANDARD DRAWING NO.	REV.	SIZE
		VCS-STD-CS-6055	03	A4
		SHEET NO.		



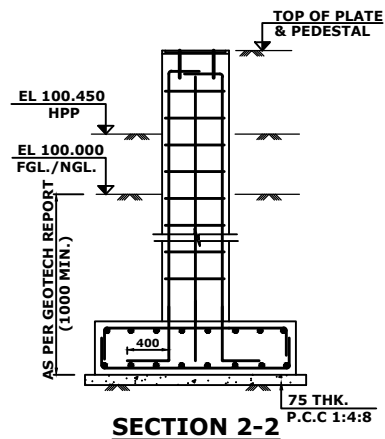
FOUNDATION PLAN
(FOUNDATION LOAD LESS THAN 8 KN)



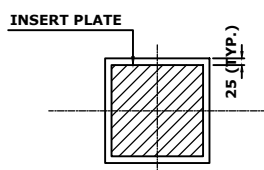
FOUNDATION PLAN
(FOUNDATION LOAD > 8 KN AND < 15 KN)



SECTION 1-1



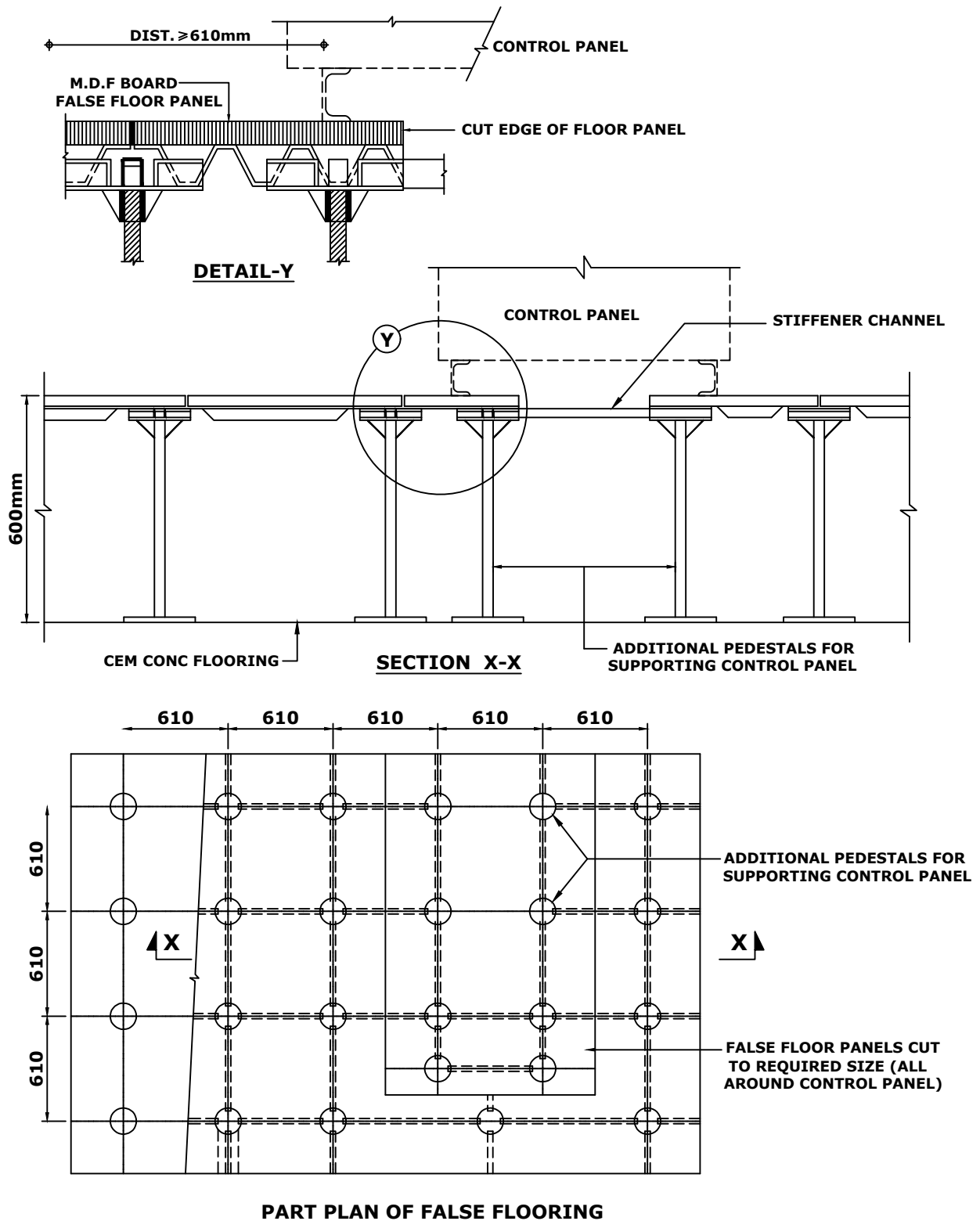
SECTION 2-2



PEDESTAL PLAN

						
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY

 VCS QUALITY SERVICES PRIVATE LIMITED	STANDARD FOR DETAIL OF FALSE FLOORING	STANDARD DRAWING NO.		REV.	SIZE
		VCS-STD-CS-6060		03	A4
		SHEET NO.	1 OF 3		



						
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD FOR DETAIL
OF FALSE FLOORING

STANDARD DRAWING NO.

VCS-STD-CS-6060

SHEET NO.

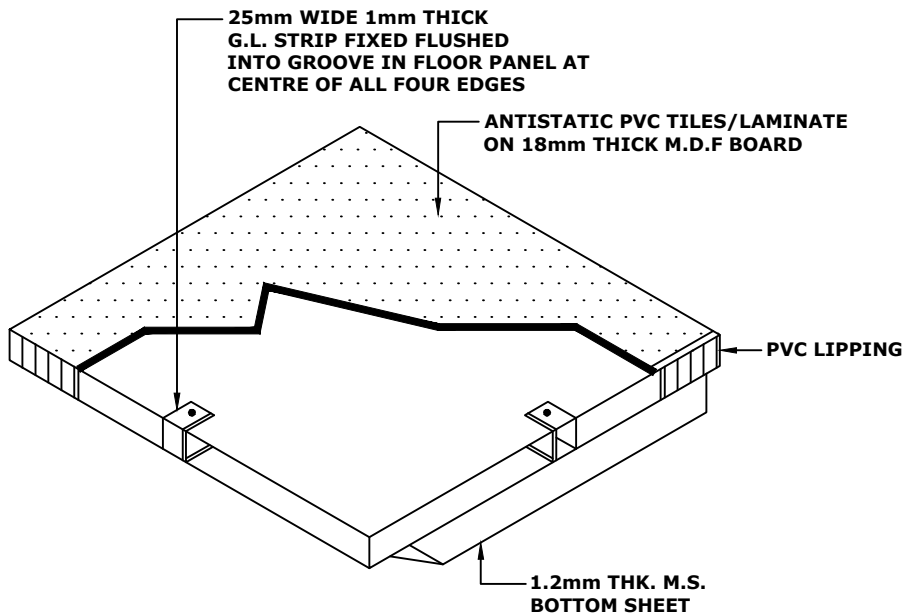
2 OF 3

REV.

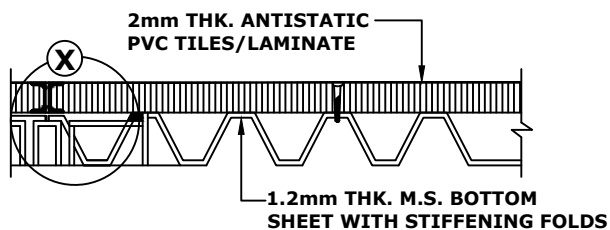
03

SIZE

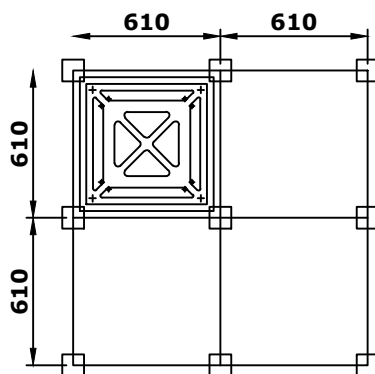
A4



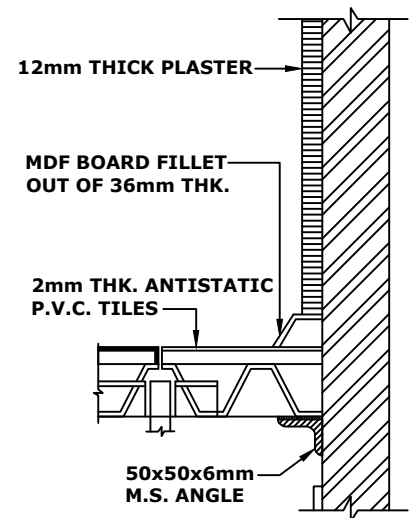
ISOMETRIC VIEW OF A PANEL



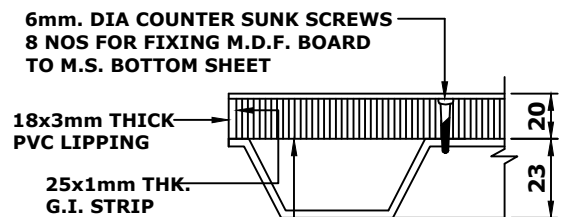
SECTION D-D



PART OF GRID PLAN

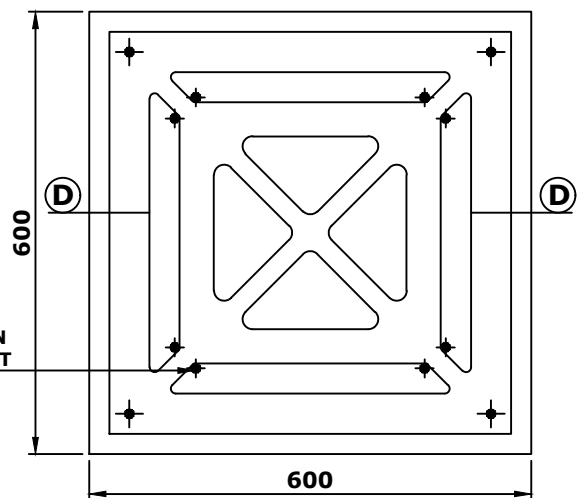


**DET. OF JUNCTION
WITH THE WALL**



16mm THICK MEDIUM DENSITY
FIBRE BOARD (EXT GRADE IS :12406)
FACED ON TOP WITH ANTISTATIC TILES

DETAIL (X)



PLAN OF FLOOR PANEL

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD FOR DETAIL
OF FALSE FLOORING

STANDARD DRAWING NO.

VCS-STD-CS-6060

SHEET NO.

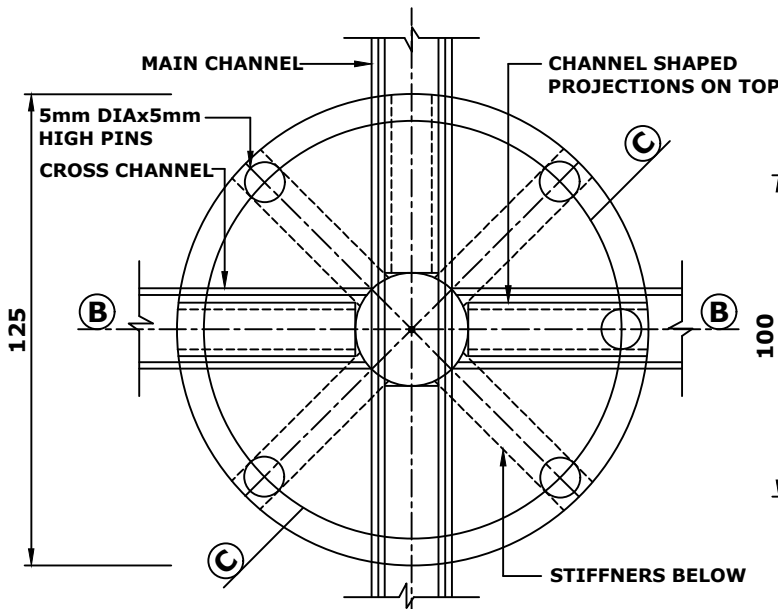
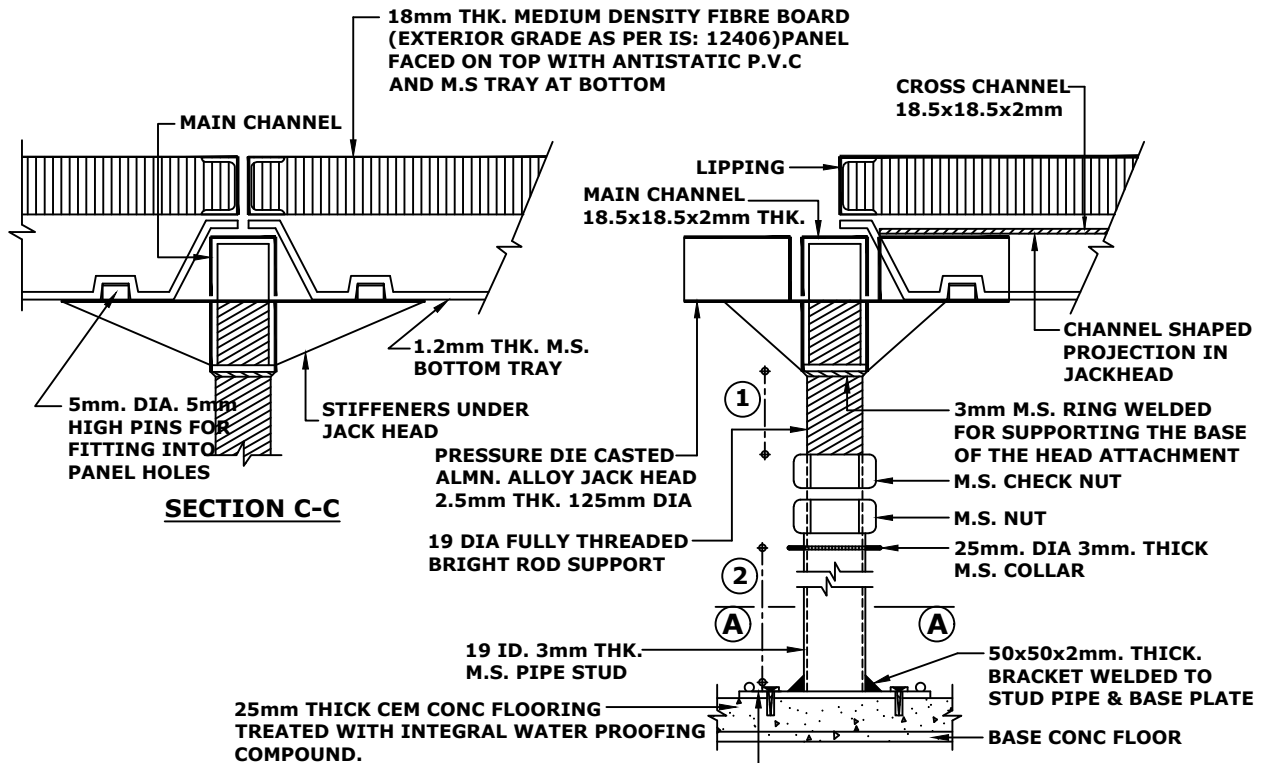
3 OF 3

REV.

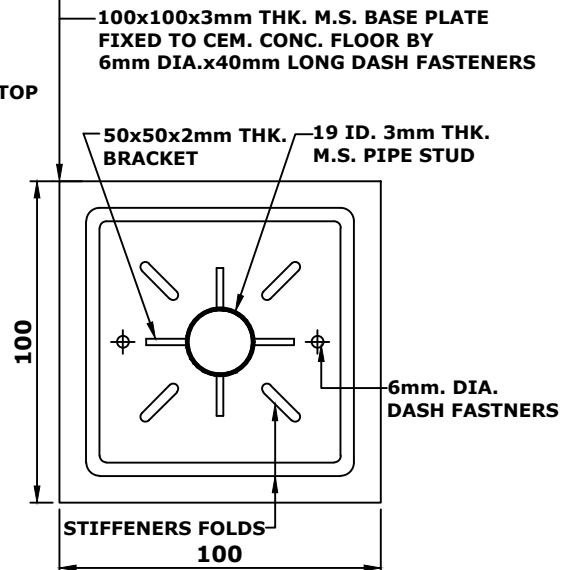
03

SIZE

A4



PLAN OF JACK HEAD



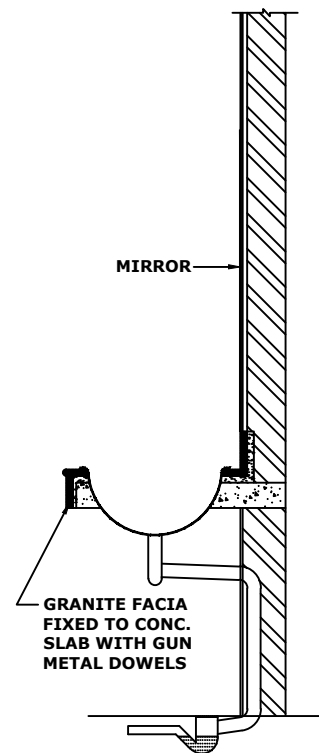
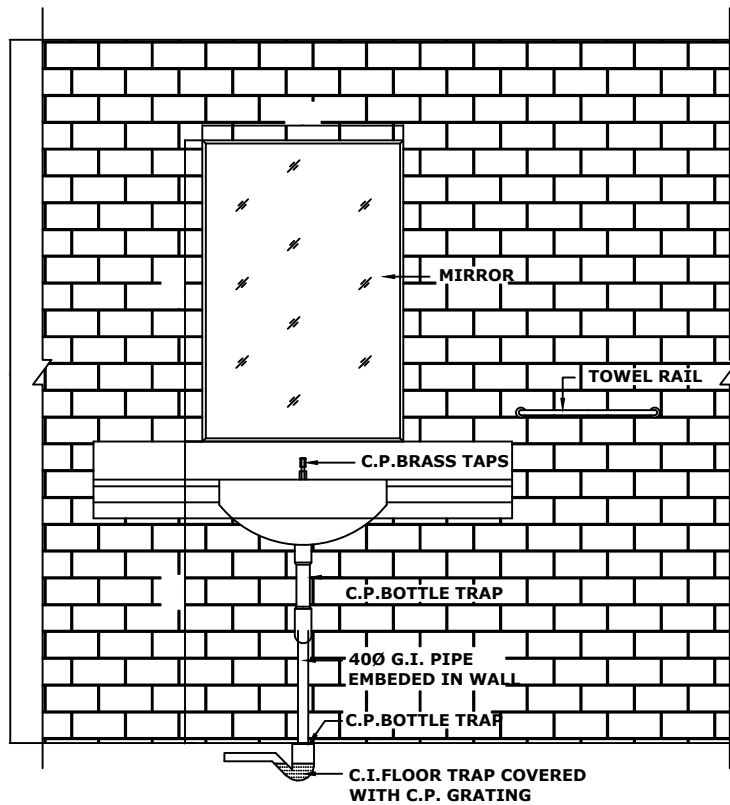
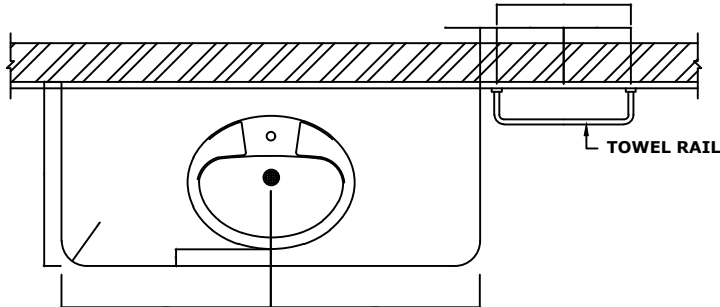
SECTION PLAN A-A

LEGEND:-

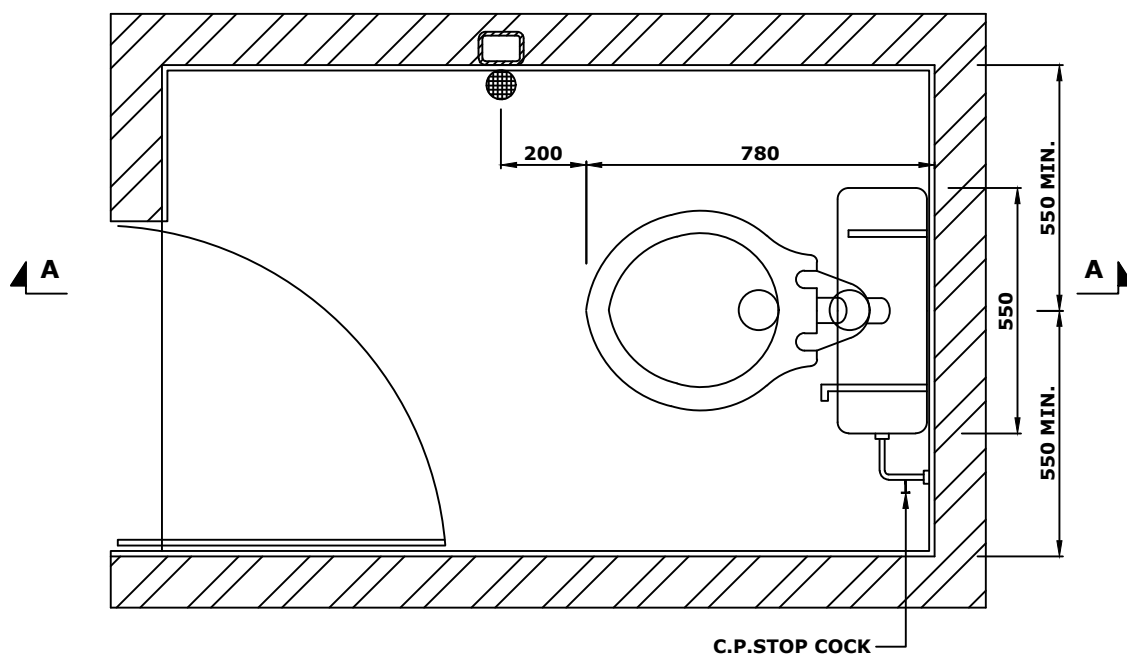
- ① 25mm. MAX ADJUSTMENT
- ② 150mm. MIN TO 175mm MAX. SECURE IN M.S. PIPE STUD

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY

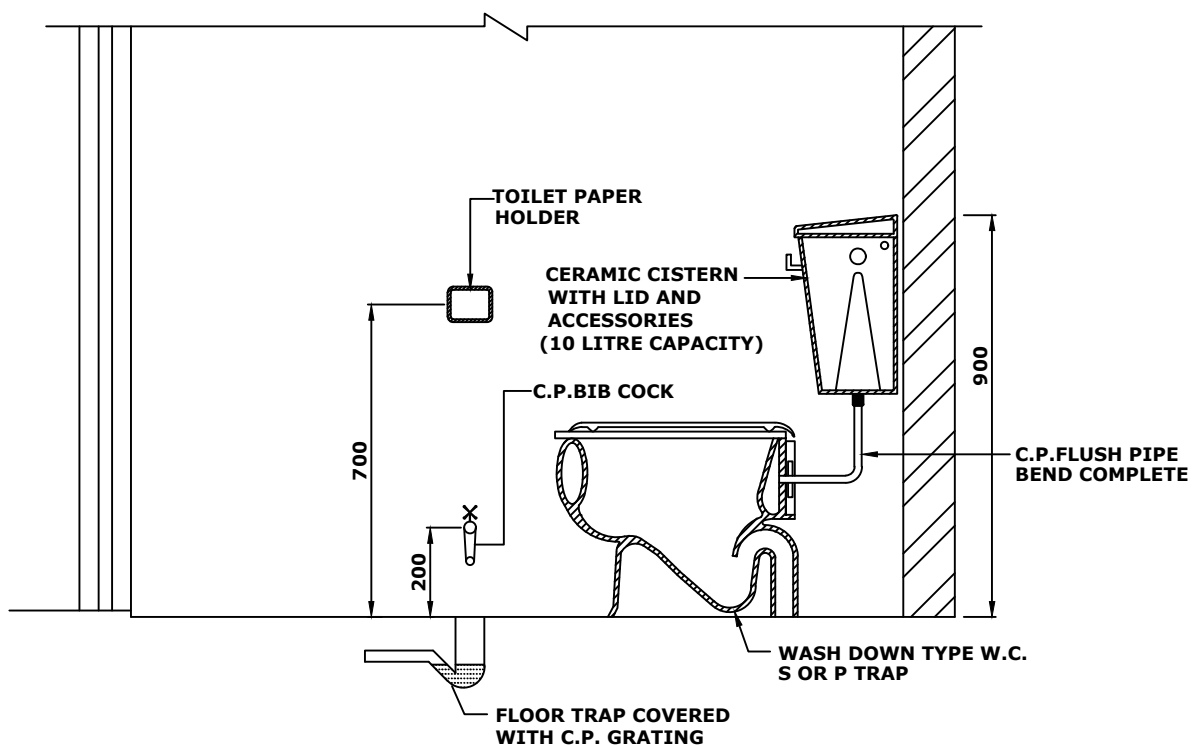
 VCS QUALITY SERVICES PRIVATE LIMITED	STANDARD FOR DETAIL OF WASH BASIN FIXING DETAIL	STANDARD DRAWING NO.		REV.	SIZE
		VCS-STD-CS-6061		03	A4
		SHEET NO.	1 OF 1		



			<i>MN</i>	<i>GDS</i>	<i>HK</i>	<i>WG</i>
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



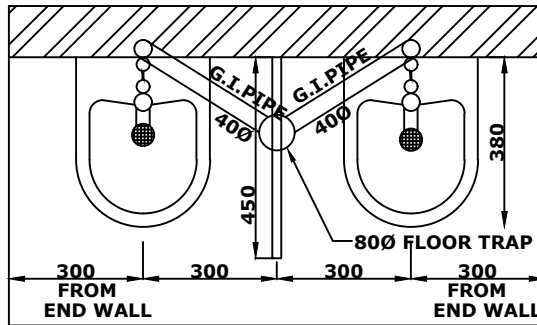
PLAN



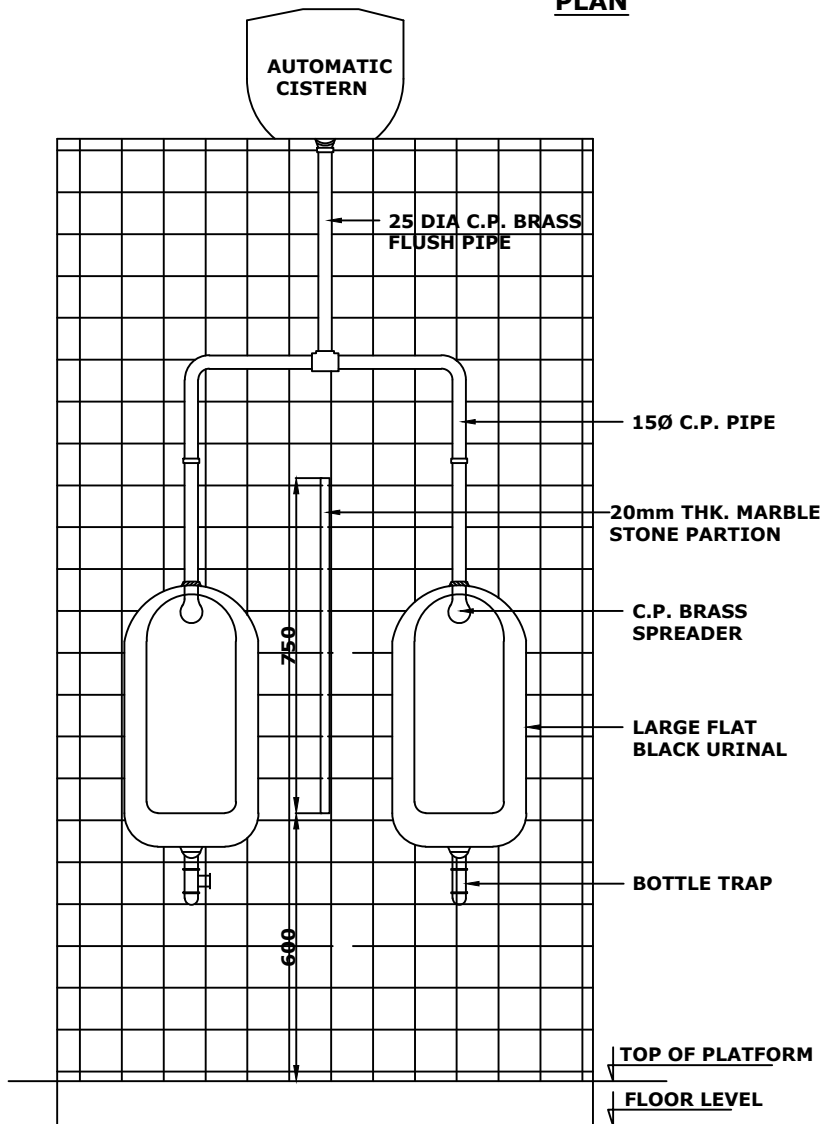
SECTION A-A

						
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY

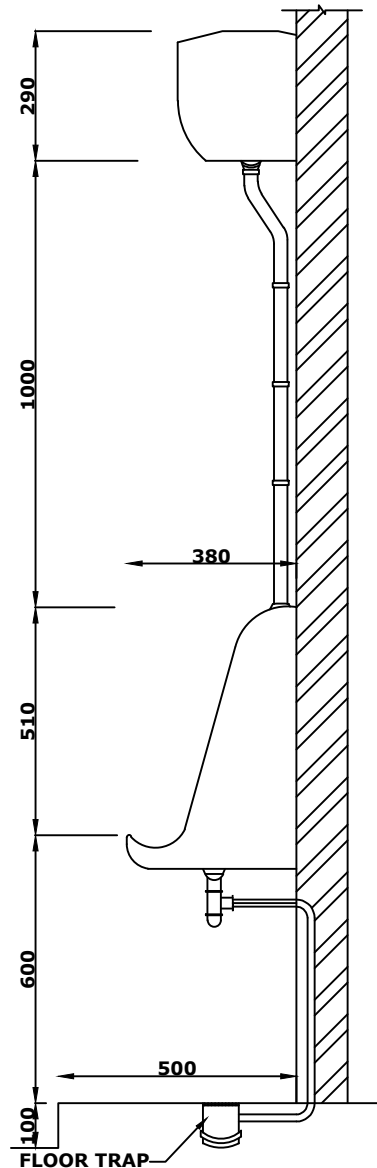
 VCS QUALITY SERVICES PRIVATE LIMITED	STANDARD FOR DETAIL OF URINAL FIXING DETAIL	STANDARD DRAWING NO.		REV.	SIZE
		VCS-STD-CS-6063		03	A4
		SHEET NO.	1 OF 1		



PLAN



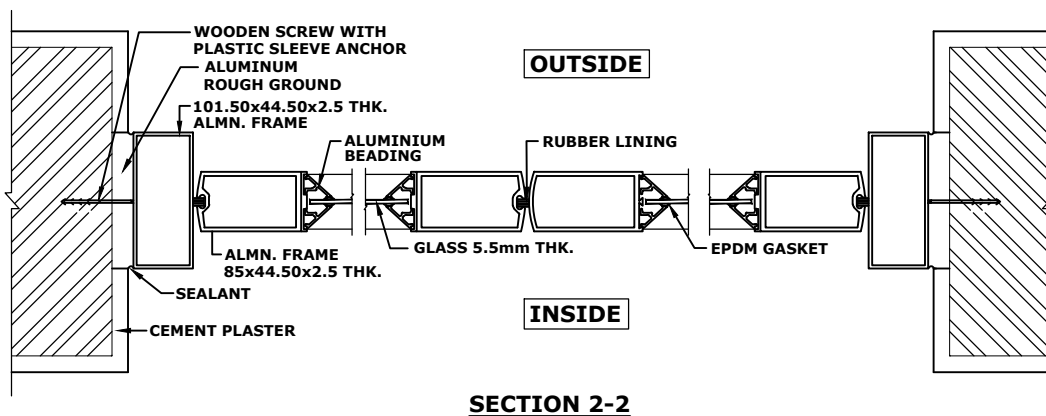
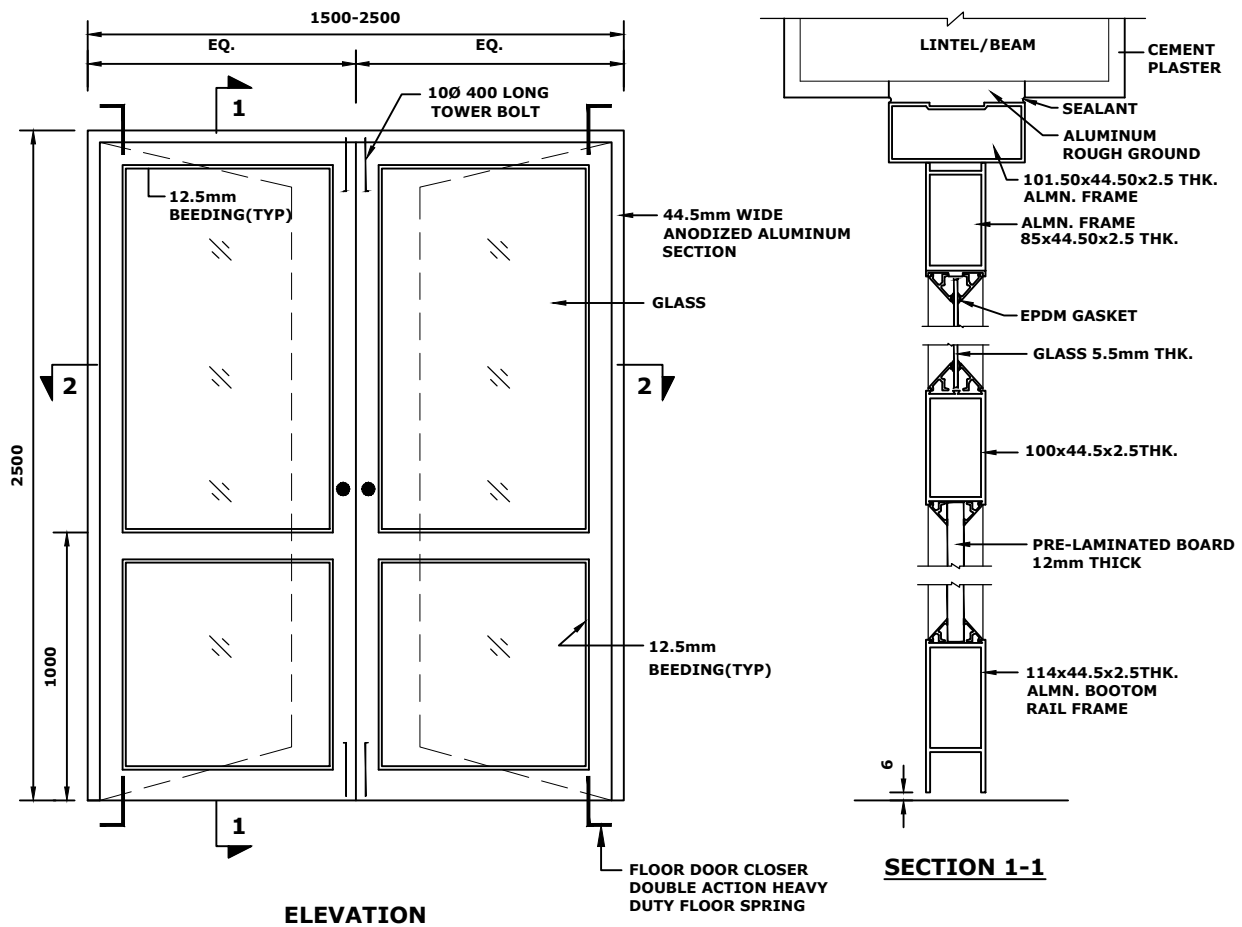
ELEVATION



SIDE ELEVATION

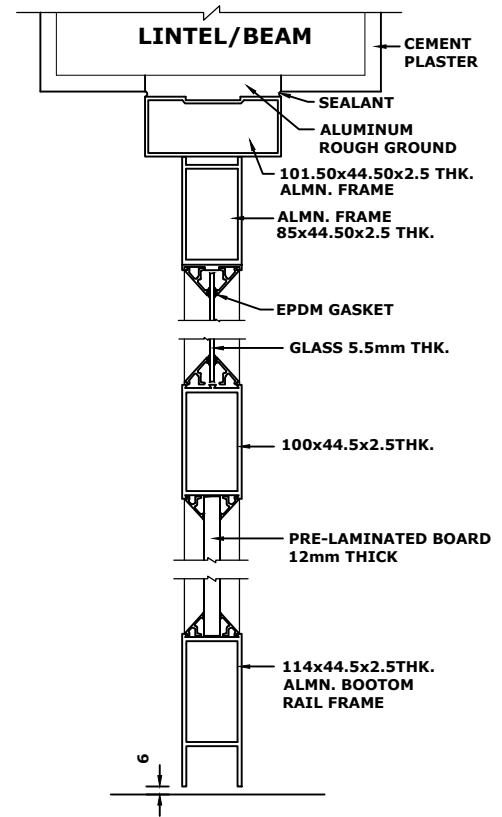
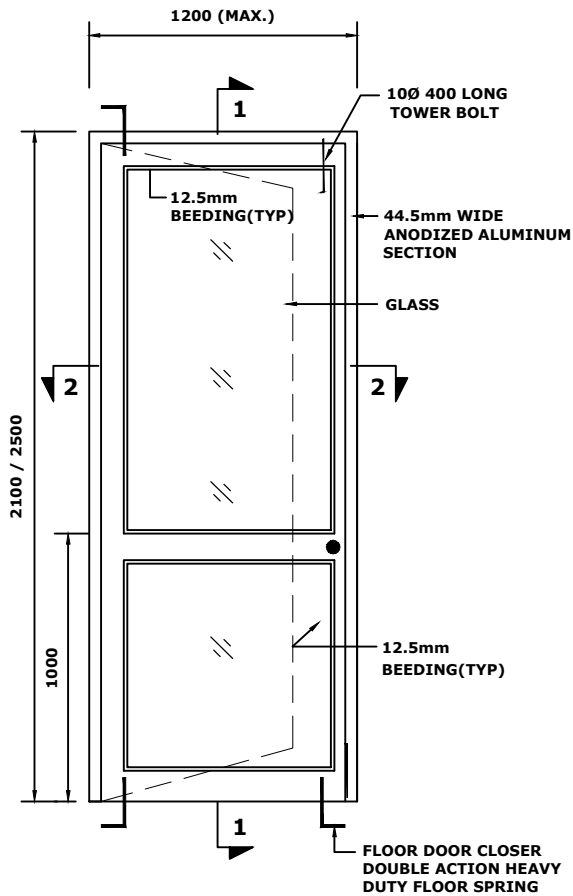
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY

 VCS QUALITY SERVICES PRIVATE LIMITED	STANDARD FOR DETAIL OF GLAZED ALUMINUM DOOR	STANDARD DRAWING NO.		REV.	SIZE
		VCS-STD-CS-6064		03	A4
		SHEET NO.	1 OF 2		

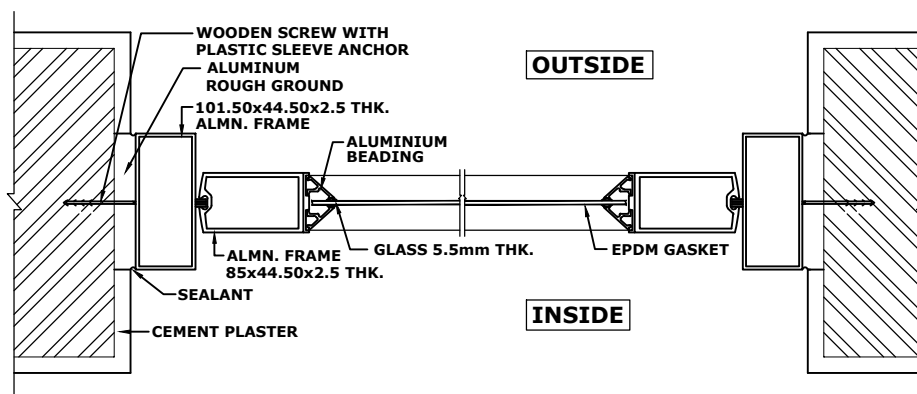


			<i>MN</i>	<i>GDS</i>	<i>HK</i>	<i>WG</i>
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY

 VCS QUALITY SERVICES PRIVATE LIMITED	STANDARD FOR DETAIL OF GLAZED ALUMINUM DOOR	STANDARD DRAWING NO.		REV.	SIZE
		VCS-STD-CS-6064		03	A4
		SHEET NO.	2 OF 2		



SECTION 1-1



SECTION 2-2

			<i>MN</i>	<i>GDS</i>	<i>HK</i>	<i>WG</i>
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD FOR DETAIL
OF WOODEN FLUSH DOOR

STANDARD DRAWING NO.

VCS-STD-CS-6065

SHEET NO.

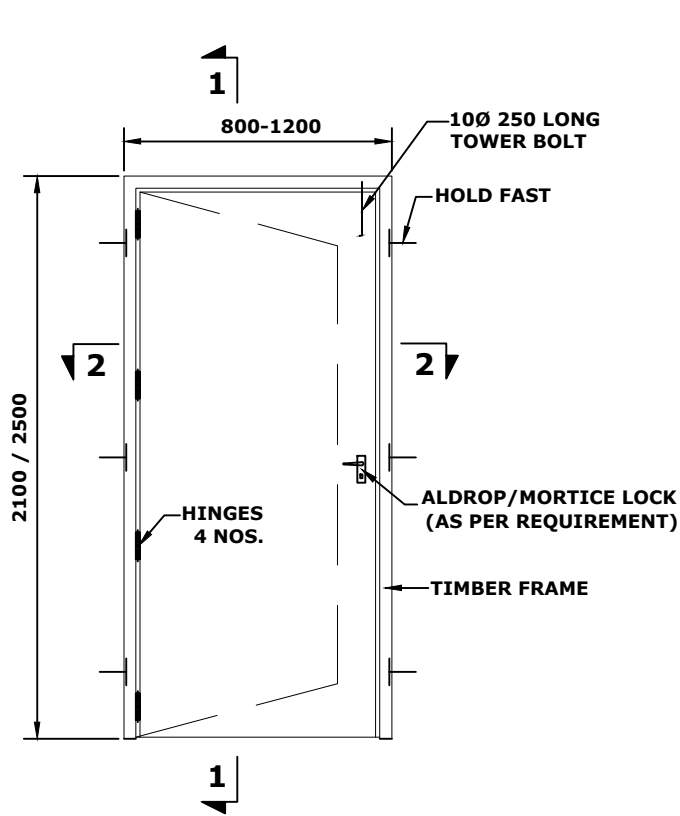
1 OF 1

REV.

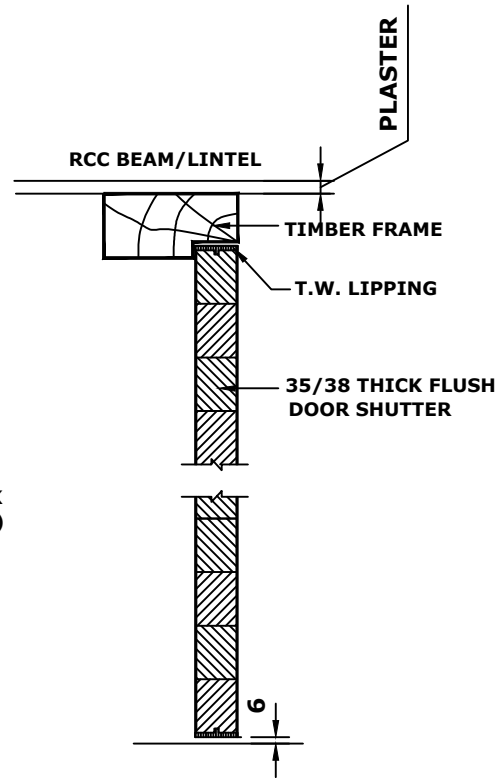
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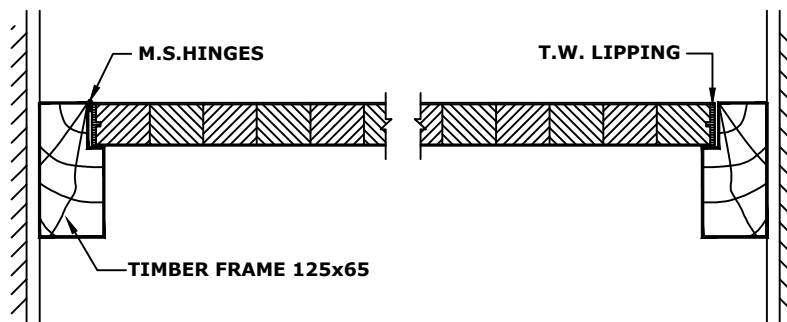
A4



ELEVATION



SECTION 1-1



SECTION 2-2

03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD FOR DETAIL OF GLAZED ALUMINUM WINDOW

STANDARD DRAWING NO.

VCS-STD-CS-6066

SHEET NO.

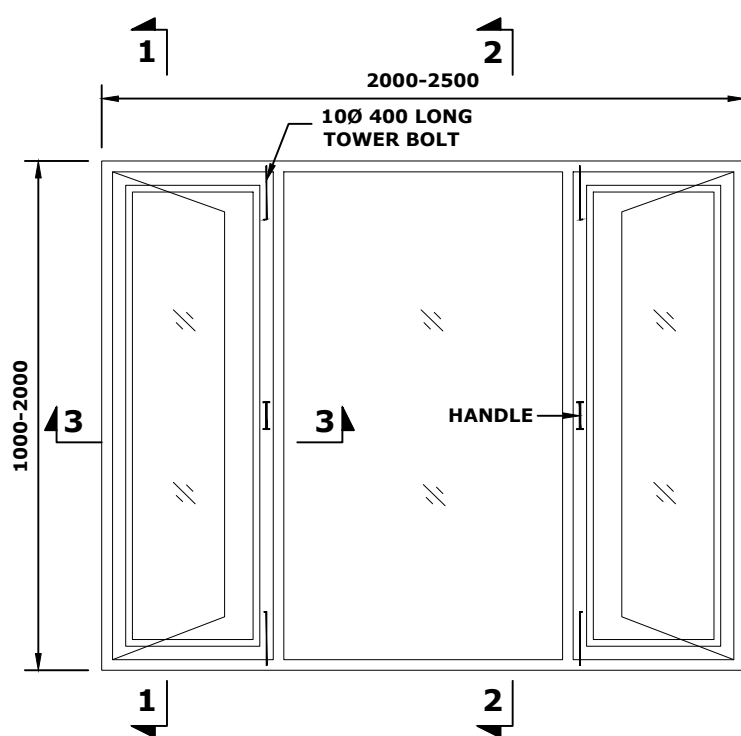
1 OF 1

REV.

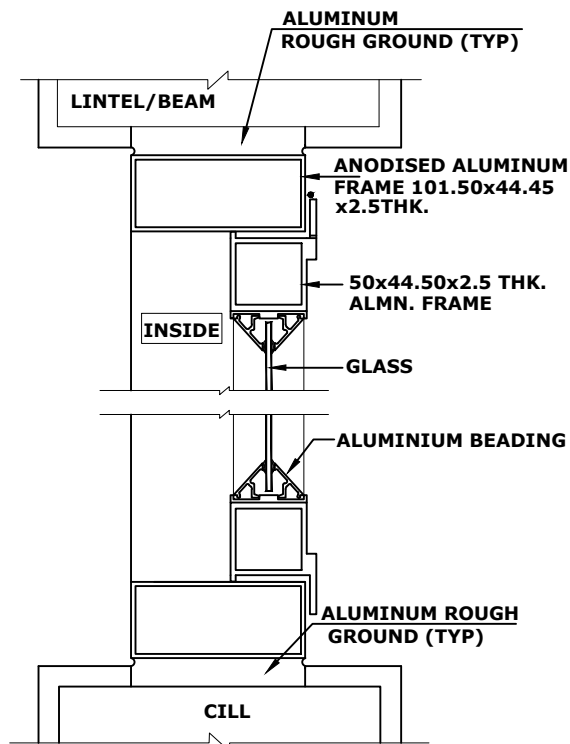
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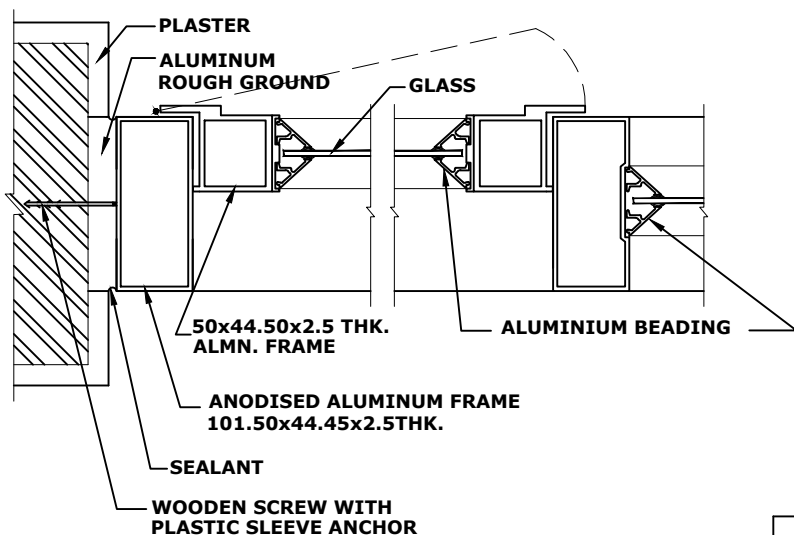
A4



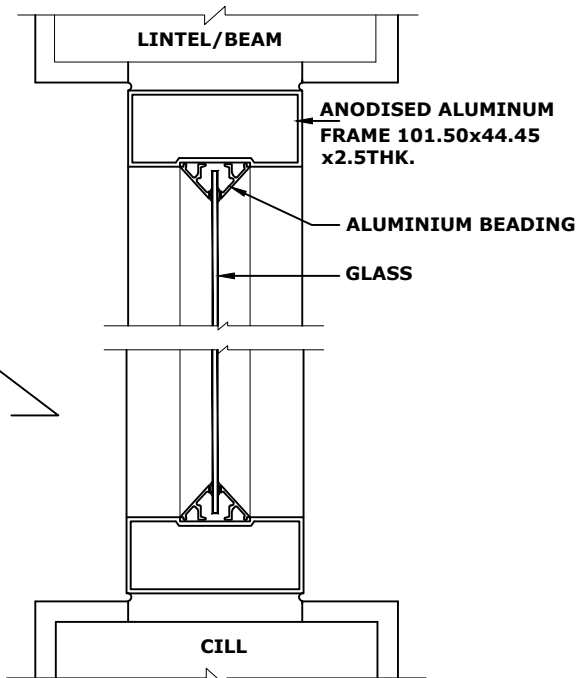
ELEVATION



SECTION 1-1



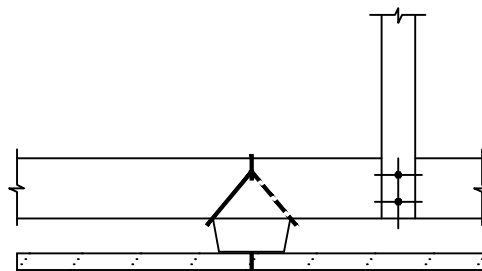
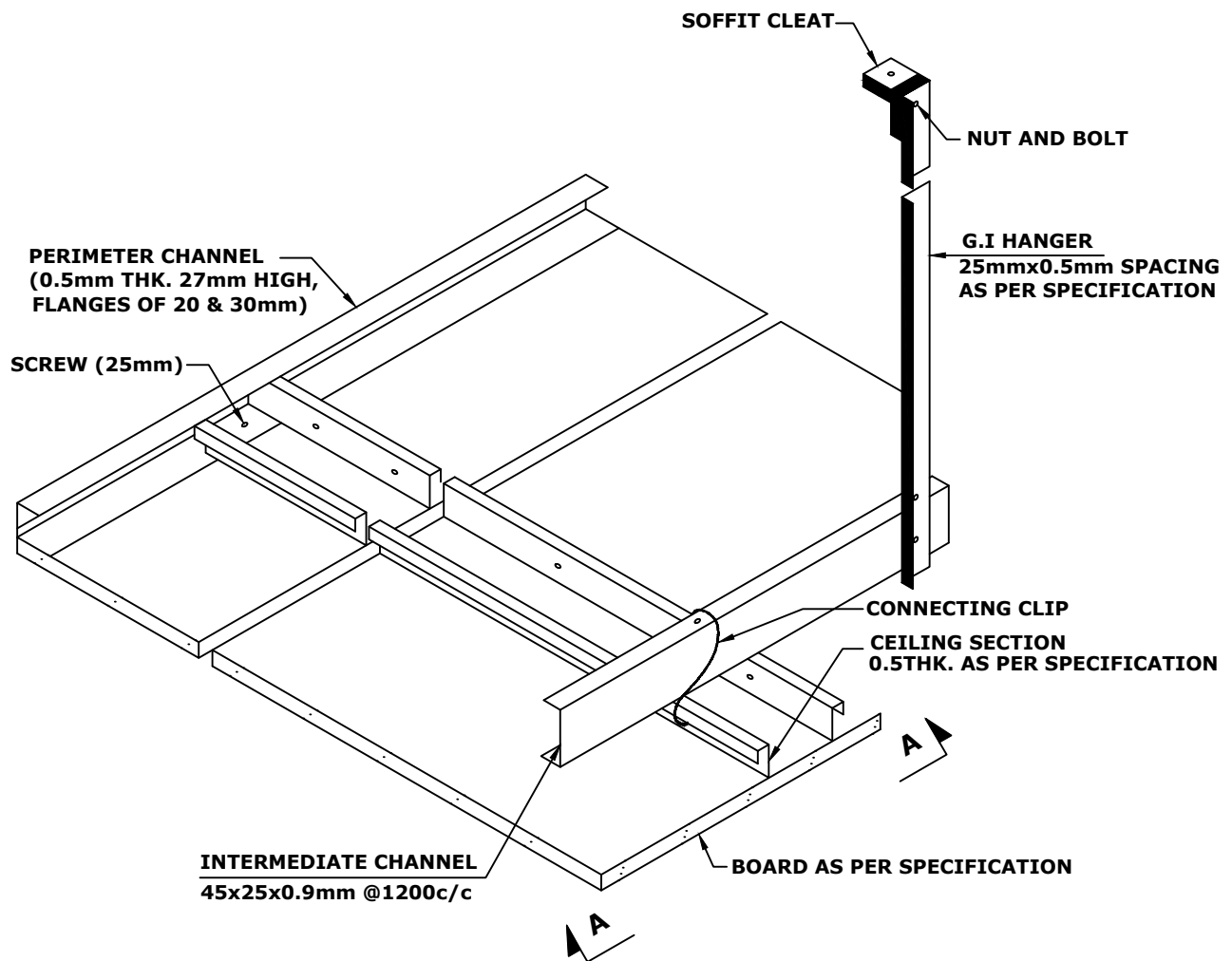
SECTION 3-3



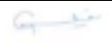
SECTION 2-2

			<i>MN</i>	<i>GDS</i>	<i>HK</i>	<i>WG</i>
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY

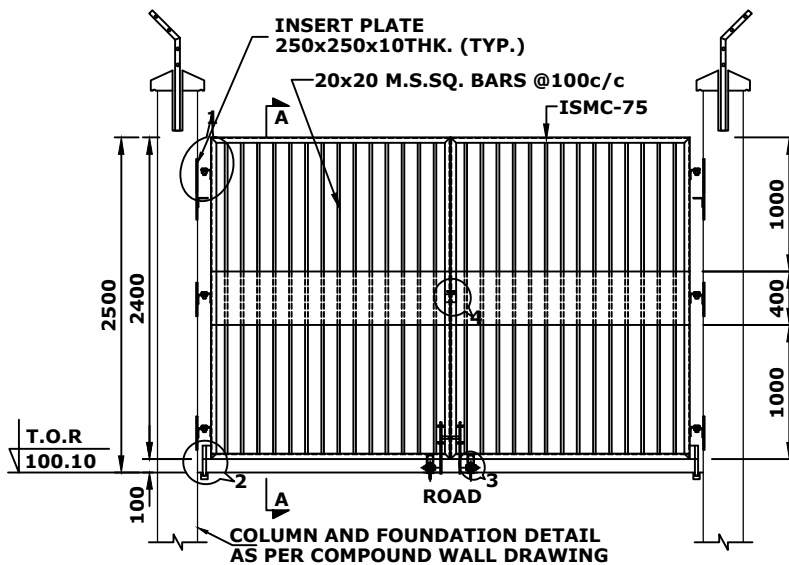
 VCS QUALITY SERVICES PRIVATE LIMITED	STANDARD FOR DETAIL OF FALSE CEILING	STANDARD DRAWING NO.		REV.	SIZE
		VCS-STD-CS-6067		03	A4
		SHEET NO.	1 OF 1		



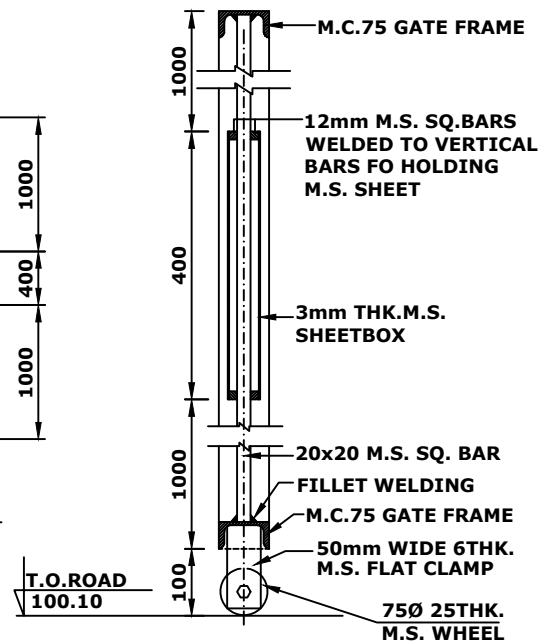
VIEW A-A

						
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG
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REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY

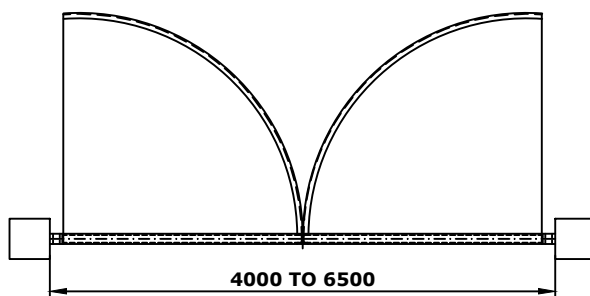
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		VCS-STD-CS-6068		03	A4
		SHEET NO.	1 OF 4		



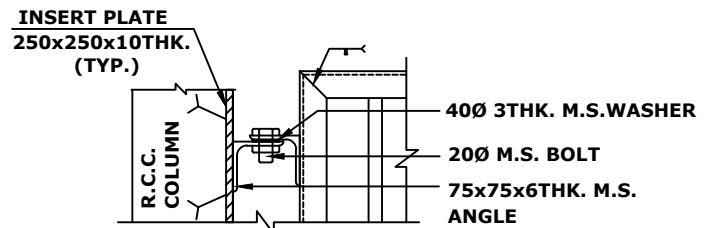
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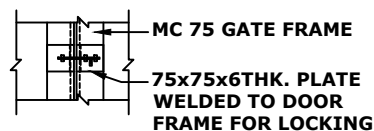
SECTION A-A



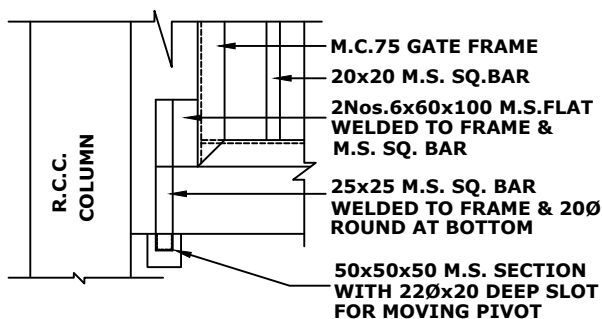
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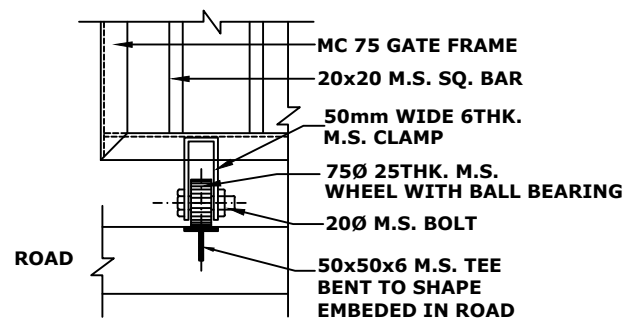
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DETAIL AT 4



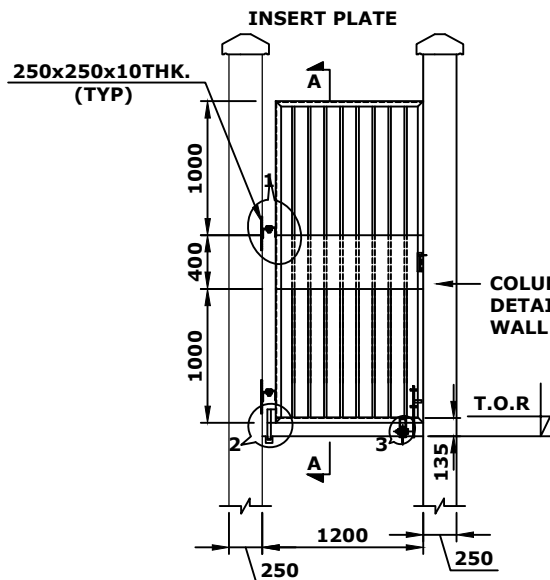
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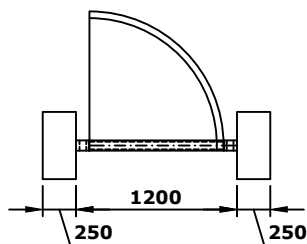
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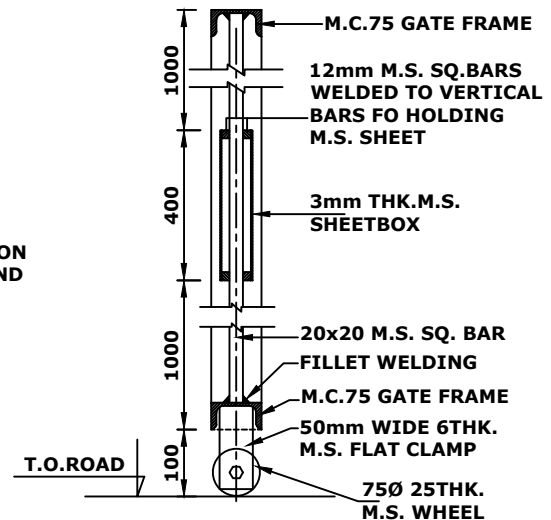
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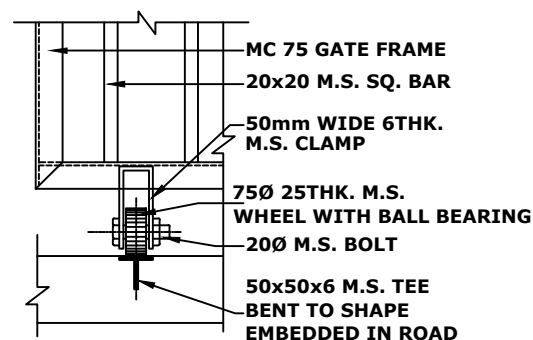
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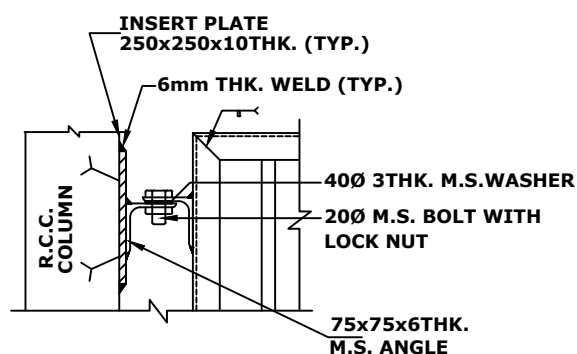
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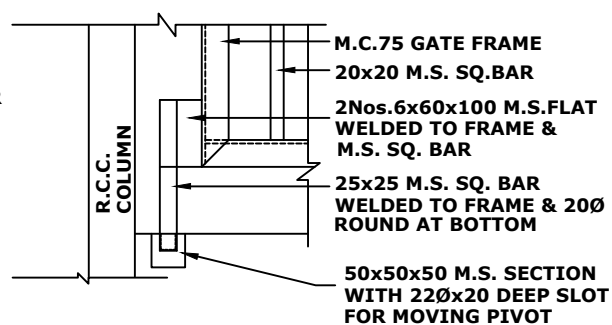
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DETAIL AT 3



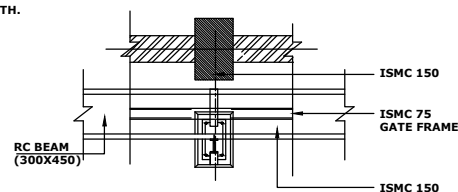
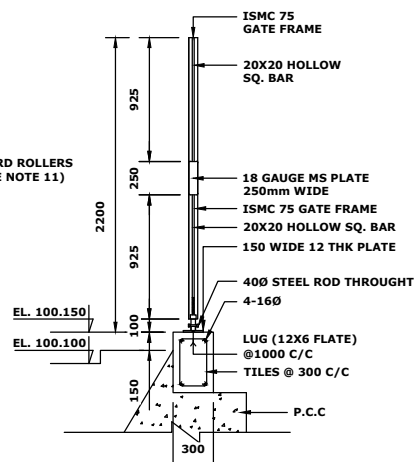
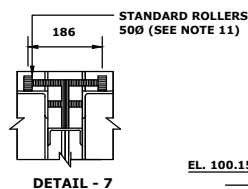
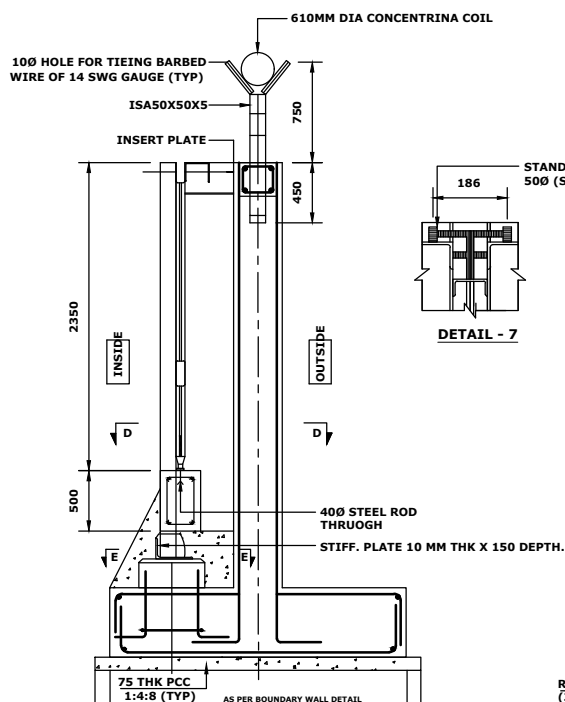
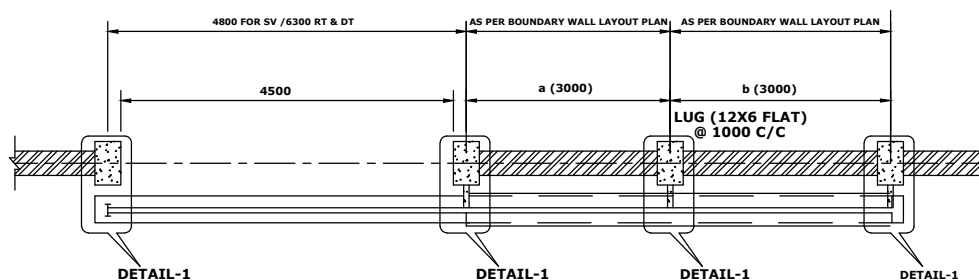
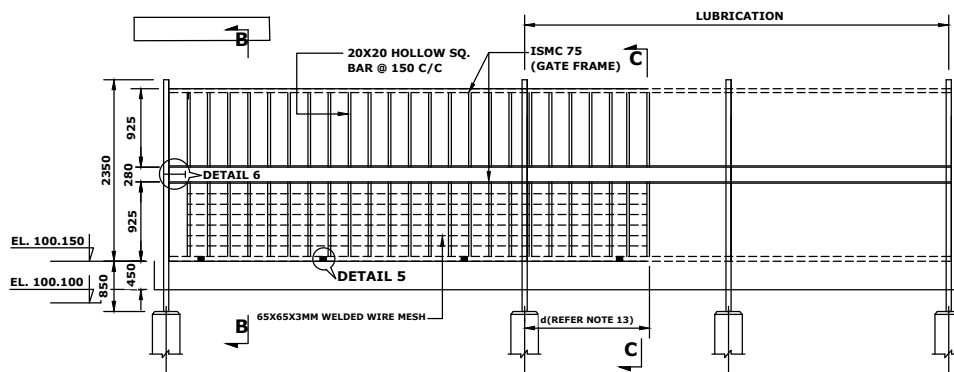
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DETAIL AT 2

						
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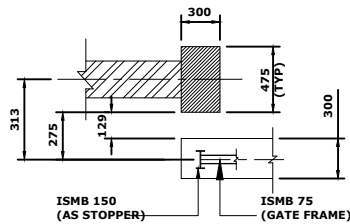
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		VCS-STD-CS-6068		03	A4
		SHEET NO.	3 OF 4		



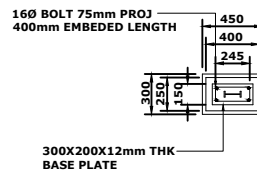
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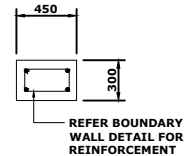
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		SHEET NO.	4 OF 4		



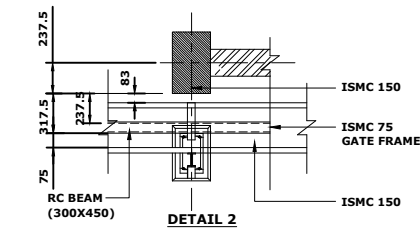
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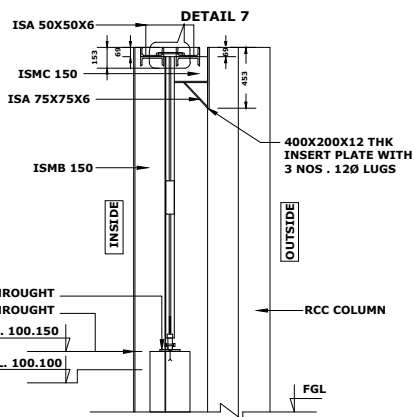
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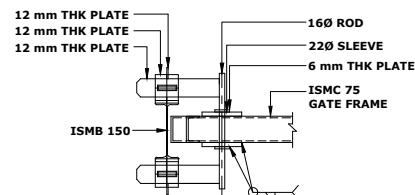
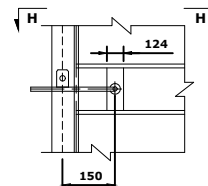
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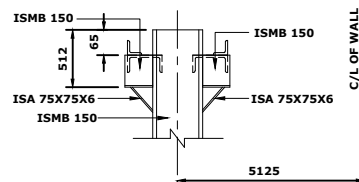
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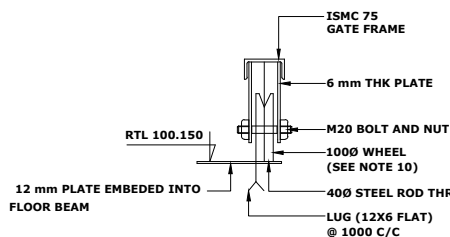
SECTION C-C



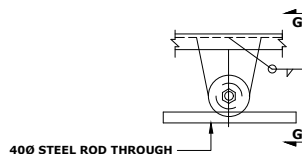
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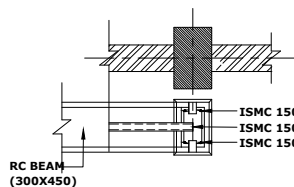
VIEW F-F



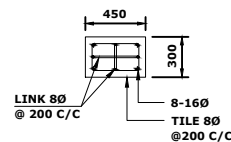
VIEW G-G



DETAIL - 5



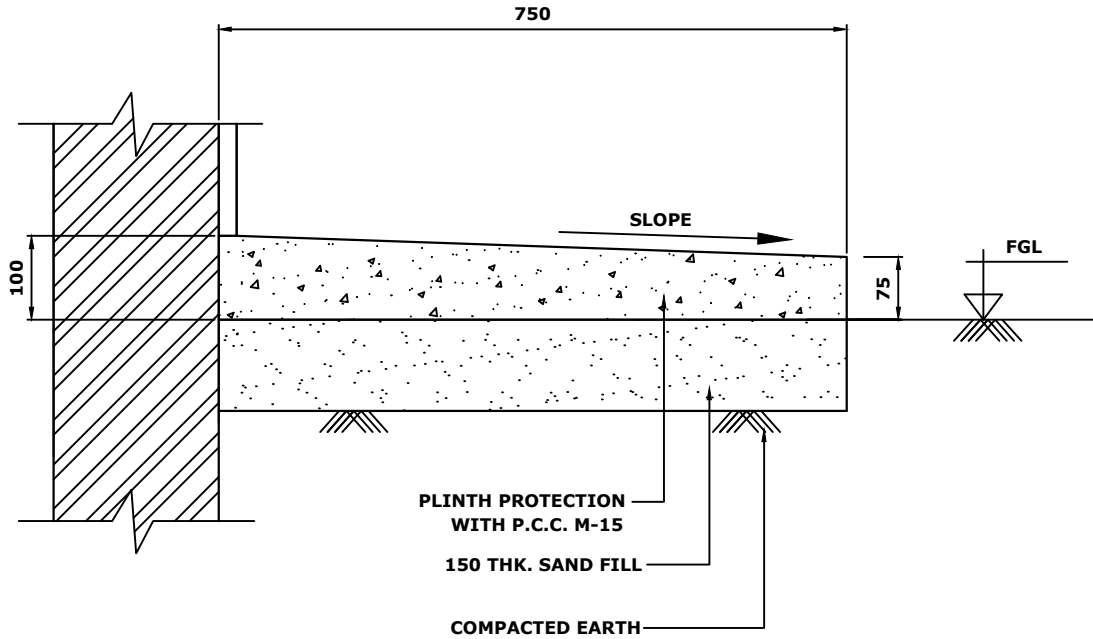
DETAIL 4



SECTION E-E

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REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY

 VCS QUALITY SERVICES PRIVATE LIMITED Empowering Quality	STANDARD FOR DETAIL OF TYPICAL PLINTH PROTECTION DETAIL	STANDARD DRAWING NO.	REV.	SIZE
		VCS-STD-CS-6070	03	A4
		SHEET NO.	1 OF 1	



TYP. PLINTH PROTECTION DETAIL

						
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02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD FOR DETAIL OF ALUMINUM SLIDING WINDOW

STANDARD DRAWING NO.

REV.

SIZE

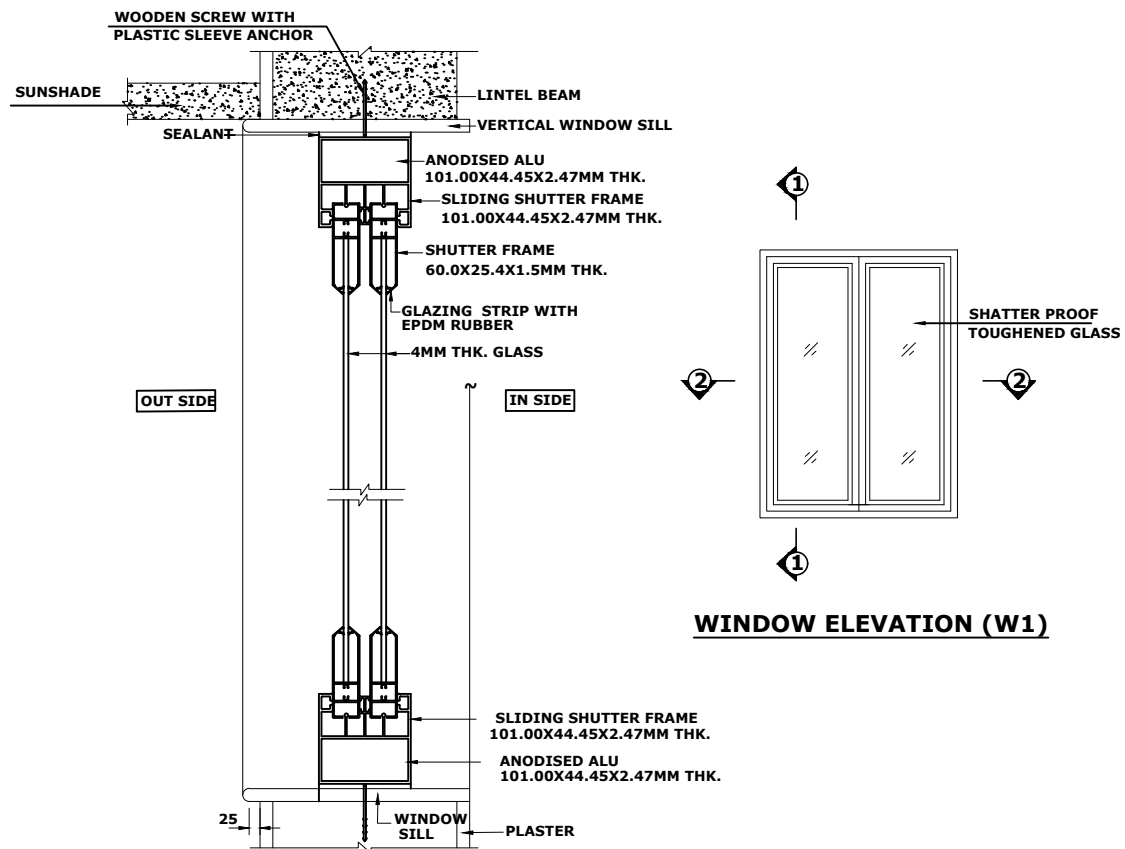
VCS-STD-CS-6071

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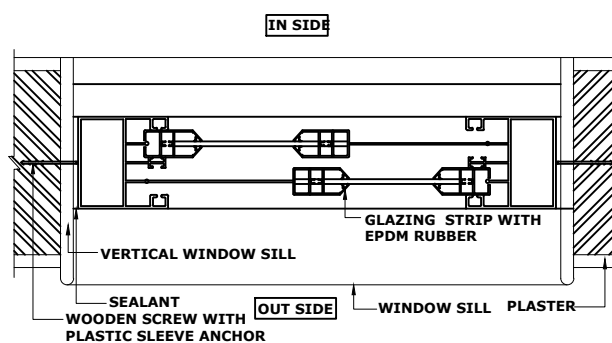
A4

SHEET NO.

1 OF 1



SECTION 1-1



SECTION 2-2

DOUBLE PANEL ALUMINIUM WINDOW

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02	30.01.20	RE-ISSUED AS STANDARD	YS	GDS	RKB	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



VCS QUALITY SERVICES
PRIVATE LIMITED

STANDARD FOR DETAIL OF ALUMINUM VENTILATOR

STANDARD DRAWING NO.

REV.

SIZE

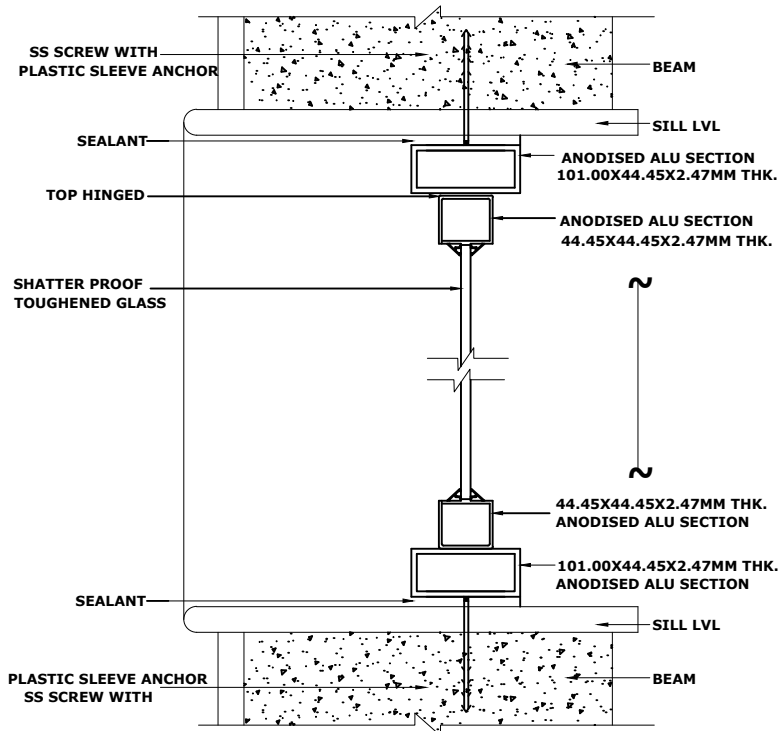
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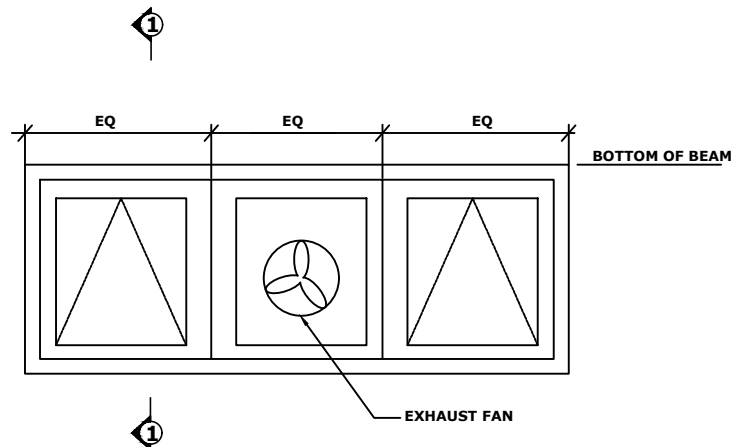
A4

SHEET NO.

1 OF 1

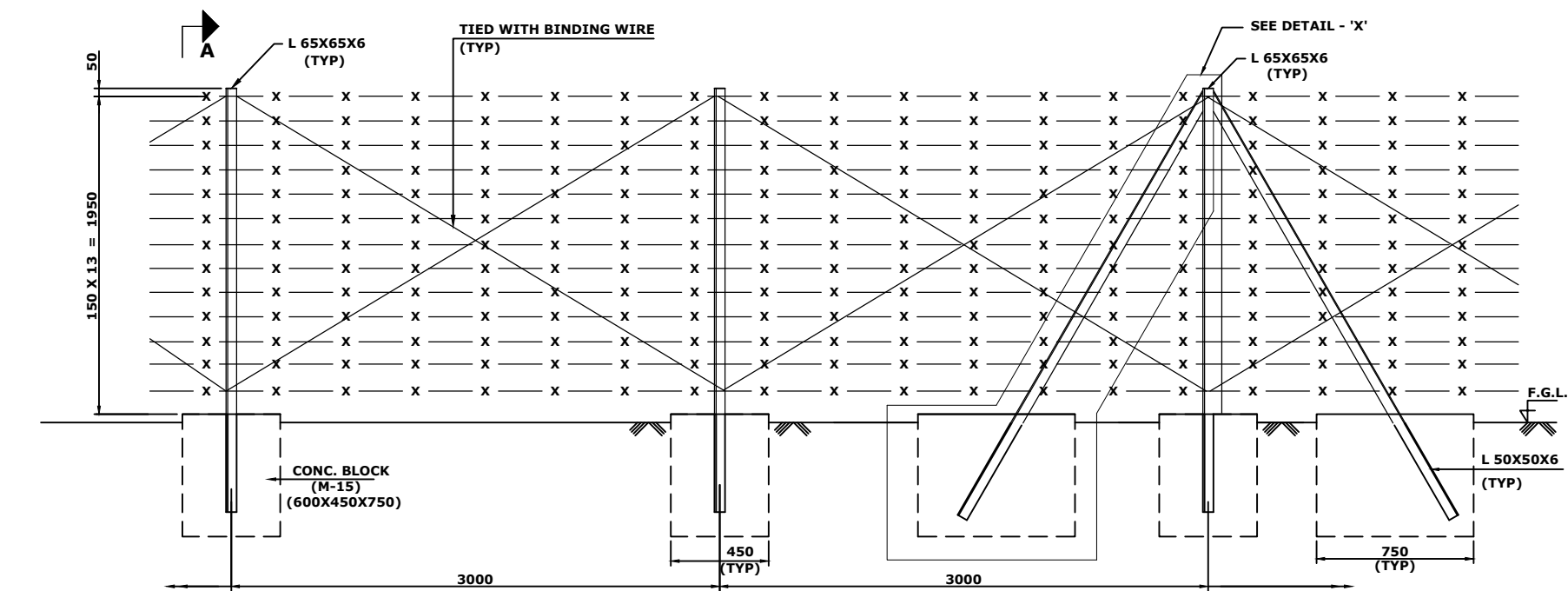


SECTION 1-1

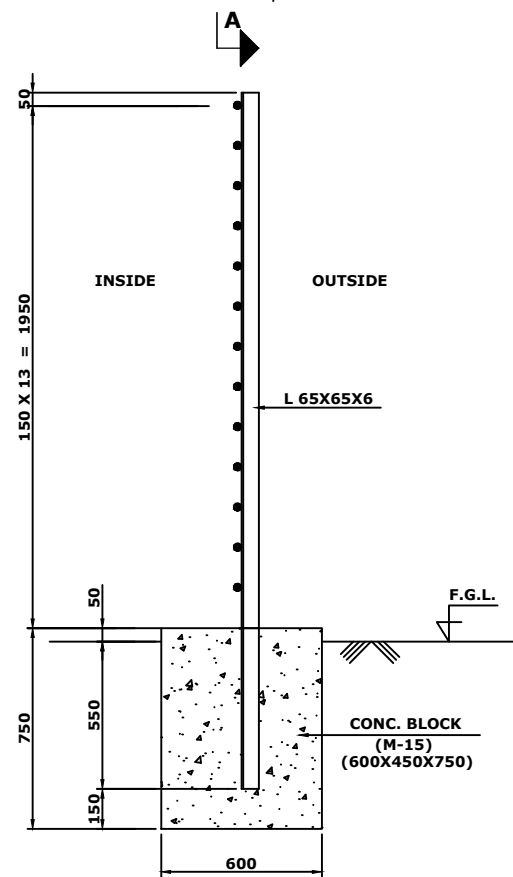


VENTILATOR ELEVATION

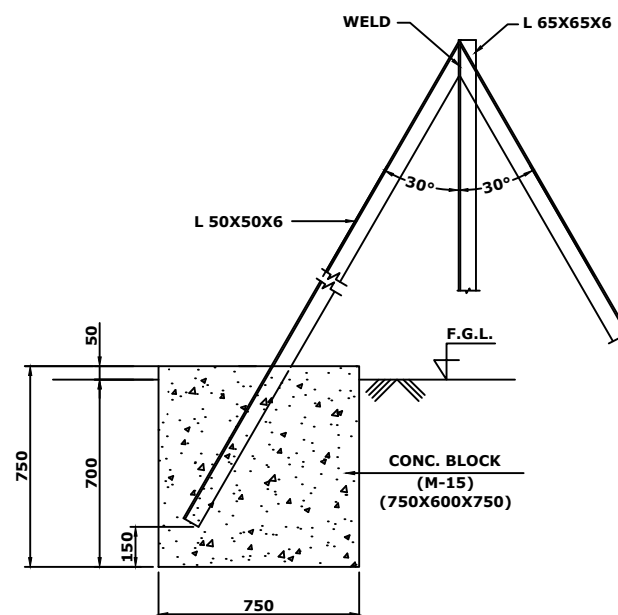
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REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



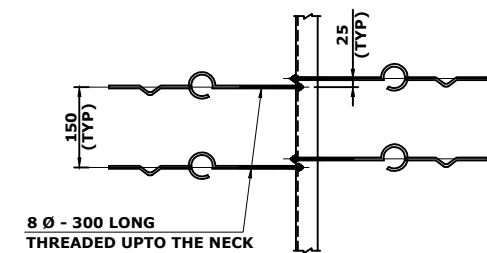
BARBED WIRE FENCE
(OUTSIDE)



SECTION ELEVATION A - A



DETAIL - X



**FIXING DETAIL OF
STRAINING BOLT
WITH POST**

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. THE GALVANIZED STEEL BARBED WIRE DESIGNATED AS STEEL BARBED WIRE A-1 TO IS:278 SHALL HAVE LINE WIRE OF Ø2.5MM, POINT WIRE OF Ø 20MM & MINIMUM WEIGHT OF COMPLETE BARBED WIRE SHALL BE 108gm/m WITH 75mm DISTANCE BETWEEN TWO BARBED WIRES.
3. LINE POST SHALL BE PLACED AT 3.0M C/C.
4. STRUT SHALL BE PROVIDED AT EVERY 15TH. POST OF BOTH SIDE & END POST ON ONE SIDE.
5. STRAINING BOLTS SHALL BE PROVIDED AT THE END POST & AT PLACES AS DIRECTED BY ENGINEER INCHARGE.
6. EXPOSED FOUNDATION BLOCK AT GROUT LEVEL SHALL BE FINISHED SMOOTH IN CEMENT MORTAR 1:6.
7. GALVANIZED BARBED WIRE SHALL BE TIED TO THE ANGLE IRON POST EITHER WITH WELDED M.S NIBS OR WITH G.I WIRE THROUGH HOLES IN THE POST.



**VCS QUALITY SERVICES
PRIVATE LIMITED**

**STANDARD FOR DETAIL
OF BARBED WIRE FENCING
(WITH ANGLE IRON POST)**

										
03	03.02.22	RE-ISSUED AS STANDARD	MN	GDS	HK	WG	STANDARD DRAWING NO.		REV.	SIZE
02	30.01.20	RE-ISSUED AS STANDARD	BSS	MO	RKB	SK	VCS-STD-CS-6073		03	A3
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY	SHEET NO.	1 OF 1		



Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR EARTHWORK IN SITE GRADING

VCS-SS-CS-6002

03	31.01.2022	NV	GDS	HK	GW
02	14.02.2020	NV	GDS	RKB	SK
01	16.10.2019	MA	MO	AD	SK
00	05.07.2017	MA	MO	AD	SK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY : If printed

CONTROLLED COPY : If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	05.07.2017	MA	MO	RKB	AD	Issued for use as Standard
01	16.10.2019	MA	MO	RKB	AD	
02	14.02.2020	NV	GDS	RKB	SK	New revision system updated
03	31.01.2022	NV	GDS	HK	GW	VCS QMS Integration

ABBREVIATION

m	Metre
Mm	Millimetre
IS	Indian Standard
m ²	Square metre
GPS	Global Positioning System
VCS	VCS Quality Services Pvt Ltd

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2.0	REFERENCES	5
3.0	GENERAL	5
4.0	MATERIAL FOR EARTHWORK	5
5.0	CUTTING TREES	6
6.0	CLEANING AND STRIPPING	6
7.0	EARTHWORK IN EXCAVATION/CUTTING	7
8.0	EARTHWORK IN FILLING.....	8
9.0	REMOVAL OF SURPLUS EARTH.....	10
10.0	EXCAVATION IN ROCK	10

1.0 SCOPE

This specification and the method of measurements described thereon are applicable for earthwork involved in Site Grading & Rock Cutting

2.0 REFERENCES

2.1 BIS CODES

IS: 2720 Part IV - Methods of tests for soils, Part-V- Grain size Analysis

IS: 2720 Part V - Methods of tests for soils, Part 5- Determination of liquid & plastic limit.

IS: 2720 Part VI - Methods of tests for soils, Part 6- Determination of shrinkage factors.

IS: 2720 Part VII - Methods of tests for soils, Part 7- Determination of water content dry density relation using light compaction.

2.2 VCS SPECIFICATIONS

VCS-SS-CS-6003 Earthwork for underground piping

VCS-SS-CS-6022 Earthwork in Foundations

NOTE: - Latest Edition of all Codes and Standards shall be followed.

3.0 GENERAL

3.1 CONTRACTOR shall maintain adequate drainage facilities at SITE at all times during the execution of work. Additional ditches, drains & such other temporary means to achieve this, over and above what is shown in the drawings, shall be provided and maintained by CONTRACTOR at his own cost.

3.2 Adequate dewatering facilities like dewatering pumps and piping etc. shall also be provided by the CONTRACTOR for this work, including dewatering during excavation etc. as required, at his own cost.

4.0 MATERIAL FOR EARTHWORK

4.1 Only soil considered suitable by the Engineer-in-charge shall be deployed for the construction and that considered unsuitable shall be disposed off, as directed by Engineer-in-charge, at his own cost and no claim for compensation will be entertained.

4.2 The CONTRACTOR shall give the samples of soil he proposes to use for filling, along with the following characteristics of the samples, to Engineer-in-charge for approval, prior to collection and use. The tests for these characteristics shall be done in a laboratory / test house as approved by Engineer-in-charge.

a. Mechanical analysis or grain size analysis as per IS: 2720 Part IV.

- b. Liquid limit as per IS: 2720 Part V.
 - c. Plastic limit as per IS: 2720 Part V.
 - d. Determination of Shrinkage limit factors as per IS: 2720 Part VI.
 - e. Determination of water content dry density relation using light compaction as per IS: 2720 Part VII.
- 4.3 The soil used for filling shall be free from boulders, lumps, tree roots, rubbish or any organic deleterious matter.
- 4.4 Soil having plasticity index less than 20 shall be used for filling purpose.
- 4.5 Soil having laboratory maximum dry density of less than 1.5 gm/cc shall not be used.
- 4.6 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 material, proposed to be used, for filling.
- 4.7 The work shall be so planned and executed that the best available soil is reserved for the top portion of Embankments.

5.0 CUTTING TREES

- 5.1 All trees having girth above 30 cms, which are not marked for preservation, shall be cut down and their roots dug up to a depth of 1 metre from the existing ground level.
- 5.2 All holes or hollows produced by digging up roots shall be carefully filled with approved soil, including all leads and lifts, rammed and compacted to obtain 90% of maximum laboratory dry density of soil and levelled as directed.
- 5.3 All uprooted trees shall be stacked or disposed off as directed by Engineer-in-charge.
- 5.4 PAYMENT

This clause shall apply to item rate tenders only.

Cutting of trees above 30 cms girth shall be paid per number. The rate quoted shall include cutting, uprooting removing the trees within plant boundary as directed, including filling holes or hollows produced by removal of roots etc. as per specifications.

6.0 CLEANING AND STRIPPING

- 6.1 All the areas, including depressions, where filling or cutting is to be carried out shall be cleared and stripped completely of bushes, roots, vegetation, plantation trees, shrubs, trees up to 30 cms girth, organic and other objectionable materials. All these shall be completely uprooted and virgin soil exposed and not merely scrapped at the surface. The roots of trees of girth up to 30 cms shall be removed to a minimum depth of 1m below existing ground level and holes, hollows filled up with selected approved available soil within all leads and lifts and compacted to obtain 90% of

laboratory dry density of soil as per IS: 2720, Part VII and leveled as directed by Engineer-in-charge. All soft patches must be worked out to remove soft soil and selected approved earth must be filled back and the areas (areas coming under filling) compacted to obtain 90% of maximum laboratory dry density of soil, as per IS: 2720 Part VII. The depth of stripping shall be generally 50 to 150 mm as decided by Engineer-in-Charge.

- 6.2 Material obtained from clearing shall be stacked or disposed off as directed by Engineer-in-charge within a lead as per directions of Engineer-in-Charge.

6.3 PAYMENT

This clause shall apply to item rate tenders only.

No separate payment shall be made for clearing, stripping and disposal of materials obtained from clearing. This shall be considered as part of cutting work in areas of cutting and filling work in areas of filling and the rates quoted under the respective items of

- a. Earthwork in Excavation/ Cutting
- b. Earthwork in filling (both with available earth & earth obtained from approved borrow areas), shall be inclusive of clearing and stripping with all operations described above in clause no.6.0 in respective areas of cutting and filling.

No separate payment shall be made for clearing, stripping and disposal of materials obtained from clearing of borrow areas for earth. This shall be considered as part of filling work in area of filling and the rate quoted under the respective items.

7.0 EARTHWORK IN EXCAVATION/CUTTING

- 7.1 After clearing and stripping of areas as specified above in clause No.6.0, spot levels at intervals and pattern as decided by the Engineer-in-charge, shall be taken jointly by CONTRACTOR and Engineer-in-charge. Excavation / cutting shall commence only after the levels are signed by the contractor as a token of his acceptance.
- 7.2 Excavation/ cutting shall be carried out strictly as per the instruction of Engineer-in-charge.
- 7.3 If the contractor excavates/ cuts beyond the required level, additional quantity of earthwork shall not be paid for. The excavation taken below the specified level shall be made good by filling with approved material, to the required compaction, at Contractor's cost.
- 7.4 The final bed and sides of excavation must be levelled, dressed and compacted. In case of areas under excavation for site grading, the final surface shall be levelled, dressed and consolidated by means of sheep foot / power driven rollers to obtain maximum compaction. However, no test control is required in such areas.

7.5 Shoring and strutting shall be adopted only with the permission of Engineer-in-charge in writing. Such shoring and strutting shall follow the necessary specification.

7.6 Provisions for dewatering shall be governed by the relevant clauses.

7.7 Payment

This clause shall apply to item rate tenders only.

Payment for Excavation shall be on the basis of volume of excavation calculated on the basis of joint level taken as per clause 7.1 and the final finished grade levels, the volume being calculated by the Trapezoidal rule including dewatering, if required. Intermediate payment will be on the basis of volume calculated based on spot levels taken during the time of the billing. Reference is also invited to clause 7.3.

8.0 EARTHWORK IN FILLING

8.1 After clearing, stripping and consolidation of areas as specified in clause 6.0, spot levels at intervals and pattern as decided by Engineer-in-charge shall be taken jointly by the CONTRACTOR and Engineer-in-Charge and filling shall commence only after the levels are signed by the CONTRACTOR as a token of his acceptance. Approved fill Material shall be spread in uniform layers not exceeding 30 cms in loose depth.

The contractor has to make his own approach and access roads from the borrow area to the demarcated filling areas. While the CONTRACTOR may make use of such short cuts as may be available to him for earth movement from borrow areas to the filling areas, the OWNER does not guarantee any passage way or right of way for the CONTRACTOR'S work other than available at site. No claim shall also be admissible to the CONTRACTOR on account of his having to take longer leads or routes for earth movement, than envisaged by him, either due to any road cuttings, non-availability of routes, or any other grounds whatsoever.

In case total filling required in any area consists of soil both from borrow areas and available approved excavated material from within plant area, then joint levels, shall be taken before commencing filling with earth from borrow area.

However, earth available from borrow areas required for filling can be used only after the available earth from excavation within demarcated area has been utilized and clearance to this effect obtained from the Engineer-in-charge.

8.2 All clods, lumps etc, shall be broken before compaction.

8.3 Successive layers of filling shall not be placed until the layer below has been thoroughly compacted and tested to satisfy the requirements laid down in this specification.

8.4 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 VII. The moisture content shall preferably be on the wet side for potentially expansive soil.

- 8.5 After adjusting the Moisture Content as described in clause 8.4, the layers shall be thoroughly compacted by either sheep foot roller or power driven roller or vibratory roller, as approved by Engineer-in-charge, till the specified maximum laboratory dry density is obtained.
- 8.6 Each layer shall be tested in field for density and accepted by Engineer-in-charge, subject to achieving the required density, before laying the next layer. A minimum of one test per 500m² for each layer shall be conducted.
- 8.7 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 Engineer-in-charge to obtain the required density.
- 8.8 The filling shall be finished in conformity with the alignment, levels, cross-section and dimensions as shown in the drawing.
- Earthen embankment shall be filled 300mm more on both sides, where height is more than 1M and this extra filling shall be dressed, after compaction, in conformity with alignment, level, cross-section and dimension as shown in the drawing, to achieve proper compaction in the slope. No extra payment shall be made in this regard.
- 8.9 Extra material shall be removed and disposed off as directed by the Engineer-in-charge.
- 8.10 Tolerances
- 8.11 General site grading, including cutting and filling in depressions, shall be carried out to within up down tolerance of +5 cms of final lines, grades and slopes.

Earth Work In Filling In Open Lined/Unlined Wells

For earth work in filling in open lined/unlined wells, only locally available coarse sand shall be used, in layers of 500 mm thickness. Each layer shall be thoroughly wetted by sprinkling water, before next layer is filled up. Filling shall be done upto 1m depth below NGL as above. Layers from a depth of 1m below NGL, upto NGL, shall also comprise of locally available coarse sand and compacted with suitable Mechanical / manual means,

to obtain same level of compaction as required for filling above NGL. Filling above NGL shall be done as per CI. 8.1 to 8.10 above.

8.12 Payment

This clause shall apply to item rate tenders only.

- a. Payment for filling shall be made on cubic metre of volume calculated on the basis of cross section plotted from the levels of ground, where filling is to be carried out and the levels reached after filling is duly consolidated, volume being calculated by Trapezoidal method.

- b. In case of simultaneous cut and fill operation, wherever specified, payment shall be made on the basis of one composite rate for cutting and filling. All other details about measurement etc. remaining same as above.
- c. Payment for filling in open wells, lined or unlined, shall be made on the basis of volume calculated on the basis of average area multiplied with depth of open well
- d. No extra payment shall be made towards testing.

9.0 REMOVAL OF SURPLUS EARTH

9.1 Surplus earth and soil from excavation and general site grading shall be removed from the construction areas to the area demarcated by the Engineer-in-charge.

9.2 Payment

This clause shall apply to item rate tenders only.

Payment shall be made only for lead beyond initial lead from construction area. Rate shall include loading, transportation, dumping, stacking the surplus earth and soil in the area demarcated by the Engineer-in-charge.

Payment shall be made on cubic metre basis of the difference of measurements of the volumes of the excavation and the measurement of the filling with the excavated earth. However, the contractor's entitlement to payment shall be restricted to the actual quantity of earth removed. Quantity generated due to void in back filled volume of earth shall also be removed by the contractor at no extra cost and this disposal of earth shall not be measured and paid under any item.

10.0 EXCAVATION IN ROCK

Blasting operations for site grading shall be carried out as per specification No. VCS-SS- CS-6022.



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VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR EARTHWORK FOR UNDERGROUND PIPING

VCS-SS-CS-6003

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ABBREVIATION

m	Metre
Cm	Centimetre
Mm	Millimetre
Km	Kilometre
U/G	Underground

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1.0 SCOPE

This specification deals with earthwork in trenches and pits (for valves, manholes, catch pits etc.) for underground piping.

2.0 REFERENCES

BIS CODES

IS: 783 Code of practice for laying of RCC pipes.

IS: 1200 (Part-I) Method of measurement of building and civil engineering works.

IS: 3764 Excavation work - code of safety.

2.2 SPECIFICATIONS

VCS-SS-CS-6002 Earthwork in Site Grading

VCS-SS-CS -6022 Earthwork in Foundations

NOTE: - Latest Edition of all Codes and Standards shall be followed.

3.0 MATERIAL

All workmanship and materials shall conform to the provisions of IS: 1200 (Part-1) and IS: 3764.

4.0 EARTHWORK IN EXCAVATION FOR TRENCHES / PITS FOR PIPELINES

4.1 Excavation

Plant, machinery and equipment's for excavation shall be selected and deployed to provide optimum mechanization in excavation of trenches and pits. The selection for excavation and earth movement machinery etc. shall take into account type of materials to be excavated, method of excavation, prevailing weather conditions and type of transport to be used.

The excavation of area of cut shall be so timed that the bottom level is not exposed to the deteriorating influence of the weather for longer duration.

Excavation and earth moving equipment shall be deployed such that minimum damage is caused to the natural sub-soil structure of exposed formations.

The monitoring of soil deformations, ground water levels during and possibly after construction work shall be taken into consideration.

In the event, when excavation works are carried out in the vicinity of structures of any importance, the above monitoring shall be carried out within a distance, from the edge of the excavation of 5 to 15 times the excavation depth, depending upon the subsoil conditions and the stability of the neighboring structures.

- 4.2 Trenching work shall be carried out in all classes of soil including soft rock and excluding hard rock and shall be for all depths.
- 4.3 The trench shall be cut true to the line and level as per drawings.
- 4.4 If the trench is excavated below the required level than that indicated in the drawing, the extra depth shall be filled with concrete 1:5:10 or approved equivalent materials, as directed by the Engineer-in-Charge, at no extra cost to the owner.
- 4.5 In case of pressure piping, the trench shall be excavated generally as to provide a cover of 1000 mm or dia of pipe whichever is more. In case of gravity sewers/ pipes, the trench shall be excavated to conform to invert levels as per drawings. However in certain cases, the pipes may run at shallower levels or at deeper levels depending upon drawing, site condition etc. No rebate for lesser excavations, nor extra payment due to deeper excavations, shall be admissible in those cases where pipeline laying rates are inclusive of earthwork items. The rates quoted shall be deemed to cover all works connected with trenching, whether trenches are with single pipeline or have multiple pipelines in common trenches including road cutting and making good the same.
- 4.6 The width of the trench shall be sufficient to give free working space of personnel, equipment, supports and ancillaries on each side of the pipe. The free working space shall conform to IS: 783. Generally it shall not be less than 150 mm on either side or 1/3 dia of outer diameter of the pipe, whichever is greater.
- 4.7 When pipelines are running parallel, whether the trenching shall be individual or common, shall be decided by the Engineer-in-Charge and such decision shall be final and binding on the contractor. No extra shall be payable for common excavations.
- 4.8 All earthwork involved in excavations of all types of manholes, catch pits, valve chambers, inspection chambers, chambers for instrumentation tapping etc., which are coming on the alignment of U/G piping or as defined by drawing as a part of U/G piping work, shall be paid extra under Earth work in excavation, back filling and removal of surplus earth etc. under relevant clauses of the SOR.
- 4.9 Aspects such as variations in the soil conditions and the geological structure, depth of excavation, the existence of ground water and surface water, the type and extent of excavation, the topography of site, the proximity of items such as roads, buildings and buried services, construction traffic and activities near the excavation eg. stock piling shall be taken into account when determining whether the sides of excavation should be free standing, sloping or temporary supported.

Suitable drainage and / or dewatering system like Well Point method / Bore well method etc. shall be provided to prevent or limit ingress of surface or sub surface water into excavation.

Serviceable materials intended for reuse should be used as soon as possible after excavation otherwise they should be stock piled at a location beyond 1.5m from the top edge of the excavation or beyond a distance equal to the depth of the excavation whichever is higher at a location approved by the Engineer-in-charge. If excavated serviceable material is not possible to be stacked within the limits specified above, due to some constraint, it shall be stacked away at a location approved by Engineer-in-Charge and paid separately under relevant item.

Areas used for temporary stockpiling of excavated material shall be kept clean and orderly, with excavated material kept by the side of road to avoid traffic movement. Excavated areas shall be restored to their original condition before completion of works.

types of shoring and strutting, wherever necessary, shall be adopted to with hold the face of earth or cutting in slope, as per site requirements and direction of Engineer-in-Charge. Supports shall be maintained such that the integrity of the sides of the excavation is not impaired.

- 4.10 Any obstacle encountered during excavation shall be reported immediately to the Engineer-in-Charge and shall be dealt with as instructed.
- 4.11 The contractor shall maintain all excavated trenches and pits, in a dry and trim condition.
- 4.12 Necessary barricading and protection of slopes against slips due to traffic movement shall be provided to the satisfaction of Engineer-in-Charge. Necessary warning flags and lights shall be provided to caution traffic in the areas where trenches and/ or pits are provided.
- 4.13 In case of road cutting, all road material i.e. metal etc., shall be taken out carefully and kept separately for reuse and road work shall be redone up to the original level, as it was prior to cutting the road, with the excavated road materials after laying and testing of the pipeline, within 10 days from the date of starting this work, at the cost of the contractor. The contractor shall provide suitable warning signs and barricades to prevent accidents.

Contractor shall also provide reasonable bye pass at his own cost when a road is cut for Laying pipeline. Tankage dykes cut due to laying of the pipes, shall be redone conforming to the original specifications, by the Contractor at his own cost. Secondary dykes, to take care of any eventuality during construction, shall be provided by the Contractor at his own cost.

- 4.14 Dewatering shall be done in advance of the installation of the pipe to allow adequate inspection of padding of the bottom, if required. Dewatering shall be continued throughout during installation and backfilling.

The trench shall follow the gradient of pipeline as specified in the drawing. The contractor shall keep the trench in good condition, until the pipe is laid and tested. No extra claim shall be entertained due to its caving or setting down, either before or after the pipe is laid.

In case, pipe is lowered in caved trench and backfilled before being inspected by the Engineer-in-Charge, the Contractor shall re-excavate the trench for inspection and backfill it at his own cost.

5.0 BACKFILLING AND COMPACTION IN TRENCHES AND AROUND VALVE PITS, MANHOLES ETC.

BACKFILLING

Trenches shall be back filled with suitable materials which should be compacted to the same degree or better as the surrounding soils.

- 5.1 The soil used should be selected and approved by Engineer-in-Charge. Suitable material can be extracted from available excavated material. The soil should be free from rubbish, grass, organic matter, stones, building waste and Black Cotton Soil etc. It should be free from clods and hard lumps. In case good soil is not available from excavated material for back filling, trench shall be filled back with locally available coarse sand up to 30 cm. thick above the pipe and rest of trench shall be filled back with excavated soil up to required level.'
- 5.2 The filling should commence only after approval of Engineer-in-Charge is obtained and after the structures or pipes to be buried are tested and approved. Otherwise, if required, contractor shall uncover buried portion and refill at his own cost.

Temporary excavation supports should be removed as back filling and compaction proceeds, such that unacceptable movement of the supported ground does not occur.

Voids caused by extracted supports should be filled and compacted.

- 5.3 Filling should be done in layers. Each layer should be not more than 15 cm thick when loose and should be well rammed, with necessary watering, to obtain at least 90% of maximum laboratory dry density.

Compaction trials should be carried out on each soil type to be placed in backfill, in order to confirm the type of machine and number of passes required to obtain optimum compaction for given soil moisture contents. These trials should also be used to determine the variability of the proposed fill material for different weather conditions.

- 5.4 Care must be exercised to protect cables, pipes, joints, and other features from damage due to backfilling and consolidation.
- 5.5 Filling should extend up to the level of original ground surface or as per drawing or as directed by Engineer-in-Charge. The finished surface should be properly trimmed and dressed. The adjoining area should be cleaned and no heaps of surplus earth should be left out.

6.0 TRANSPORTATION OF SURPLUS EARTH

Unserviceable materials and serviceable materials not intended for re-use shall be removed from the work site and disposed off at a location as approved by Engineer-in-charge.

The surplus earth is generated due to pipe laying, valve chambers, and manhole construction etc. Surplus earth is also generated due to voids in the back filled volume of earth. The removal of surplus earth shall include excavation, loading, transportation, dumping, stacking or spreading, as per the directions of Engineer-in-charge.

7.0 PAYMENT

This clause shall be applicable for item tender rate only.

- 7.1 Unless specifically stated in the schedule of rates, no separate payment for earthwork in excavation, backfilling, transportation, dewatering etc. shall be admissible and the payment for the same is deemed to have been included in the relevant items of the contract.
- 7.2 In case payment for earthwork is specified separately in the Schedule of Rates, the payment shall be based on the actual quantity of excavation, backfilling and transportation done, taking into consideration the slopes authorized by the Engineer-in-Charge for excavation, volume of backfilling calculated on the basis of excavation reduced by the volume of pipes.
- 7.3 In cases where hard rock excavation is involved, the matter shall be referred to Engineer-in-Charge, before proceeding with the work.



Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR ROADS & FLEXIBLE PAVEMENTS (UPTO WBM LAYER)

VCS-SS-CS-6004

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ABBREVIATION

m	Metre
mm	Millimetre
Cm	Centimetre
IS	Indian Standard
IRC	Indian Road Congress
M ²	Square metre
M ³	Cubic metre
WBM	Water Bound Macadam

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1.0 SCOPE

This specification covers the material and construction details for earthwork in filling for embankments, filling with sand/murum, WBM sub-base, WBM base course and shoulders for roads and flexible pavements.

2.0 REFERENCES

2.1 CODES & STANDARDS

IS: 460	Specifications for Test Sieves
IS: 2720	Methods of Test of Soil
IRC: 19	Standard Specifications and Code of Practice for Water Bound Macadam
IRC: 36	Recommended Practices for the Construction of Earth Embankments for Road Works

2.2 SPECIFICATIONS

Specifications for Road and Bridge Works - Ministry of Surface Transport (Road Wing)

NOTE: -Latest Edition of all Codes, Standards and Specifications shall be followed.

3.0 CONSTRUCTION OF EMBANKMENTS SUBGRADE AND SHOULDERS

3.1 MATERIALS

Only those materials, considered suitable by the Engineer-in-Charge shall be employed for the construction and that considered unsuitable shall be disposed off as directed by Engineer-in- Charge at contractor's 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 Engineer-in-Charge prior to collection and use, for approval.

- a. Mechanical analysis or grain size analysis as per IS: 2720 Part IV.
- b. Liquid limit as per IS: 2720 Part V.
- c. Plastic limit as per IS: 2720 Part V.
- d. Determination of Water content Dry density relation using Heavy compactions. IS: 2720 Part VIII.

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 1.5gm/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 AND COMPACTION

- 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 95 % of maximum laboratory dry density of the soil as per IS: 2720 Part VIII. 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 earth fill 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 cm in loose depth for embankment filling. Shoulder construction shall be so organized 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 thoroughly 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 8-10T rollers or equivalent vibratory rollers till 95% of maximum laboratory dry density for embankment and 97% of maximum laboratory dry density for sub-grade as per IS:2720 Part VIII is obtained.
- 3.2.8 Each layer shall be tested in field for density and accepted by Engineer-in-Charge subjected to achieving the required density before laying the next layer. A minimum of one test per 500m² area for each layer shall be conducted.
- 3.2.9 All type of rollers that should be employed for compaction shall be as per direction of Engineer-in-Charge.

- 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 Engineer-in-Charge 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 Engineer-in-Charge.

3.3 TOLERANCE

Embankment and shoulders for roads, units etc. shall be carried to within a tolerance of plus minus 2.5 cm. from final lines but shall be to required grades and slopes.

4.0 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 Engineer-in-Charge.
- 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 Engineer-in-Charge. Only inaccessible reaches shall be worked manually. Each layer shall be uniformly compacted to obtain 85% relative density in case of sand and 95% of maximum laboratory dry density in case of murram. 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 500 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 Engineer-in-Charge.
- 4.5 The finished surface must be dressed to required grade and slope. Excess material must be removed from compaction site, as directed by Engineer-in-Charge.

5.0 WATER BOUND MACADAM SUB BASE/BASE COURSE

The sub-base course shall consist of one or more layers, each of 100mm compacted thickness.

The base course shall consist of one or more layers, each of 75mm compacted thickness.

5.1 MATERIALS

5.1.1 STONE AGGREGATE FOR WBM

5.1.1.1 The coarse aggregates shall be hard, crushed or broken stone metal from quarries approved by Engineer-in-Charge, 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.

- 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 45mm	125mm	100
Grade-I	90mm	90-100
	63mm	25-60
	45mm	0-15
	22.4mm	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
63mm to 45mm	90mm	100
Grade-2	63mm	90-100
	53mm	25-75
	45mm	0-15
	22.4mm	0-5

- c. Physical requirement of coarse aggregates for sub-base course shall be as below:

- i. Los Angles Abrasion Value 50% (Maximum)

or

- ii. Aggregate Impact Value 40% (Maximum)
- d. Physical requirement of coarse aggregates for base course shall be as below:

- i. Los Angles Abrasion Value 40% (Maximum)
- or

Aggregate Impact value 30% (Maximum)

- ii. Flakiness index value 20% (Maximum)

Samples of test shall be representative of the material to be used and collected as per IS: 2430.

5.1.1.2 The aggregates shall be unloaded at the road side on firm, well drained ground, as directed by Engineer-in-Charge. The various grades shall be placed separately and contamination by earth and other extraneous matter shall be prevented effectively.

5.1.2 SCREENINGS

5.1.2.1 Screening to fill voids in the course aggregates shall, as far as possible be the same material as the course aggregates where it is decided by the Engineer-in-Charge to use other materials, the same shall 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 index of such material is below 20 and 6 respectively and the fraction passing 75 micron sieve does not exceed 10 percent.

Grading Requirement of Screening

Size of	Sieve Designation	Percentage by Weight
Screening	(IS: 460)	Passing the Sieve
13.2mm	13.2mm	100
	11.2mm	95-100
	5.6mm	15-35
	180micron	0-10

This grading, however, shall not be mandatory, in case either murrum or gravel is used as screening.

For procurement of quantities for coarse aggregates and screenings required for 100mm and 75mm compacted thickness of WBM sub base course and base course shall be as per the IRC- 19.

5.1.3 BINDING MATERIAL

Binding material, to prevent reveling of WBM, shall consist of fine grained material possessing P.I value up to 6.

Application of binding material shall not be necessary where murrum or gravel is used as screenings.

Binding material shall be obtained from quarries/ sources approved by the Engineer-in-charge.

5.2 LAYING OF WBM

5.2.1 SPREADING CORASE AGGREGATES

- a. The sub grade or sub-base to receive WBM course 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 course for lateral confinement of aggregate. After shoulders are ready, their 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.
- b. 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 6 in apart.
- c. 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 meter long straight edge is laid parallel to centre line of the road.
- d. 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.
- e. 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.

5.2.2 ROLLING ROAD METAL

- a. Immediately following the spreading of the coarse aggregates, it 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 meter 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.

- b. 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.
- c. 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.

5.2.3 APPLICATION OF SCREENING

- a. After the coarse aggregate has been rolled as described in Clause 5.2.2, 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.
- b. 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.
- c. 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 as 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.
- d. The quantity of screenings used shall be such as to fill all voids in the water bound macadam courses.

5.2.4 SPRINKLING AND GROUTING

After spreading the screening, 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 the sub-grade does not get

damaged due to the addition of the excessive quantity of water during the construction.

5.2.5 APPLICATION OF BINDING MATERIAL

- a. 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 an 8-10 tone 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 the 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.

- b. The quantity of binding material used shall be such as to fill all voids in the water bound macadam.

5.2.6 SETTING AND DRYING

After final compaction of the course, the layer shall be allowed to dry overnight. Next morning, hungry spots shall be filled with screenings or binding material as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam has set.

5.2.7 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 Engineer-in-Charge. The specification and mode of measurement for subsequent layers of WBM will be similar to that described before.

6.0 CONSTRUCTION OF SHOULDERS OR BERMS

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 up to 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 compacted by suitable means to prevent edge slips and the work properly trimmed and dressed.

7.0 PAYMENT

This clause shall apply to item rate tenders only.

7.1 FILLING IN EMBANKMENT, SUB GRADE AND SHOULDERS

7.1.1 Payment for filling shall be made on cubic meter of volume calculated on the basis of cross section plotted from the level of the ground surface prepared as described in clause 3.2 above and from where filling is to be carried out and the levels reached after filling and due consolidation.

7.1.2 Rates for embankment, shoulder or fill formation shall include cost of breaking clods, watering, consolidation, providing testing apparatus and testing the degree of consolidation, providing and operating, including POL and operator charges of necessary road rollers and other equipment, dressing and levelling of sides and top surfaces etc.

7.2 FILLING WITH SAND / MURRUM

Payment for sand/murum filling shall be made on the basis of volume of fill, after placement and compaction. The rate quoted shall include cost of sand/murum, royalties, transportation, handling, compacting, watering, testing at various stages, dressing, removal of surplus material and any other work incidental to this.

7.3 WATER BOUND MACADAM SUB BASE/ BASE COURSE

Paying for laying WBM shall be made on square meter basis of each layer of WBM laid, measured after consolidation and finishing. Rate shall include supply of all materials, royalty, taxes, handling, transportation, spreading metal in layers, including screenings, consolidation by power roller, binding with murum or other approved binding material, cost of carrying the material to work for all leads and lifts, providing and running roller etc. complete as per specifications and satisfaction of Engineer-in-Charge.

7.4 SUBSEQUENT LAYERS OF WBM

Payment for surface preparation, rectification of damaged portions of proceeding layers of water bound macadam and filling in ruts and depressions shall be made in M² or M³ as % per schedule of items. Payment for subsequent layer of WBM shall be made on M² basis as per Cl. No.5.2.6.



Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR CONCRETE PAVEMENT

VCS-SS-CS-6006

					
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ABBREVIATION

m	Metre
mm	Millimetre
cm	Centimetre
IS	Indian Standard
IRC	Indian Road Congress
m ²	Square metre
WBM	Water Bound Macadam
RCC	Reinforcement Cement Concrete
PCC	Plain Cement Concrete
M.S	Mild Steel
°C	Degree Celsius
BS	British Standard
Cl.	Clause

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1.0 SCOPE

This specification establishes the requirements of material, laying and finishing of concrete pavements.

2.0 REFERENCES

2.1 BIS CODES

IS: 456	:	Plain and Reinforced Concrete-Code of Practice.
IS: 1834	:	Specification for Hot Applied Sealing Compounds for Joints in Concrete.
IS: 1838	:	Part-1-Specification for Preformed Fillers for Expansion Joints in Pavements and Structures (Non Extruding and Resilient Type): Part 1 Bitumen Impregnated Fiber.
IS: 2720	:	Part-8-Method of Test for Soils-Part 8: Determination of Water Content-Dry Density Relation Using Heavy Compaction.
IS: 9214	:	Method of determination of modulus of sub-grade reaction (k value) of soils in the field.

2.2 VCS SPECIFICATIONS

VCS-STD-CS-6018	RCC pavement details
VCS-SS-CS-6007	Standard specification for roads and flexible pavement
VCS-SS-CS-6004	Standard specification for roads and flexible pavement (Up to WBM layer)
VCS-SS-CS-6021	Standard specification Materials
VCS-SS-CS-6023	Standard specification for plain and reinforced cement concrete

NOTE: - Latest Edition of all Codes and Standards shall be followed.

3.0 MATERIALS

For specification of materials, VCS document no. VCS-SS-CS -6021 shall be followed.

4.0 GRADES, TYPE OF CONCRETE MIX, PROPORTIONING AND BATCHING

4.1 The grades of concrete shall be as follows:

Type-I Pavement	-	M30
Type-II Pavement	-	M25
Type-III Pavement	-	M25

- 4.2 Specification for Concrete mix, Mix Proportioning and Batching shall be as described in Specification no. VCS-SS-CS -6023 and IS: 456.

5.0 EQUIPMENTS

All equipment's like sub grade templates, hand tempers, vibrating screens, internal vibrators, longitudinal floats, bridges, push brooms, straight edges, edging tools etc. shall be on the worksite in first class working condition and shall have been inspected by the Engineer-in-Charge 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.

6.0 PREPARATION OF SUB GRADE

- 6.1 The area where concrete 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 95% 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.
- 6.2 For areas, where pavement is to be laid on cutting / natural grade level, Sub grade shall be thoroughly compacted to 95% of laboratory dry density as per IS: 2720 Part VIII. For filled up areas, top 450 mm of the soil shall be compacted to 95% of laboratory dry density below pavement in layers of 150 mm.
- 6.3 The difference between the sub grade levels of Type-I, Type-II and Type-III Concrete pavements (due to difference in thickness of Type-I, Type-II and Type-III pavements) shall be achieved by stripping the grade level and not by filling. Hence, site-grading level below pavement shall be kept up to sub grade level of Type-II or Type-III as the case may be, to avoid filling of smaller thickness at later stage.
- 6.4 The sub grade or sub base for laying of the concrete pavement shall comply with the following requirements:
- 6.4.1 No soft spots shall be present in the sub grade.
- 6.4.2 The uniformly compacted sub grade or base course shall extend at least 300mm on either side of the area to be concreted.
- 6.4.3 The sub grade shall be properly drained.
- 6.4.4 The minimum modulus of sub-grade, in wet condition, reaction obtained with a Plate Bearing Test as per IS: 9214 shall be 6.0 Kg/cm².
- 6.4.5 Sub grade shall be prepared to the lines and grades to match with the slope of pavement as shown on the drawings.

7.0 PREPARATION OF SUB BASE

- 7.1 WBM under Type - 1 Pavement (Ref Drawing no. VCS-STD-CS-6018)

WBM Base Coarse shall consist of 2 layers of WBM Gr.-II, each of 75mm compacted thickness, as per IRC-19 and described in Specification no. VCS-SS-CS -6004

- 7.2 PCC 1:5:10 under Type-II and Type-III Pavement (Ref. Drawing no. VCS-STD-CS - 6018)
- 7.3 PCC 1:5:10 in sub base layer shall be as described Specification no. VCS-SS-CS -6023
- 7.4 Sub Base layer shall be prepared to the lines and grades to match with the slope of pavement as shown on the drawings.
- 7.5 No concrete shall be placed around manholes or other structures until they have been brought to required grade and alignment. All sides of manholes / pits etc. shall have same elevation.
- 7.6 The sub base layer shall be in moist condition at the time of concrete placement.

8.0 FORMS

- 8.1 All side Forms shall be of mild steel unless use of wooden sections is specially permitted. The steel forms shall be of MS channel sections and their depth shall be equal to thickness of the pavement. The sections shall have a length of at least 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.
- 8.2 The forms should be in a sufficient number and they should not be removed until concrete has hardened sufficiently.
- 8.3 In case wooden forms are permitted, these shall have minimum base width of 100 mm for 150mm or lesser thick slabs and 150mm for 200mm thick slabs.

9.0 LAYING OF REINFORCEMENT, MIXING, PLACING, COMPACTION & FINISHING AND CURING

9.1 LAYING OF REINFORCEMENT

All reinforcement work shall confirm to IS: 456 and as described in Specification no. VCS-SS-CS -6023

9.2 MIXING

Mixing shall be as described in Specification no. VCS-SS-CS-6023.

9.3 PLACING

- 9.3.1 The place where concrete is to be poured should be clean and free from all loose dirt, wooden pieces, dust, standing water etc.
- 9.3.2 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 it sag during carriage and placement of concrete.

9.3.3 Placing and vibration should not take totally more than 20 minutes from time of mixing. Method of placing should be got approved by Engineer-in-Charge. Segregation during carriage and placement should be avoided. If during carriage concrete segregates, it should be remixed before placement.

9.3.4 Concrete should not be dropped from a height of over 1.5m.

9.3.5 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.

9.3.6 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 Engineer-in-Charge continuously until completion of the part of the work between construction joints or as directed by Engineer-in-Charge.

9.3.7 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 proportioning 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.

9.3.8 All concreting placement should be co-coordinated with placement of conduits, inserts, embedded parts etc. executed either by same agency or separately.

9.3.9 Concrete shall be laid in panels as shown in the standard drawing or as directed by Engineer-in-Charge.

9.4 COMPACTION & FINISHING

9.4.1 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 pavement is very small, hand consolidation and finishing shall be done as follows:

- 9.4.1.1 Concrete as soon as placed, shall be struck off uniformly and screeded 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.
- 9.4.1.2 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 is compaction and screeding to the approximate level required. Subsequent tamping should advance 75 mm at a time in the direction in which the work is proceeding and in final stages, the tamping should be closer, about 12 mm at a time, until a level and dense surface is obtained.
- 9.4.1.3 If so directed by Engineer-in-charge, hand operated vibrating tamper consisting of normal type of hand tamper attached to a pneumatic or electric vibrating unit shall be used for compaction.
- 9.4.1.4 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.
- 9.4.1.5 Compaction by tamping shall be carried on till the mortar in the mix just works up to the surface. The surface shall be examined after compaction correction. If needed correction shall be made by adding or removing concrete, followed by further compaction and finishing.
- 9.4.2 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 75 mm wide, operated from a foot bridge.
- 9.4.3 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.
- 9.4.4 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.
- 9.4.5 EDGING
- Before the concrete has its initial set, the edges shall be carefully finished with an edge of the radius required and pavement edge shall be left smooth and true to line.

9.5 CURING

Curing of concrete shall be as described in Specification no. VCS-SS-CS-6023.

10.0 JOINTS

10.1 Wherever called for on the drawings, expansion joints, construction joints and sealing joints shall be provided as per details indicated in the drawing and as directed by Engineer-in-Charge.

10.2 SEALING OF JOINTS

10.2.1 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 as conforming to IS: 1834, Type B. The filler material for Expansion and Sealing joints shall be preformed fillers of Bitumen Impregnated Fiber, conforming to IS: 1838, Part-I.

10.2.2 The edges of the joints shall be thoroughly cleaned and primed with a thin bituminous paint, which shall be allowed to dry before the sealing compound is applied.

10.2.3 The primer shall be applied with a brush. The composition of primer shall be as follows:

S.no.	Name Of Material	Percentage by weight
1.	200-Penetration Bitumen Blended	66
2.	Light creosote oil Hot/Cold	14
3.	Solvent Naphtha	20

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°C and the temperature does not exceed 180°C for long periods.

10.2.4 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.

11.0 OPENING TO TRAFFIC

11.1 Traffic shall not be allowed for a period of 28 days after laying of concrete in pavement.

11.2 Before opening the pavement to traffic, all joints shall be filled and trimmed or topped out as required.

11.3 Sampling, testing and acceptance of concrete work shall be according to IS: 456-2000

12.0 METHOD AND BASIS FOR PAYMENT

12.1 PLAIN AND REINFORCED CONCRETE

This clause shall be applicable for item tender rate only.

12.1.1 Payment for plane and reinforced concrete in pavements shall be made on cubic meter basis of the volume of the actual finished work done and shall be inclusive of cost of providing Forms, Pockets, Chamfers, Fillets, Grooves, Cement wash, Curing by normal moist curing or using curing compound etc. as directed by Engineer-in-Charge. The rates shall be deemed to include complete cost of getting the respective mix designs approved, making and testing concrete cubes and carrying out other tests including tests of various ingredients, as per specifications and as directed by Engineer-in-Charge.

12.1.2 No separate payment shall be made for any admixture used by the contractor for accelerating or retarding the strength of concrete or for achieving specified workability / water tightness. The rate quoted shall be deemed to be inclusive of all costs related to any such additive / admixture.

12.1.3 The rate shall however be exclusive of reinforcement, metal inserts, pipe sleeves and any filler material in expansion / sealing joints.

12.1.4 Where the strength of concrete mix (nominal or design mix) as indicated by tests, lies in between the strengths of two grades given in VCS Specification no. VCS-SS-CS-6023 and it is accepted by owner/Engineer-in-charge, such concrete shall be classified as a grade belonging to the lower of the two grades between which it lies. In case the cube strength shows higher results than those specified for the particular grade of the concrete, it shall not be placed in the higher grade nor shall the Contractor be entitled for any extra payment on such account. The concrete giving lower strength than specified may be accepted at reduced rates after satisfying the safety of the structure by checking it with tests as specified or rejected entirely at the discretion of the Engineer-in Charge. The rejected concrete shall be dismantled at no extra cost to the owner and no payment or extension of time shall be granted for the concrete so rejected and the formwork and reinforcement used for the same. Cost of any material supplied by the Owner free of cost shall be recovered from the contractor at double the prevailing market rate. In case the concrete of lower strength can be improved by carrying out some strengthening measures entirely at the discretion of the Engineer-in-Charge, then Contractor shall carry out the said measures including all related tests at his own cost. If the Contractor is able to make up the strength to the required grade by such improvement measures to the entire satisfaction of Engineer-in-Charge, payment shall be made for the grade achieved. However, if the strength of concrete is not made up to the strength of required grade, payment shall be made only for the lower strength if such concrete is accepted by the Engineer-in-Charge.

12.1.5 Deductions for openings, pockets etc. shall be as specified in relevant Indian Standard Codes.

12.2 REINFORCEMENT

12.2.1 Payment for plain round mild steel reinforcement bars and high strength deformed steel bars shall be on the basis of weight of bare steel, irrespective of any coating applied, in metric tons. The weight of the bar shall be derived from the sizes and corresponding unit weights given in hand book of Bureau of Indian Standards. Standard hook length, chairs, spacer bars and authorized laps only shall be included in the weight calculated. Binding wire shall not be weighed nor otherwise measured. Measurement for weight shall not include cutting allowance etc.

12.2.2 Rate quoted for reinforcement shall include cost of supplying, de-coiling, straightening, cleaning, cutting, bending, placing, binding, welding if required, and providing necessary cover blocks of concrete.

12.3 JOINTS

Payment for expansion joints, construction joints and sealing joints shall be made on running meter basis. The rate shall include cleaning of joints, filler material and sealing with approved compound, all material, labour etc. complete, as per drawing.



Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR FLEXIBLE PAVEMENT WITH BITUMEN PREMIX CARPET

VCS-SS-CS-6007

					
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ABBREVIATION

m	Metre
mm	Millimetre
cm	Centimetre
IS	Indian Standard
IRC	Indian Road Congress
m ²	Square metre
m ³	Cubic metre
Kg	Kilogram
Kg/m ²	Kilogram per Square Metre
Cm/yr	Centimetre per year
MOST	Ministry of Surface Transport

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1.0 SCOPE

This specification establishes the material, construction requirements and procedures for the flexible pavement with open-graded bitumen premix carpet.

2.0 REFERENCES

2.1 CODES & STANDARDS

IS: 73	Paving bitumen
IS: 269	Ordinary Portland cement, 33 grade
IS: 2116	Sand for masonry mortars
IRC: 37	Guidelines for the Design of Flexible Pavements

2.2 SPECIFICATIONS

Specifications for Road and Bridge Works - Ministry of Surface Transport (Road Wing)

NOTE: -Latest Edition of all Codes, Standards and Specifications shall be followed.

2.0 MATERIAL

3.1 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. The aggregates shall conform to the physical requirements specified in Table 500.3 of MOST Specification except that the water absorption shall be limited to 1% maximum.

3.2 SAND

The sand for seal coat 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. The sand shall pass 2.36mm sieve and be retained on 180micron sieve.

3.3 BINDER

The binder shall be bitumen of S65 (Grade 60/70 penetration) for Hot/ Moderate climate or S90 (Grade 80/100 penetration) for Cold climate (high altitude and snow bound regions). Physical and Chemical properties of Paving Bitumen shall be as per IS: 73. The bitumen shall be collected in drums. Any leaking or damaged drum shall not be accepted.

4.0 QUANTITIES OF MATERIAL (PREMIX CARPET)

4.1 FOR PREMIX CARPET 20MM THICK

S. no.	Material	For Premix Carpet per100m ²	For seal coat per100m ²
1	Coarse aggregate 12mm and down size	2.75m ³	-
2	Bitumen	150 Kg	68.3 Kg
3	Coarse sand as sealing aggregate	-	0.6 m ³

4.2 FOR PREMIX CARPET 25MM THICK

S. no.	Material	For Premix Carpet per100m ²	For seal coat per100m ²
1	Coarse aggregate 12mm and down size	3.5m ³	-
2	Bitumen	185 Kg	68.3 Kg
3	Coarse sand as sealing compound	-	0.6 m ³

4.3 FOR PREMIX CARPET 50MM THICK

S. no.	Material	For Premix Carpet per100m ²	For seal coat per100m ²
1	Coarse aggregate 25mm and down size (For 35mm thick carpet 1 layer)	5.5m ³	-
2	Coarse aggregate 12mm and down size (For 15mm thick carpet layer)	2.0m ³	-
3	Bitumen		

	a) For 35mm thick Carpet (1 layer)	269 kg	68.3 kg
	b) For 15mm thick Carpet (II layer)	110 kg	-
4	Coarse sand as sealing aggregate	-	0.6 m ³

4.4 FOR PREMIX CARPET 75MM THICK

S. no.	Material	For Premix Carpet per100m ²	For seal coat per100m ²
1	Coarse aggregate 25mm and down size (For 50mm thick 1 layer)	8.5m ³	-
2	Coarse aggregate 12mm and down size (For 25mm thick II layer)	3.5m ³	-
3	Bitumen		
a	For 50mm thick (1 layer)	375 kg	68.3 kg
b	For 25mm thick (II layer)	185 kg	-
4	Coarse sand as sealing aggregate		0.6 m ³

5.0 LAYING

5.1 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 2mm 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 Engineer-in-charge.

If pot holes or ruts are found on the existing road surface, these irregularities must be filled in with premix chippings and well rammed about a week before the carpet is laid.

5.2 TACK COAT

5.2.1 The binder shall be heated to the temperature appropriate to the grade of cutback bitumen /bituminous emulsion used and approved by the Engineer-in-Charge at the rate of 1 kg /m² by means of sprayers and shall be spread uniformly. The normal

range of spraying temperature shall be 500 - 80° C for cutback of grade RC-70 / MC-70 and for bituminous emulsion 20° - 60° C.

- 5.2.2 The tack coat shall be applied just ahead, keeping pace with laying of premix carpet.

5.3 PREPARATION OF PREMIX

- 5.3.1 Mechanical mixers shall be generally used for preparation of premix. Improvised hand mixing drums may be used, if permitted by the Engineer-in-charge.
- 5.3.2 Stone chippings of specified size shall be thoroughly mixed dry in the mixer at the rate indicated above. Binder heated at a temperature 150°C-163°C and aggregates in the range of 155°C-163°C are added in the given proportions to the mixer drum and thoroughly mixed till the stone chips are completely coated with the binder. The discharge temperature of the mix shall be between 130 °C and 160 °C.
- 5.3.3 The premix mixture shall be transported from mixing plant to the work site in suitable tripper vehicles.

5.4 SPREADING OF PREMIX

The mix transferred from the tipper trucks at site to the paver shall be spread immediately by means of self-propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix true to the specified lines, grades and cross sections.

The mix shall be spread in such a manner that after compaction, the required thickness of the premix carpet is obtained. The camber should be checked by means of camber boards and irregularities leveled out. .

However, in restricted locations and in narrow widths where the available paver cannot be operated in the opinion of Engineer-in-Charge, manual laying of mix may be permitted.

5.5 ROLLING

- 5.5.1 When the premix has been laid for a length of 15-20 meters, rolling shall be commenced with tandem rollers (8 to 10 tones). Rolling should commence from edges and proceed towards centre longitudinally except that on super elevated and unidirectional cambered portions, it shall progress from the lower to the upper edge parallel to the centerline of the pavement. The roller shall move at a speed not more than 5Km/hr.
- 5.5.2 The wheels of roller shall be continuously moistened to prevent the premix adhering to the wheels and being picked up.
- 5.5.3 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.

- 5.5.4 Rolling operation shall be completed in every respect before the temperature of the mix falls below 100 °C. Roller shall not remain stationary on freshly compacted surfaces.

5.6 SEAL COAT

5.6.1 Seal Coat (For low rainfall areas - under 150 cm/yr)

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 4.

5.6.2 Seal Coat (For high rainfall areas- over 150 cm/yr)

The material requirement for seal coat in high rainfall areas is as under:-

Binder 80/100 = 98 kg /100m² of road surface

Coarse aggregates

6.3mm passing IS 10mm

Square mesh, retained on

IS sieve 2.36mm = 0.9m³/100m² of road surface.

A liquid seal coat, preferably with chippings as above (though coarse sand can also be used) should be applied after laying the carpet. The binder after being 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.

6.0 REMOVAL OF SURPLUS EARTH

- 6.1 Surplus earth and soil from excavation shall be removed from construction area to the area demarcated by the Engineer-in-charge.
- 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.

7.0 BRICK PITCHING ON EMBANKMENT SLOPES

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 and 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.
- 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 450 to the length of the ditch as shown in drawings.
- 7.7 Mortar joints shall never exceed 6mm 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 as required to close any line of bricks.
- 7.9 The face of pitching shall be made even and smooth.
- 7.10 The brickwork shall be raked and flush pointed with cement mortar 1:3 as specified.

8.0 PAYMENT

This clause shall be applicable for item tender rate only.

8.1 BITUMEN PREMIX CARPET

Payment shall be made on square metre (m²) basis of finished surface including all labour & materials as per above specifications.

8.2 BRICK PITCHING

Payment for brick pitching shall be made on the basis of area paved. It shall include all operations described above, except the excavation item.



Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR RCC PIPE CULVERTS & ERC CROSSING

VCS-SS-CS-6008

					
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ABBREVIATION

m	Metre
mm	Millimetre
IS	Indian Standard
IRC	Instrumentation Road Crossings
ERC	Electrical Road Crossings
PVC	Poly Vinyl Chloride
RCC	Reinforcement Cement Concrete

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1.0 SCOPE

The scope of this specification covers R.C.C pipe culverts and ERC/ IRC crossings with RCC or PVC pipes.

2.0 REFERENCES

2.1 BIS CODES

- IS: 458 : Precast Concrete Pipes (with and without reinforcement)
- IS: 783 : Code of practice for laying of RCC pipes
- IS: 4985 : Un-plasticized PVC pipes for potable water supplies

NOTE:- Latest Edition of all Codes and Standards shall be followed.

2.2 SPECIFICATIONS

- VCS-SS-CS-6002 Earthwork for Site Grading
- VCS-SS-CS-6003 Earthwork for underground piping
- VCS-SS-CS-6022 Earthwork in Foundations

3.0 MATERIALS

- 3.1 All pipes must be new and perfectly sound, free from cracks, cylindrically straight and of standard nominal diameter and length, with even texture. RCC Pipes shall be of collar type only and each pipe shall have one collar with it. PVC Pipes shall be Class-I as per IS: 4985.

For pipe culverts, class of RCC pipe shall be NP3 / NP4 or as mentioned in the drawings.

- 3.2 The Contractor shall submit manufacturer's test certificate for acceptance of RCC/PVC pipes.
- 3.3 Spun yarn for pipe joints shall be of best quality. It shall be free from dust etc.

4.0 TRANSPORTATION AND STACKING

- 4.1 The transportation of materials to the worksite and stacking shall be done in a manner to cause minimum inconvenience to the traffic and other construction work.
- 4.2 The pipe shall be protected during handling against impact, shocks and free fall to avoid cracks and damage.
- 4.3 The Contractor shall be fully responsible for the safety and security of materials transported and stacked in the field.

4.4 EARTHWORK

Refer standard VCS-SS-CS-6002, VCS-SS-CS-6022 for earthwork.

5.0 LOWERING AND LAYING OF RCC PIPES

5.1 GENERAL

The laying and jointing of RCC pipes shall confirm to IS: 783. Pipes shall be jointed by collar joints.

The trench shall be checked for proper level, grade and alignment before lowering the pipes.

5.2 LOWERING

The RCC pipe shall be lowered cautiously to prevent disturbance to the bed and sides of the trench. The heavy RCC pipes shall be lowered by means of proper tripods, chain pulley blocks or as directed by Engineer-in-charge. Great care should be taken to prevent sand etc. from entering the pipes.

5.3 LAYING

5.3.1 Laying of RCC pipes shall proceed upgrade of slopes.

5.3.2 The error of grade shall not be rectified by packing up earth underneath the pipe. If required, concrete shall be used for packing.

5.3.3 The end of RCC pipes shall be kept closed to keep dirt, mud and foreign materials out. Adequate provision shall be made to prevent floating of pipes in the event of flooding of trenches.

The body of RCC 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.

5.4 JOINTING OF RCC PIPES

5.4.1 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. The collar shall then be slipped over the joint covering equally both the pipes. Spun yarn soaked 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 center the two ends of the pipes within the collar and to prevent the cement mortar of the joint penetrating into the pipes.

5.4.2 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 hand 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 45°

- 5.4.3 Any surplus mortar projecting inside the joint is to be removed and guarded against any damage. Sack or gunny bags shall be drawn past each joint after completion.

5.5 CURING

The Cement mortar joints in RCC pipes shall be cured at least for seven days.

5.6 TESTING

All joints in culvert pipelines shall be tested to a head of 1.5 m of water above the top of the highest pipe, if required, by Engineer-in-Charge.

5.7 PAYMENT

This clause shall be applicable for item tender rate only.

Payment shall be made on running meter basis, which includes supplying, transporting, lowering, laying, jointing and curing, concreting around RCC pipes etc., all complete.

6.0 LOWERING AND LAYING OF PVC PIPES

- 6.1 Lowering and laying of PVC pipes shall be done as per IS: 4985. The jointing of the pipes shall be done by expanding one end after heating and using solvent cement.

6.2 PAYMENT

Payment shall be made on running meter basis of PVC pipes, which includes supplying, transporting, lowering, laying and jointing, concreting around PVC pipes etc., all complete.



Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR GRAVEL FILLING

VCS-SS-CS-6010

					
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ABBREVIATION

m	Metre
mm	Millimetre
IS	Indian Standard
SOR	Schedule of Rates
HDPE	High Density Polyethylene
HM	High Molecular

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1.0 SCOPE

This specification covers gravel filling over PE Film in open areas, within unit battery limits or at any other location.

2.0 REFERENCES

2.1 BIS CODES

IS: 383	Specification for coarse and fine aggregates from natural sources for concrete
IS: 2720 Part VII	Methods of tests for soils, Part 7, Determination of water content - dry density relation using light compaction
IS: 10889	Specification for HDPE films

2.2 VCS SPECIFICATIONS

VCS-SS-CS-6002	Earthwork in Site Grading
VCS-SS-CS-6022	Earthwork in Foundations

NOTE: - Latest Edition of all Codes and Standards shall be followed

3.0 MATERIAL

3.1 GRAVEL

- 3.1.1 The material to be used for gravel filling shall be either gravel or hard durable crushed stone from source/ quarries approved by Engineer-in-charge. It shall be free from flat, elongated, soft and disintegrated particles without any fissures. It shall also be free from clay and weathering action. The size of gravel/ crushed stone shall range from 27 mm to 50 mm.
- 3.1.2 The gravel/ crushed stone shall be stacked by the side of gravel fill area on firm, well drained ground in regular stacks, as directed by Engineer-in-charge and contamination by earth and other extraneous matter shall be prevented effectively.

3.2 FILM SPECIFICATION

Film specification shall be generally as per IS: 10889. The various requirements shall be as follows:

a.	Material	:	HM HDPE Grade-I
b.	Appearance	:	Uniform in color, texture and finish. No visible defects, free from un-dispersed raw material, streaks and foreign matter particles
c.	Film form	:	In flat sheets or rolls

d.	Odour	:	Free from objectionable odour.				
e.	Density (mass)	:	<table border="0"> <tr> <td>i</td> <td>180 gms/ sq.m.(for film)</td> </tr> <tr> <td>ii</td> <td>0.954 gms/ ml @ 27° ± 2°C.(for compound)</td> </tr> </table>	i	180 gms/ sq.m.(for film)	ii	0.954 gms/ ml @ 27° ± 2°C.(for compound)
i	180 gms/ sq.m.(for film)						
ii	0.954 gms/ ml @ 27° ± 2°C.(for compound)						
f.	Film thickness	:	600 gauge (0.15mm) minimum or more to achieve above density.				
g.	Melt flow index	:	As per clause no. 4.1.5 of IS: 10889				
h.	Tensile strength at break						
	Machine direction	:	300 kgf/cm ²				
	Transverse direction	:	250 kgf/cm ²				
i.	Elongation at break						
	Machine direction	:	300 %				
	Transverse direction	:	300 %				
j.	Yield tolerance	:	As per clause no.4.3 of IS:10889				
k.	Impact resistance (falling dart) for 600 gauge (.006")	:	Less than 420 gf				
l.	Water penetration	:	Nil				
m.	Carbon black content	:	2.5±0.5% by mass				
n.	Nominal width	:	5 to 10 m				
o.	Joint breaking strength	:	10KN/m				

4.0 CONSTRUCTION DETAILS

4.1 PREPARATION OF SUB GRADE

The area to be filled with gravel shall be cleared of all loose material and virgin soil shall be exposed. Such exposed surface shall be consolidated properly to obtain 90% of maximum laboratory dry density of the soil as per IS: 2720 Part VII. All soft patches shall be worked out to remove the soft soil and selected approved earth shall be filled back and compacted. The sub grade shall be free from sharp objects such as stone, weed roots etc. and shall be smooth without any depressions and humps etc. The surfaces so prepared shall be leveled and sloped as per drawings, for effective drainage.

4.2 FILM LAYING

The film shall be spread over the prepared sub grade and laid loose so as to provide for the thermal contraction etc. The adjacent layer of film should be jointed firmly. A minimum of 200 mm overlap and jointing by heat sealing shall be done. The loose ends of the film shall be firmly anchored at the ends as per the instructions of the Engineer-in-Charge. The joints of the film shall be kept to the minimum.

4.3 GRAVEL FILLING

- 4.3.1 The gravel / crushed stone aggregate shall be spread uniformly and evenly, on the prepared base covered with film, in required quantities from the stacks. The aggregate shall be spread to proper profiles and slopes / gradients, in such a way that it will not damage or pierce the film.
- 4.3.2 The surface of the aggregate spread shall be carefully trued up and all high and low spots remedied by removing or adding aggregates, as may be required. The thickness of layer of aggregate so spread shall be 100mm.

5.0 PAYMENT

This clause shall be applicable for item tender rate only.

- 5.1 Payment of gravel filling shall be made on the basis of area covered with 100mm thick (or as specified in Item description in SOR) layer of gravel / crushed stone. The rate quoted shall include cost of PE Film, gravel / crushed stone, transportation, handling, laying & dressing etc. over consolidated and exposed ground including the cost of clearing and stripping, leveling, consolidation, watering, testing of exposed ground, removal of waste / surplus earth within plant battery limit and covering of prepared sub base with film etc., as directed by Engineer-in-charge, all complete.
- 5.2 Payment for the removal of loose top soil, as described in Cl. 4.1 above, shall be included in the item for gravel filling. No separate payment for consolidation of exposed ground surface shall be made.



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VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR MISC. CIVIL & STRUCTURAL WORKS FOR UNDERGROUND SERVICES

VCS-SS-CS-6011

					
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ABBREVIATION

m	Metre
mm	Millimetre
cm	Centimetre
IS	Indian Standard
m ²	Square metre
U/G	Underground
CI	Cast Iron
M.S.	Mild Steel

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1.0 SCOPE

This specification covers the material and construction details for various civil works as given below:

- a. All earthworks except for Site Grading and U/G 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 Engineer-in-charge 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 Engineer-in-charge and shall get it approved before procurement and use.

2.0 REFERENCES

2.1 BIS CODES

- IS: 5455 Cast Iron Steps for man holes
- IS: 3502 Steel Chequered Plates
- IS: 2062 Hot Rolled medium and High tensile structural steel
- IS: 1726 Cast Iron Manhole covers and frames
- IS: 1239 Specification for Steel tubes, Tubulars and Other wrought steel fittings

2.2 SPECIFICATIONS

VCS-SS-CS-6002, VCS-SS-CS-6003, VCS-SS-CS-6022 Earth work

VCS-SS-CS-6023 Plain and Reinforced Cement Concrete

VCS-SS-CS-6027 Brick Masonry

VCS-SS-CS-6043 Plastering & Pointing

3.0 EARTHWORK & BACKFILLING

3.1 Refer specification no VCS-SS-CS-002, VCS-SS-CS-003 & VCS-SS-CS-022

4.0 PLAIN AND REINFORCED CEMENT CONCRETE

4.1 Refer specification No. VCS-SS-CS-6023

5.0 BRICK WORK

Refer specification no. VCS-SS-CS-6027

6.0 CEMENT PLASTERING

6.1 MATERIALS

The specifications for cement, sand and water shall be as given in spec. No. VCS-SS-CS-6021 Cement mortar shall be of grade and thickness specified in drawing or as directed by the Engineer-in-Charge, 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 12mm 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 directed by Engineer-in-Charge.

6.2 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 25mm unless otherwise specified.

6.3 The plaster shall be protected from sun and rain by such means as the Engineer-in-Charge may approved. The plaster shall be cured for 7 days.

6.4 Construction joint shall be kept in plastering work at places approved by Engineer-in-Charge.

6.5 PAYMENT

This clause shall apply to item rate tender only.

6.5.1 Payment for plastering shall be made on basis of the area of surface plastered, measured before plastering. All Measurements shall be separately made for each face of walls.

- 6.5.2 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 up to 30 cm width.

7.0 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 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.

8.0 CHEQUERED PLATES & STRUCTURAL STEEL WORKS

Chequered plates shall be 6mm (7mm 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 directed by Engineer-in-Charge. The edges shall be made smooth, no burrs or gagged ends shall be left. The plates may be spliced with prior consent of the Engineer-in-Charge. 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 M.S flats, angles and rounds etc., as per drawings and as approved by Engineer-in-Charge. 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.

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 30mm square and the rate shall include making of opening of all sizes and supplying 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.

9.0 C.I. MANHOLE FRAME AND COVER

C I manhole frame and covers shall conform to IS: 1726 with size and grade as shown in drawing.

10.0 VENT PIPES

These shall be M.S. Black Steel Tube conforming to IS: 1239 Medium grade or as specified in drawing. The pipe bends shall be embedded in 1:3:6 grade cement concrete or as shown in drawing.

All pipes shall be 25mm clear of wall or column with M.S. holder bat clamp as per instructions of the Engineer-in-Charge. 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.

11.0 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 fabric action shall be in accordance with the approved drawing.

Payment for these items shall be made on weight basis and rate shall include fabrication, erection, welding jointing and painting etc. all complete.

12.0 BRICK BAT FILL

- 11.1 The brick bats used as filling in valve pits shall be from common burnt clay building bricks. A sample of brickbats used shall be got approved from Engineer-in-charge.
- 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 m2 basis as shown in drawing and the rate shall include supply, laying, compacting etc. complete with all materials & labour.



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VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR PLUMBING AND DRAINAGE

VCS-SS-CS-6012

					
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ABBREVIATION

m	Metre
mm	Millimetre
CM	Cement Motar
IS	Indian Standard
CP	Chrome Plated
M.S.	Mild Steel
G.I.	Galvanised Iron
Kg	Kilogram
Kg/cm ²	Kilogram Per Square Centimetre
Psi	Pounds Per Square Inch
HCI	Heavy Cast Iron
CI	Cast Iron

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1.0 SCOPE

- 1.1 This specification is intended to establish and define the materials and constructional requirements for plumbing & building drainage work.
- 1.2 All materials, fixtures and workmanship shall be in accordance with the relevant Indian Standard, specifications and codes of practices.

2.0 REFERENCES

2.1 BIS CODES

IS: 269	:	Ordinary Portland cement, 33 grade
IS: 554	:	Dimensions for pipe threads where pressure-tight joints are made on threads
IS: 651	:	Specification for Glazed Stoneware pipes and fittings
IS: 778	:	Copper alloy gate, globe and check valves for water works purposes
IS: 782	:	Specification for Caulking lead
IS: 1239	:	Mild steel tubes, tubulars and other wrought steel fittings
IS: 1726	:	Cast iron manholes covers and frames
IS: 1729	:	Cast Iron/Ductile Iron drainage pipes and pipe fittings for Over ground non pressure pipeline and spigot series
IS: 2470	:	Code of practice for installation of septic tanks
IS: 3486	:	Cast iron spigot and socket drain pipes
IS: 3950	:	Surface boxes for sluice valves
IS: 3989	:	Centrifugally cast (spun) iron spigot and socket soil, waste and Ventilating pipes, fittings and accessories
IS: 5455	:	Cast iron steps for manholes

2.2 VCS SPECIFICATIONS

VCS-STD-CS-6003	Details of Soak Pit
VCS-STD-CS -6004	Details of Septic Tank

NOTE: - Latest Edition of all Codes and Standards shall be followed.

3.0 H.C.I. NAHNI TRAP (FLOOR TRAP)

Nahni trap shall be of heavy cast iron as per IS: 3989 with 100mm inlet and 80/100mm 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, as directed by Engineer-in-Charge.

4.0 STONEWARE GULLY TRAP CHAMBER

The square mouth gully trap shall be of 100mm dia, conforming to IS: 651, of specified and/ or approved quality stoneware, complete with cast iron grating, and shall be got approved from Engineer-in-Charge. The size of CI frame and cover shall be of 300 x 300mm. It shall be properly fixed, as directed by the Engineer-in-Charge.

The size of the chamber shall be 300 x 300 x 675mm (internal). It shall be constructed of brick masonry walls, 125mm thick, in 1:4 cement mortar and M-20 concrete foundations. Inside & 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.

5.0 VALVE CHAMBER, INSPECTION CHAMBER & MANHOLES

The size and type of construction of valve chamber, inspection chamber and manholes shall be as specified in the drawings or items.

6.0 C.I. SOIL / WASTE PIPES

CI pipes shall be socket and spigot of standard quality conforming to IS: 1729. The supply shall include all necessary accessories e.g. bends, Y- Junction, T- Junction, including plugs, shoes, cowls etc. complete.

CI soil / waste pipe below ground or floor shall be encased with 50mm thick PCC M20 concrete.

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 37mm for 150mm dia pipes, 25mm for 100 mm and 50mm dia pipes. All pipes shall be fixed 25mm clear of the wall with MS bat clamps or as approved by the Engineer - in Charge. 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.

All CI pipes shall be painted with two coats of paint of approve make and shade over a coat of primer. Earthwork in excavation, backfilling and removal of surplus earth/ debris shall be considered as a part of the work. No separate payment shall be made for the same.

7.0 C.I. SOIL / WASTE VENT PIPES

CI pipes shall be standard quality conforming to IS: 1729. The supply shall include all necessary accessories e.g. bends, Y- Junction, T- Junction, including plugs, shoes, cowls 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 beveled off at angle of 45° with outside of the pipe. Cement used to join shall conform to IS: 269.

All holes in walls and floors shall be made good by cement concrete M- 15 grade. all soil and waste pipes shall be tested for leakage by hydraulic test.

All CI pipes shall be painted with two coats of anticorrosive bituminous paint externally.

8.0 GI PIPES AND FITTINGS

8.1 All G.I. pipes and fittings shall conform to IS: 1239 and shall be of heavy 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 with parallel thread.

All fittings shall be malleable galvanized iron, approved by the Engineer-in-Charge. Fittings in G.I. line shall include all couplings, elbows, tees, bends, unions, nipples, reducers, flanges with nuts, bolts and rubber insertions, bushes and all other fittings to make a complete job.

Screwed G.I. 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. White lead with a few strands of fine hemp shall be applied while tightening. Compounds containing red lead shall not be used.

All pipes above ground shall be fixed with G.I. holder bat clamps, clear off the wall, at 1.2 in centre to center. If the pipes are encased or embedded in wall, they shall be secured in position by iron hooks at 1.2 in centre to center. 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 Engineer-in-Charge. No extra payment shall be made for clamps, hooks, cutting holes in walls, chasing and making good the same.

All underground pipes shall have a minimum earth cover of 600mm or as directed by the Engineer-in-Charge. No extra payment shall be made for excavation in trenches,

backfilling the same and removal of surplus earth. Before any pipes are painted or covered up, they shall be tested to a hydrostatic pressure of minimum 6 kg/ Sqcm. or 1.5 times of Design Pressure.

8.2 TESTING

Testing of GI pipes shall be done in accordance with IS: 1239 (Part 1).

9.0 GUN METAL VALVE

All full way and globe valves shall be of heavy gunmetal and tested at 300 psi and shall be approved by the Engineer-in-Charge. 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 per clause 5.0 above. Valve chamber shall be provided & fixed with heavy duty C.I. surface box conforming to IS: 3950. The surface box shall be hinged pin open type & shall be fixed in the chamber slab. It shall have a hole for opening.

10.0 M.S. RUNGS/ C.I. STEPS

The rungs for pits, manholes and septic tanks etc. shall be made out of M.S. bars conforming to Indian Standard and to the shape and size as shown 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.

11.0 SOAK PITS

All earthworks in excavation, brick work etc. shall conform to relevant I.S. standard.

The brickbats should preferably be slightly over burnt or thoroughly well burnt, deep red in colour with some proportion of deep blue or black veins. Spongy or vitrified material, as a result of excessive over burning, is useless and shall be rejected. Brickbats bigger than specified size shall be reduced to required size (40 to 50mm) before filling in soak pit and no extra payment shall be made for this. It shall be stacked at site as directed by Engineer-in-Charge. Soak pit & septic tank shall be connected with required piping.

12.0 SEPTIC TANK

Septic tanks shall be provided as per drawings and directions of Engineer-in-Charge. The sizes shall vary depending on the no. of users.

Alternatively, readymade RCC pipe septic tank, consisting of sewage receiving chamber, inspection door, vent pipe, inlet & outlet connections, manhole cover, C.I. steps etc. shall be used.

Design, testing & commissioning shall conform to IS: 2470 Part-I.

Access opening shall be provided for desludging & inspection.

The ventilating pipe shall be provided with pipe of at least 50mm dia extended 2 meters above the nearest working platform level.

In case where water table is shallow and soak pits are not recommended, up-flow filters, as per drawings shall be provided.

13.0 PAYMENT

This clause shall apply to item rate tender only.

13.1 H.C.I. NAHNI TRAP (FLOOR TRAP)

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 etc. all complete.

13.2 STONEWARE GULLY TRAP CHAMBER

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, backfilling and removal of surplus earth up to a lead of 30m and labour and material etc. all complete.

13.3 VALVE CHAMBER, INSPECTION CHAMBER & MANHOLES

Payment shall be made as per number basis including excavation, backfilling, removal of earth, construction of the valve chamber, inspection chamber and manhole, making connections of pipes through the walls including grouting, cost of M.S. rungs, cover slab, cost of CI cover and frame etc. as per specifications and directions of the Engineer-in-Charge.

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 Engineer-in-Charge.

13.4 C.I. SOIL / WASTE PIPES

The payment shall be on running meter basis of pipes laid with fittings as required on site. The rate shall include supplying and fixing of pipes and necessary specials including cowl with hemp and lead, jointing & testing, bat clamps, fixtures, painting, cutting of walls, floor and making good the same and necessary scaffolding, encasing of pipes below ground or floor with 50mm thick PCC M20 concrete earth work in excavation, backfilling & removal of surplus earth etc. complete.

13.5 C.I. SOIL / WASTE VENT PIPES

The payment shall be on running meter basis of pipes laid. The rate shall 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.

13.6 GI PIPES AND FITTINGS

Payment shall be made on running meter basis of actual pipeline laid. In addition to the sectional testing of water supply piping, the contractor shall test entire installation on completion of the job, to the entire satisfaction of the Engineer-in-Charge. 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 G.I. pipes with necessary fittings, cutting of pipes to required lengths, threading, making holes in walls and floors and making good the same, jointing, painting, excavation and refilling including testing as directed by the Engineer-in-Charge.

13.7 GUN METAL VALVE

The payment shall be made per number basis, including surface box. The rate shall include, supplying and fixing valve & surface box in position, as per drawings and directions of Engineer-in-Charge.

13.8 M.S. RUNGS/ C.I. STEPS

Payment for rungs shall be made on per number basis and the rate shall include supply, fixing, finishing the walls, painting etc. all complete.

13.9 SOAK PITS

Payment of soak pit/ up flow filter shall be made per number basis. Rate quoted shall include brick masonry work, providing & filling brick bats, earthwork in excavation, backfilling, making inlet connection with pipe and connecting the same to septic tank etc. complete as shown in drawing.

13.10 SEPTIC TANK

Payment of septic tank shall be made per number basis & rate shall include all accessories like inlet, outlet, vent pipe, manhole cover & C.I. steps, earthwork in excavation & back filling, removal of surplus earth etc. all complete.



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STANDARD SPECIFICATION FOR CHAIN LINK FENCING

VCS-SS-CS-6013

					
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ABBREVIATION

m	Metre
mm	Millimetre
IS	Indian Standard

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1.0 SCOPE

This specification specifies the requirements of chain link fence for security purposes. The height of the fence shall be approximately 2.0 m to the top of the chain link fencing at the posts and approximately 2.5 m in vertical height at the top line of barbed wire attached to the cranked tops of the posts.

2.0 REFERENCES

IS: 278	Specification for galvanized steel barbed wire for fence fabric
IS: 383	Specification for coarse and fine aggregates for concrete
IS: 456	Plain and Reinforced Concrete - Code of Practice
IS: 2721	Specification for Galvanized Steel Chain Link Fencing

NOTE: - Latest Edition of all Codes and Standards shall be followed.

3.0 REFERENCE OF SPECIFICATIONS / STANDARDS

Following standard specification shall be enclosed as part of the job specifications.

Technical Specifications - Civil and Structural Works

General Scope	VCS-SS-CS-6020

Technical Specifications - Civil and Structural Works

Material	VCS-SS-CS-6021

Technical Specifications - Civil and Structural Works

Earth work in Foundation	VCS-SS-CS-6022

Technical Specifications - Civil and Structural Works

Plain & Reinforcement Cement Concrete	VCS-SS-CS-6023

Technical Specifications - Civil and Structural Works

Structural Steel Works	VCS-SS-CS-6024

Technical Specifications - Civil and Structural Works

Earthwork in Site Grading	VCS-SS-CS-6002

Details of Chain Link Fencing	VCS-STD-CS-6002

4.0 CEMENT CONCRETE FOR FOUNDATION & SILL

Refer specification no VCS-SS-CS-6023

5.0 CEMENT CONCRETE IN PRECAST POSTS/STRUTS

(Straining posts, intermediate posts and struts)

- 5.1 Pre-Cast Cement concrete shall be of M25 grade for moderate environment exposure condition and M30 grade for severe environment exposure condition with 20mm and down size crushed stone aggregates conforming to IS: 383.
- 5.2 The work shall be carried out as per IS: 456 in all respects.
- 5.3 Necessary moulds shall be provided for casting the concrete posts and the same shall be smooth finished with 1:3 cement sand mortar as directed by the Engineer-in-Charge.

6.0 REINFORCEMENT

Refer specification No. VCS-SS-CS-6023

6.1 MATERIALS

6.1.1 CHAIN LINK FENCING

The material requirement shall conform to IS: 2721 latest edition. The chain link fencing shall be woven from 3.15 mm dia wire with mesh size of 75 sq mm. The mesh wire shall not vary from the specified dia by more than ± 0.05 mm.

6.1.2 GALVANIZED WIRES

- a. All steel wires shall be hot dipped galvanized wire and dia of the wire shall be 3.15 mm over the galvanized coating.
- b. The line wire shall be 4.0 mm dia Mild Steel.
- c. The stirrup wire for securing the line wires to the concrete intermediate posts shall be 3.15 mm diameter Mild Steel.
- d. The tying wire for securing the chain link fencing to the line wire shall be 2.50 mm diameter Mild Steel.
- e. Hair pin staples for fastening down the bottom of galvanized chain link fencing to the concrete sill shall be of 3.15 mm wire. The ends shall be bent outwards to secure anchorage.

- 6.1.3 Cleats for eye bolts shall be of uniform size and shall consist of Mild Steel angle of 75 x 50 x 6mm.

6.1.4 EYE BOLT STRAINERS

- a. The eye bolt strainer shall consist of bolts with welded eye sufficiently threaded and fitted with a nut and washer.

- b. Two-way eye bolt strainer shall have suitable ring nuts, fitted after wires have been strained on one side.
- 6.1.5 Stretcher bar shall consist of Mild Steel flats 25 mm x 4.75 mm. They shall be secured to the cleats by steel bolts.
- 6.1.6 Droppers for barbed wire shall be of Mild Steel not less than 25mm x 4.75 mm thick with 38mm x 4.85mm half round staples for fastening the barbed wire to them.
- 6.1.7 **BARBED WIRE**
 - a. Barbed wire shall conform to IS: 278. The galvanized barbed wire shall be manufactured from galvanized Mild Steel wire conforming to IS: 280. The coating on the wire shall be smooth and relatively free of lumps, globes or points, wires with excessive roughness, blisters, Sal ammoniac spots shall be rejected. A galvanized steel barbed wire of Type A-1 IS: 278 shall be made from two strands of galvanized, twisted 2.5 mm steel wire with 4 points of barbs. Each barb shall have two turns tightening around both line wires making altogether four complete turns. The barbs shall be so finished that four points are set and looked at right angles to each other.
 - b. Bracing of the rows of barbed wire shall be as shown in Standard drawing.
 - c. The barbs shall have a length of not less than 13mm and not more than 18mm.
- 6.2 **ERECTION**
 - 6.2.1 Straining posts shall be provided at all ends and corners of fences, at changes in direction or acute variations in level and at intervals not exceeding 60m on straight lengths of fence. Intermediate posts shall be spaced at regular intervals not exceeding 3M.
 - 6.2.2 Struts shall be fitted to all straining posts behind the chain link fabric in the direction of the line of fence.
 - 6.2.3 **FIXING CHAIN LINK FENCING**
 - a. There shall be four evenly spaced rows of line wire. The top wire shall be doubled, making five line wires in all. The bottom wire shall be close to the ground.
 - b. Each line wire shall be strained tightly by means of eyebolt strainers or winders at each straining point.
 - c. Each line wire shall be secured to each intermediate post by a wire stirrup passed through a hole in the posts and secured to the line wire by three complete turns on each side of the post.
 - d. The chain link fencing shall be strained between each pair of straining posts and secured to each straining post by means of a Stretcher bar. One of the top line wires shall be threaded through the appropriate adjacent rows of mesh, care being taken that no meshes in the rows are bypassed by the line wire except where deviation is necessary at the straining posts. The second top line wire shall

be strained in front of the fencing. The fencing shall be attached to the top and bottom line wire by wire ties spaced 150mm apart and to the other line wires by wire ties spaced 450 mm apart.

- e. The bottom of the fencing shall be treated as follows:

Continuous concrete sill 230 mm wide x 300 mm high for full length between posts shall be cast with the top 25 mm above G.L. and 25mm below the chain link fencing. Hair pin staples shall be threaded through the bottom row of mesh at 0.75 m c/c and set in the sill to a depth of 150 mm.

6.2.4 FIXING BARBED WIRES FOR ANTICLIMBING DEVICE.

- a. Three lines of barbed wire shall be provided as shown in drawing . The wires shall be attached by eye bolts to the cranked tops of the straining posts. On concrete intermediate posts they shall be secured to cranked tops with stirrup wires. The barbed wire shall be fitted with one dropper at the centre of each bay, secured to the wires so that they cannot be bunched together

7.0 PAYMENT

This clause shall apply to item rate tenders only.

7.1 EARTHWORK

Payment for earthwork shall be made on cubic meter basis

7.2 CEMENT CONCRETE (CAST-IN-SITU AND PRE-CAST)

Payment shall be made on cubic meter basis and the rate shall include labour, materials, mixing placing, leaving pockets, fixing chain link fencing, line wires, barbed wires inserts in concrete post while casting as shown in the drawing or as per the directions of Engineer-in-Charge, keeping the concrete post in the proper position while concreting, scaffolding, all moulds, curing etc. complete including handling & transportation from pre-casting yards to place of fixing, preparation of pre-casting yards etc. but excluding cost of reinforcement.

7.3 REINFORCEMENT

Payment for reinforcement shall be made on metric ton basis including transportation of steel to site of work, straightening, cleaning, cutting, bending to required shapes and lengths, placing, binding with soft annealed wire as per drawings, specifications and instruction of Engineer-in-Charge.

7.4 CHAIN LINK FENCING

Payment for chain link fencing shall be made on running meter basis for bottom 2.0meter height of the total height including supply of chain link fencing in 1.9meter width roll, fixing in position true to line and as per drawing. The rate shall also include supplying and fixing necessary galvanized line wires, stirrup wires, tying wires, hair pin staples for fixing the fence in cons sill, etc. tensioning the line wire and fencing, all materials and labour etc. required to complete the job as per drawings and direction of Engineer-in-Charge.

7.5 BARBED WIRE FENCING

Payment for barbed wire shall be made on running meter basis. The rate shall included supply and fixing necessary droppers, straining bolts tensioning the barbed wire etc. and all materials and labour etc. required to complete the job.



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STANDARD SPECIFICATION FOR GENERAL SCOPE

VCS-SS-CS-6020

					
03	31.01.2022	NV	GDS	HK	GW
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ABBREVIATION

IS Indian Standard

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2.0	REFERENCE	5

1.0 SCOPE

These specifications establish and define the material and constructional requirements for CIVIL and STRUCTURAL WORKS.

2.0 REFERENCE

IS: 1200

- 3.0 Methods of measurements are indicated in these specifications; where not so specified, latest revision of IS: 1200 shall be applicable.
- 4.0 Providing and operating all necessary measuring and testing devices including all materials and consumables are included in the scope of work. No separate measurement or payment for testing the quality of work and materials shall be made, but rates quoted for various items shall be deemed to include the cost of such tests which are required to ensure achievement of specified quality.
- 5.0 All materials shall be of standard quality, manufactured by renowned concerns conforming to Indian Standards or equivalent, and shall have IS mark as far as possible unless otherwise approved by the Engineer-in-Charge. The Contractor shall get all materials approved by the Engineer-in-Charge prior to procurement and use. The Contractor shall furnish manufacturer's certificates for the materials supplied by him when asked for. Further to that he shall get the materials tested from an approved test house if asked for by the Engineer-in-Charge. The cost for all the tests and test certificates for the material procured by the Contractor shall be borne by the Contractor. No separate payment shall be made for the testing. The Engineer-in-Charge shall have the right to determine whether all or any of the materials are suitable. Any materials procured or brought to site and not conforming to specifications and satisfaction of the Engineer-in-Charge shall be rejected and the Contractor shall have to remove the same immediately from site at his own expense and without any claim for compensation due to such rejection.
- 6.0 Wherever referred to in the tender document, only the latest revision of Specifications, Codes of Practice and other publications of Bureau of Indian Standards shall be applicable.
- 7.0 Wherever the Contractor executes civil and structural works involving buildings, equipment foundations, supporting structures, pipe racks, etc., the following works are deemed to have been included in the quoted rates for various works.
- a. Marking of centre lines of foundations etc.
 - b. Establishing layout and levels of foundations and superstructure etc., including establishment of reference lines, bench marks on various floors, platforms etc.
 - c. General upkeep of the plant site.
 - d. Preparation of "As-Built" scheme of structural drawings indicating constructed details including levels, centre lines, layouts, member sizes etc. complete.

- 8.0 The provisions of schedule of rates, specifications and drawings shall be read in conjunction with each other and in case of conflict amongst them, clarification shall be obtained from the Engineer-in-Charge whose decision shall be final and binding. However, the following procedure may generally be followed.
- a. Description of items in schedule of rates shall be followed when provisions therein are different from those in specifications.
 - b. Where the description of item does not call for some specific requirement but the same is given in specifications, the specifications shall be followed in addition to the requirement given in description of item.
 - c. Where drawings call for requirements different from or additional to those given in item description and specifications, the decision of the Engineer-in-Charge shall be obtained as to what shall be followed.



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VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR MATERIALS

VCS-SS-CS-6021

					
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ABBREVIATION

M	Metre
mm	Millimetre
IS	Indian Standard
MS	Mild Steel
PVC	Poly Viny Chloride
mm ²	Square Millimetre
RCC	Reinforced Cement Concrete
PCC	Plain Cement Concrete
BIS	Bureau of Indian Standard

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1.0 SCOPE

- 1.1 This specification establishes and defines the requirements of various materials to be used in Civil and Structural works.
- 1.2 Whenever any reference to BIS Codes is made, the same shall be taken as the latest revision (with all amendments issued thereto) as on the date of submission of the bid.
- 1.3 Apart from the BIS Codes mentioned in particular in the various clauses of this specification, all other relevant codes related to specific job under consideration regarding quality, tests, testing and/or inspection procedures shall be applicable. Reference to some of the Codes in the various clauses of this specification does not limit or restrict the scope of applicability of other referred or relevant codes.
- 1.4 In case of any variation/contradiction between the provision of BIS Codes and this specification, the provision given in this specification shall be followed.
- 1.5 All materials shall be of standard quality and shall be procured from renowned sources/manufacturers approved by the Engineer-in-Charge. It shall be the responsibility of the Contractor, to get all materials/ manufacturers approved by the Engineer-in-Charge prior to procurement and placement of order.
- 1.6 Whenever called for by the Engineer-in-Charge all tests of the materials as specified by the relevant BIS Codes shall be carried out by the Contractor in an approved laboratory and test reports duly authenticated by the laboratory, shall be submitted to the Engineer-in-Charge for his approval. If so desired by the Engineer-in-Charge, tests shall be conducted in the presence of the Engineer-in-Charge or his authorized nominee.
- 1.7 Quality and acceptability of materials not covered under this specification shall be governed by the relevant BIS Codes. In case BIS code is not available for the particular material, other codes e.g. BS or DIN or API/ASTM shall be considered. The decision of Engineer-in-Charge, in this regard, shall be final and binding on the Contractor.
- 1.8 Whenever asked for, the Contractor shall submit representative samples of materials to the Engineer-in-Charge for his inspection and approval. Approval of any sample does not necessarily exempt the Contractor from submitting necessary test reports for the approved material, as per the specification/relevant BIS Codes.
- 1.9 The Contractor shall submit manufacturer's test reports on quality and suitability of any material procured from them and their recommendation on storage, application, workmanship etc. for the intended use. Submission of manufacturer's test reports does not restrict the Engineer-in-Charge from asking fresh test results from an approved laboratory of the actual material supplied from an approved manufacturer/source at any stage of execution of work.
- 1.10 All costs relating to or arising out of carrying out the tests and submission of test reports and or samples to the Engineer-in-Charge for his approval during the entire tenure of the work shall be borne by the contractor and included in the quoted rates.

- 1.11 Materials for approval shall be separately stored and marked, as directed by the Engineer-in-Charge and shall not be used in the works till these are approved.
- 1.12 All rejected materials shall be immediately removed from the site by the Contractor at his own cost

2.0 REFERENCES

As mentioned in the respective clauses.

3.0 WATER

- 3.1 Water used in construction for all civil & structural works shall be clean and free from injurious amount of oil, acids, alkalies, organic matters or other harmful substances which may be deleterious to concrete, masonry or steel. The pH value of water sample shall be not less than 6. Potable water shall be considered satisfactory. Underground water can also be used with the prior approval of Engineer-in-Charge, if it meets all the requirements of IS: 456.
- 3.2 Tests on water samples shall be carried out in accordance with IS: 3025 and they shall fulfill all the guidelines and requirements given in IS: 456.
- 3.3 The Engineer-in-Charge may require the Contractor to prove, that the concrete prepared with water, proposed to be used, shall have average 28 days compressive strength not lower than 90% of the strength of concrete prepared with distilled water.
- 3.4 The Engineer-in-Charge may require the Contractor to get the water tested from an approved laboratory before starting the construction work and in case the water contains any oil/organic matter or an excess of acid, alkalies or any injurious amount of salts etc., beyond the permissible maximum limits given in IS: 456, the Engineer-in-Charge may refuse to permit its use. In case the water is supplied by the owner, contractor shall get himself satisfied regarding its quality before using the same in his works at his own expense. In case there is any change in source of water, water samples shall be tested again to meet the specified requirements.
- 3.5 Water shall be stored in tin barrels, steel tanks or water-tight reservoirs made with bricks / stone or reinforced concrete. Brick/stone masonry reservoirs shall have RCC base slab and shall be plastered inside, with 1 part of cement and 4 parts of sand and finished with neat cement punning. These reservoirs shall be of sufficient capacity to meet the water requirement, at any stage of construction.
- 3.6 Water for curing shall be of the same quality as used for concreting and masonry works. Sea water shall not be used for preparation of cement mortar, concrete as well as for curing of plain/reinforced concrete and masonry works. Sea water shall not be used for hydro testing and checking the leakage of liquid retaining structures also.

4.0 AGGREGATE

4.1 GENERAL

- 4.1.1 Coarse and fine aggregates for Civil and Structural Works shall conform in all respects to IS: 383 (Specification for coarse and fine aggregates from natural sources for concrete). Aggregates shall be obtained from an approved source known to produce the same satisfactorily. Aggregates shall consist of naturally occurring (crushed or uncrushed) stones, gravel and sand or a combination thereof. These shall be chemically inert, hard, strong, dense durable, clean and free from veins, adherent coatings, injurious amount of alkalis, vegetable matter and other deleterious substances such as iron pyrites, coal, lignite, mica, shale, sea shells etc.
- 4.1.2 Source and type of aggregates shall be got approved by the Engineer-in-Charge prior to procurement. Change in source and type of aggregates, at later stage, shall not be generally permitted; but under specific circumstances, Engineer-in-Charge can allow a change in source and type of aggregate. Contractor shall produce necessary test certificates from approved laboratories regarding the quality and suitability of the proposed aggregates and submit fresh mix design for approval of the Engineering-Charge. Any such change, if permitted by the Engineer-in-Charge, shall be without any time and cost implication to the owner.
- 4.1.3 Aggregates which may chemically react with alkalis of cement or might cause corrosion of the reinforcement shall not be used. If so desired by the Engineer-in-Charge, the Contractor shall carry out alkali reactivity tests and submit the results to him for approval.
- 4.1.4 The maximum quantities of deleterious materials in the aggregates as determined in accordance with IS: 2386 - Part II (Methods of Test for aggregates for concrete), shall not exceed the limits defined in IS: 383. No special test is required to prove the absence of such deleterious matters if the aggregates are from a known source with satisfactory prior data on the properties of concrete made with them. In case of newly developed quarry sites, the contractor shall submit necessary test results as per IS: 383 and IS: 2386 to the Engineer-in-Charge prior to his acceptance and approval. The method of Sampling shall be in accordance with the requirements given in IS: 2430.
- 4.1.5 Coarse and fine aggregates shall be batched separately. All-in-aggregate shall be used only where specifically permitted by the Engineer-in-Charge.
- Separate sieve analysis and grading curves shall be prepared by the Contractor for any/all batches of coarse and fine aggregates, and submitted to the Engineer-in-Charge, whenever asked for, to ensure conformity with those submitted along with the mix design.
- 4.1.6 Whenever required by Engineer-in-Charge, the aggregates(coarse/fine) shall be washed and/or sieved by the contractor before use in the works to obtain clean and graded aggregate at no extra cost to the owner.
- 4.1.7 Aggregates not in conformity with the specifications shall be rejected and the Contractor shall immediately remove them from the site of work.
- 4.2 COARSE AGGREGATES

- 4.2.1 Coarse aggregates are the aggregates, which are retained on 4.75mm BIS Sieve. It shall have a specific gravity not less than 2.6 (saturated surface dry basis).
- 4.2.2 These may be obtained from crushed or uncrushed gravel or stone as per clause 3.1 and may be supplied as single sized or graded. The grading of the aggregates shall be as per IS: 383 or as required by the mix design, to obtain densest possible concrete. For this purpose, the contractor shall submit to the Engineer-in-Charge at least three sets of mix design and test results, each with different grading of coarse aggregates, proposed to be used. The Engineer-in-Charge may allow "All-in-aggregates" to be used provided they satisfy the requirements of IS: 383.

4.3 FINE AGGREGATES

- 4.3.1 Fine aggregates are the aggregates which pass through 4.75mm BIS sieve but not more than ten percent (10%) pass through 150 micron BIS sieve. These shall comply with the requirements of grading zones I, II and III of IS: 383. Fine aggregates conforming to grade zone IV shall not be used for reinforced concrete works.
- 4.3.2 Fine aggregates shall consist of material resulting from natural disintegration of rock and which has been deposited by streams or glacial agencies, or crushed stone sand or gravel sand. Sand from sea shores, creeks or river banks affected by tides, shall not be used for filling or concrete works.

4.4 SAMPLING AND TESTING

The Contractor shall carry out all tests including mix designs of concrete, at his own expense, at the start of work as well as during any stage of construction as required by the Engineer-in-Charge. Test shall be carried out in accordance with IS: 516-Methods of test for strength of concrete and IS: 2386-Methods of test for aggregates for concrete. Testing shall be carried out from laboratories approved by the Engineer-in-Charge. The method of sampling shall be in accordance with the requirements given in IS: 2430.

4.5 STORAGE OF AGGREGATES

- 4.5.1 Storage of all types of aggregates at site of work shall be at contractor's expense and risk and shall be stored as specified in IS: 4082. Aggregates shall in no case be stored near to the excavated earth or directly over ground surface.
- 4.5.2 The Contractor shall maintain sufficient quantities of aggregates, near to the place of work, required for the continuity of the work. Each type and grade of aggregate shall be stored separately on hard, firm surface having adequate slope for drainage of water.
- 4.5.3 Aggregates delivered at site in wet condition or becoming wet due to rain or any other means, shall not be used for at least 24 hours. The Contractor shall obtain prior approval of the Engineer-in-charge for the use of such aggregates and shall adjust the water content in accordance with IS: 2386 to achieve the desired mix. In the absence of test results, and to allow variation in mass of aggregates and water content on account of moisture content, the Contractor can make suitable adjustment in the masses as per IS: 456, for preparation of nominal mix concrete only.

5.0 SAND

5.1 SAND FOR MASONRY MORTARS

- 5.1.1 The sand shall consist of natural sand, crushed stone sand or crushed gravel sand or a combination of any of these. The sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain the amount of clay, silt and fine dust more than specified in IS: 2116.
- 5.1.2 The sand shall not contain any harmful impurities such as iron pyrites, alkalis, salts and coal or other organic impurities, mica, shale or similar laminated materials, soft fragments, sea shells in such form or in such quantities as to affect adversely the hardening, strength or durability of the mortar.
- 5.1.3 Unless found satisfactory as a result of further tests as may be specified by the Engineer-in-Charge, or unless evidence of such performance is offered which is satisfactory to him, the maximum quantities of clay, fine silt, fine dust and organic impurities in the sand, when tested in accordance with IS: 2386, shall not be more than 5% by mass in natural sand, or crushed gravel sand or crushed stone sand. For organic impurities, when determined in accordance with IS: 2386, colour of the liquid shall be lighter than that indicated by the standard solution specified in IS: 2386.

5.1.4 GRADING OF SAND

The particle size grading of sand for use in mortars shall be within the limits as specified below:

GRADING OF SAND FOR USE IN MASONRY MORTARS

IS SIEVE DESIGNATION	PERCENTAGE	REF.TO
IS: 460(PART I)	PASSING BYMASS	METHOD OF
4.75 mm	100	IS: 2386(Part I)
2.36 mm	90 to 100	
1.18 mm	70 to 100	
600 micron	40 to 100	
300 micron	5 to 70	
150 micron	0 to 15	

In case of a sand whose grading falls outside the specified limits due to excess or deficiency of coarse or fine particles, this shall be processed to comply with the standard by screening through a suitably sized sieve and/or blending with required quantities of suitable sizes of natural sand particles or crushed stone screenings which are by themselves unsuitable. Based on test results and in the light of practical experience with the use of local materials, deviation in grading of sand may be

considered by the Engineer-in-Charge. The various sizes of particles of which the sand is composed shall be uniformly distributed throughout the mass.

5.1.5 SAMPLING AND TESTING

The method of sampling shall be in accordance with IS: 2430. The amount of material required for each test shall be as specified in relevant parts of IS: 2386. Any test which the engineer-in-charge may require in connection with this shall be carried out in accordance with the relevant parts of IS: 2386.

If further confirmation as to the satisfactory nature of the material is required, compressive test on cement mortar cubes (1:6) may be made in accordance with IS: 2250 using the supplied material in place of standard sand and the strength value so obtained shall be compared with that of another mortar made with a sand of acceptable and comparable quality.

5.2 SAND FOR FILLING

Sand for filling shall meet the requirements of IS: 383 and shall be natural sand, hard, strong and free from any organic and deleterious materials. Any sand proposed for filling, shall be used only after it is approved by the Engineer-in-Charge. Sand obtained from sea shores, creeks or river banks affected by tides shall not be used for filling. Fine aggregates suitable for concreting works shall be suitable for filling also. No sand below grading zone-III as per IS: 383 shall be allowed for filling.

6.0 CEMENT

Cement to be used for civil and structural works shall be one of the following. Specific requirement for the type of cement to be used shall be as shown in the drawings or as specified in the contract or as directed by the Engineer-in-Charge.

Specification for 33 grade ordinary Portland cement	IS: 269
Specification for Portland slag cement	IS: 455
Specification for Portland pozzolana cement (fly ash based)	IS: 1489 Pt.1
Specification for Portland pozzolana cement (calcined clay based)	IS: 1489 Pt.2
Specification for Masonry Cement	IS: 3466
Specification for high alumina cement for structural use	IS: 6452
Specification for rapid hardening Portland cement	IS: 8041
Specification for 43 grade ordinary Portland cement	IS: 8112
Specification for 53 grade ordinary Portland cement	IS: 12269
Specification for Sulphate Resisting Portland cement	IS: 12330

6.1 STORAGE AT SITE

6.1.1 The storage of cement (lifted from the Owner's godown or procured by the Contractor himself) at the site of work shall be at contractor's expense and risk and shall meet the requirements of IS: 4082. The cement shall be stored above ground in a suitable weather tight building or godown and in such a manner as to permit easy access for proper inspection and also to prevent deterioration due to moisture. In the event of any damage occurring to the quality of cement due to faulty storage or on account of negligence on the part of the contractor, such damages shall be borne by the contractor himself.

6.1.2 All approved cement shall be arranged in batches with type, brand and date of receipt fagged on them. A maximum of eight bags shall be stacked one over the other. Cement bags shall be used in the same order as received from the manufacturer/owner. The contractor shall maintain a register, on day to day basis, giving the details of the receipt/consumption, source of supply and type of cement etc. The register shall always be accessible to the Engineer-in-Charge for verification.

6.2 TESTS AFTER DELIVERY

Each consignment of cement supplied by Owner or contractor, shall, after delivery at site and at the discretion of the Engineer-in-Charge, be subjected to any or all of the tests and analyses, required by the relevant Indian Standard Codes. In case the cement is supplied by the owner, the contractor shall get himself satisfied regarding its quality before using the same in his works at his own expense. The contractor shall carry out and bear the cost of all tests and analyses required to ensure quality of cement before using in actual works, irrespective of the fact whether the cement is supplied by the Owner or procured by him.

6.3 REJECTION

The Engineer-in-Charge may reject at his discretion any cement, notwithstanding the manufacturer's certificate or failing to meet the requirements of relevant BIS Codes for testing of cement. He may similarly reject any cement which has deteriorated owing to inadequate protection from moisture or due to intrusion of foreign matter or any other cause. Any cement which is considered defective shall not be used and shall be promptly removed from the site by the contractor.

7.0 STEEL

7.1 GENERAL

All steel bars, sections, plates, and other miscellaneous steel materials, etc shall be free from loose mill scales, rust as well as oil, mud, paint or other coatings. The materials, construction specifications such as dimensions, shape, weight, tolerances, testing etc, for all materials covered under this section, shall conform to respective BIS Codes.

7.2 REINFORCEMENT BARS

Reinforcement bars, to be used for civil and structural works shall be one of the following or in combination thereof.

Specification for mild steel and medium tensile steel bars and hard

drawn steel wire for concrete reinforcement (grade I). IS: 432

Specification for hard drawn steel wire fabric for concrete

reinforcement. IS: 1566

Specification for High strength deformed steel bars and wires for

concrete reinforcement. IS: 1786

Steel for general structural purposes (Grade A). IS: 2062

7.3 STRUCTURAL STEEL

Structural steel to be used for general structural purposes shall be one of the following or in combination thereof.

Structural steel sections shall conform to following BIS Codes.

Steel tubes for structural purposes. IS: 1161

Mild Steel Tubes, tubulars and other wrought steel fittings. IS: 1239

Steel for general structural purposes (Grade A). IS: 2062

Hollow steel sections for structural use. IS: 4923

7.4 MISCELLANEOUS STEEL MATERIALS

Miscellaneous steel materials shall be conforming to the following BIS Codes.

Specification for mild steel and medium tensile steel bars and hard drawn

steel wire for concrete reinforcement (grade I) (For mild steel bars of anchor bolts, rungs, metal inserts, grating etc.) IS: 432

Hexagonal head bolts, screws & nuts of product grade C. IS: 1363

Technical supply conditions for threaded steel fasteners. IS: 1367

Plain washers IS: 2016

Steel wire ropes for general engineering purposes IS: 2266

Mild Steel Tubes, tubulars and other wrought steel fillings.

(For Hand rail tubular sections). IS: 1239

Steel chequered plates. IS: 3502

Hexagonal bolts and nuts (M42 to M150). IS: 3138

7.4.1 ANCHOR BOLTS

Material for Anchor Bolts such as MS bars, washers, nuts, pipe sleeves and plates etc. shall be as per relevant BIS Codes mentioned above.

7.5 STORAGE

The storage of all materials at site of work shall be at the contractor's expense and risk and shall be done as per the requirements given in IS: 4082. The contractor shall maintain the proper records of receipt/consumption. The records shall always be accessible to the Engineer-in-Charge for verification.

The reinforcement bars, structural steel sections and other miscellaneous steel materials etc, shall be stored in such a way as to avoid and prevent deterioration, corrosion, bending, twisting and wrapping. In case of any damage occurring to the material on account of faulty storage or negligence by the contractor, same shall be borne by the contractor himself.

7.6 TESTS AFTER DELIVERY

Materials supplied by the Owner or Contractor, shall, after delivery at site and at the discretion of Engineer-in-Charge, be subjected to any or all of the tests, required by the relevant BIS Codes. The Contractor shall carry out and bear the cost of such tests irrespective of the fact whether the material is procured by the Owner or the contractor. In case steel is supplied by the Owner, the Contractor shall get himself satisfied regarding its quality before using the same in his works at his own expense.

7.7 REJECTION

The Engineer-in-charge may reject at his discretion any material, notwithstanding the manufacturer's certificate or failing to meet the requirements of relevant BIS Codes for testing of materials. He may similarly reject any material, which has deteriorated or corroded etc., due to improper storage, handling or transport. Defective materials shall not be used and removed from the site by the contractor at his own expense.

8.0 BRICK

8.1 GENERAL

Bricks for masonry works shall conform to IS: 1077 - Specification for common burnt clay building bricks and shall be of class 5.0 (with minimum compressive strength of 5.0N/mm²). Specific requirement for any other class of bricks shall be as shown in drawings or as described in the contract for a particular site or type of work. Physical requirements, quality, dimensions, tolerances etc. of common burnt clay building bricks shall conform to the requirements of IS: 1077.

Bricks shall be hand - moulded or machine moulded and shall be made from suitable soils. The bricks shall have smooth rectangular faces with sharp corners and shall be well burnt, sound, hard, tough and uniform in colour. These shall be free from cracks, chips, flaws, stone or humps of any kind.

8.2 TESTS AFTER DELIVERY

The Contractor shall take samples of each type of brick as directed by the Engineer-in-Charge as per the requirements of IS: 5454 and tests shall be carried out as per IS: 3495. The cost for carrying out any or all the tests shall be borne by the Contractor. The bricks, when tested, as per IS: 3495 shall have a minimum average compressive strength, as given in the Code, for a particular class of brick. Water absorption shall not be more than 20% by its dry weight, when soaked in cold water for 24 hours.

Brick samples so approved, shall be deposited with the Engineer-in-Charge. All subsequent deliveries shall be up to the standards of the approved samples.

8.3 STACKING OF BRICKS

Bricks shall be stored at site as per the requirements given in IS: 4082 and shall not be dumped at site. They shall be unloaded from trucks to a place on a leveled surface near to the work site. They shall be stacked in regular tiers even as they are unloaded, to minimize breakages and defacement of bricks. The supply of bricks shall be so arranged that as far as possible, at least two days' requirements of bricks are available at site at any time. Bricks, of different class, shall be stacked separately.

8.4 LOCAL BRICKS/CLASS 3.5 BRICKS.

Where shown on drawings, locally available bricks of nonmodular size (230mm x 115mm x 75mm) in place of bricks of modular size (190mm x 90mm x 90mm) can be used in case the bricks satisfy the other requirements of IS: 1077. Minimum compressive strength of these bricks shall not be less than 3.5N/mm².

9.0 STONE

9.1 GENERAL

All Stones used for masonry works shall conform to the requirements of following BIS Codes.

Method of identification of natural building stones. IS: 1123

Recommendations for dimensions and workmanship of natural

building stones for masonry work. IS: 1127

Recommendations for dressing of natural building stones. IS: 1129

9.2 QUALITY OF STONES

Stones shall be of approved quality, hard, dense, strong, sound, durable, clean and uniform in colour. They shall also be free from veins, adherent coatings, injurious amount of alkalies, vegetable matters and other deleterious substances such as iron, pyrites, coal, lignite, mica, sea shells etc. Unless otherwise approved, stones from one single quarry shall be used for any one work. The strength of stones should be adequate to carry the imposed load and shall meet all the requirements of IS: 1905, taking into account the appropriate crushing strength of stone and type of the mortar used. The percentage of water absorption, when tested in accordance with IS: 1124 shall not exceed 5 percent.

Stones normally used, shall be small enough to be lifted and placed by hand. The length of the stone shall not exceed 3 times the height. Width of stone on base shall not be less than 150 mm and in no case exceed 3/4th thickness of the wall. Height of the stone shall not be more than 300mm.

9.3 UNLOADING/STACKING

The stones shall be unloaded from the trucks to a site near to the place of work as defined in IS: 4082 and shall be stacked on a firm ground having adequate stop for drainage. The supply of stones shall be so arranged that as far as possible, at least two days' requirements of stone are available at site at any time.

10.0 ADMIXTURES

10.1 GENERAL REQUIREMENTS FOR ADMIXTURES

10.1.1 All concrete admixtures shall in general comply with the following BIS Codes unless otherwise stipulated in this specification.

Specification for integral cement water proofing compounds. IS: 2645

Specification for other admixtures for concrete. IS: 9103

10.1.2 Generally, admixtures shall have ISI certification marks. However, even in case of BIS certified admixtures, Engineer-in-Charge may require the Contractor to carry out and submit any or all the tests (as specified in relevant BIS Codes), from approved laboratories, over and above the manufacturer's test certificate, before giving his final approval.

In case, admixtures certified by BIS are not available, the contractor shall submit to the Engineer-in-Charge the type and/or proprietary brand of the admixture from only reputed manufacturers along with necessary test certificates from recognized and approved laboratories or any other document directed by Engineer-in-Charge for the latter's final approval. In such cases, names of at least two manufacturers shall be submitted to the Engineer-in-Charge for his selection. In case, both the names are rejected, the contractor shall submit a fresh list of two manufacturers for approval by the Engineer-in-Charge.

The Engineer-in-Charge may direct the contractor to submit test results as required by IS: 2645 or IS: 9103 for any admixture proposed to be used in the concrete in any

approved laboratory at his discretion at any stage of the work. The cost of any/all tests required to satisfy compliance with this specification shall be borne by the Contractor.

In case of non-availability of any BIS code for testing and acceptability criteria, relevant American, British or German Code shall be applicable.

- 10.1.3 Prior approval of the Engineer-in-Charge shall be obtained while using water reducing admixtures in the concrete (PCC/RCC) or mortar. Other type of admixtures such as accelerating admixtures, retarding admixtures or air entraining admixtures, shall not be used unless specified on the design drawings or prior approval taken from the design approving authority. Once approved, utmost care shall be exercised, at site by the Contractor to maintain the consistency in the quality of admixture and the concrete/ mortar so produced.
- 10.1.4 The suitability and effectiveness of any admixture shall be verified by trial with the designed concrete mixes using cement, aggregates together with any other materials to be actually used in the works as per the direction of Engineer-in-Charge. If two or more admixtures are to be used simultaneously in the same concrete mix, the Contractor must submit necessary test results from an approved laboratory to show their interaction and compatibility. Any/all tests specified in BIS Codes shall be carried out only with the type of material and mix design, to be actually used in the work site.
- 10.1.5 No admixture shall impair the durability of the concrete nor combine with the ingredients to neither form harmful compounds nor increase the risk of corrosion of reinforcement. Use of admixtures shall not reduce the dry density of concrete. Once the proportion of admixture has been established, strict check shall be maintained not to alter the proportions of ingredients and water-cement ratio of the Design Mix during execution.
- 10.1.6 The chloride contents in admixtures shall not exceed 2% by mass of the admixture or 0.03% by mass of the cement.
- 10.1.7 Admixtures which do not meet the requirements stipulated in this specification shall be rejected and shall not be used.
- 10.2 WATER PROOFING COMPOUNDS
- 10.2.1 Water proofing compounds shall be mixed with only ordinary Portland cement of grade 33, conforming to IS: 269.
- 10.2.2 The permeability of the specimen with the admixture shall be less than half of the permeability with similar specimen without the use of these compounds. These compounds shall be used in such proportion as recommended by manufacturer but in no case it shall exceed 3% by weight of cement.
- 10.2.3 The initial setting time of the cement with the use of these compounds shall not be less than 30 minutes and final setting time shall not be more than 10 hours. Test shall be carried out in accordance with IS: 4031.

- 10.2.4 Compressive strength of specimen at 3 days shall not be less than 160kg/sq.cm nor 80% of the 3 days compressive strength of mortar cubes prepared with same cement and sand only, whichever is higher. Similarly compressive strength at 7 days shall not be less than 220 kg/sq.cm nor less than 80% of the 7 days compressive strength prepared with the same cement, and sand only, whichever is higher. The test to determine the compressive strength shall conform to IS: 4031.

11.0 WATER BARS (WATER STOPS)

- 11.1 PVC water bars shall be used in reinforced concrete construction of liquid retaining structures or any other structure to safeguard them from hydrostatic pressure and water leakage and any relative movement between two parts of the structure due to thermal loading shrinkage or differential movement of foundations. Wherever desired or shown in the drawings, they shall be used at expansion/contraction/construction joints. These shall be pre-formed and shall provide a permanent water tight seal along the entire joint in the poured concrete structures. These shall also be flexible enough to withstand deflection/displacements at joints arising due to variation of temperatures or settlement of foundations. The minimum thickness of water bar shall be as shown on drawings or described in the schedule of rates and unless otherwise mentioned, these shall be able to withstand a water head of at least 12 meters.
- 11.2 Performance requirements of P V C water bars shall meet the requirements of IS: 12200. These shall be of approved make and of ribbed/serrated/plane type with a bulb at the centre. The thickness and width of water bars shall be as per schedule of rates/drawings but in no case the thickness shall be less than 5mm and width less than 150mm. The joining of the water bars shall be carried out by vulcanising strictly as per the manufacturer's specifications. Lapped joints shall not be allowed under any circumstances.

12.0 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 for bitumen mastic for flooring.	IS: 1195
Specification for Bitumen felts for water proofing 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

Specification for Bitumen Mastic for Tanking and Damp proofing. IS: 5871

Specification for Glass fibre base coal tar pitch & bitumen felts. IS: 7193

Code of practise for 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 Engineer-in-Charge. Tests and acceptable criteria shall be as per relevant BIS Codes.

13.0 PVC PIPES

PVC Pipes shall conform to the requirements of IS: 4985.

14.0 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/mm² 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 formwork 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 concrete. Storage of Wood/Timber shall be as per the requirements of IS: 4082.

For proper identification and selection of suitable timber for formwork, 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

15.0 ANTITERMITE COMPOUNDS

- 15.1 Chloropyrifos emulsifiable concentrates (1%) conforming to IS: 8944 shall be used for treatment of soil for protection of buildings against attack by subterranean termites.

16.0 POLYSULPHIDE SEALANTS

- 16.1 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.



Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR EARTHWORK IN FOUNDATIONS

VCS-SS-CS-6022

					
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ABBREVIATION

m	Metre
mm	Millimetre
Cm	Centimetre
m ²	Square metre
m ³	Cubic metre
CNS	Cohesive Non Swelling

CONTENTS

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1.0 SCOPE

This specification deals with earth work in excavation and filling.

2.0 REFERENCES

2.1 SPECIFICATIONS

VCS-SS-CS-6002 Earthwork in Site Grading

VCS-SS-CS-6003 Earthwork for underground piping

3.0 CLASSIFICATION OF SOIL

3.1 SOFT / LOOSE / HARD / DENSE SOIL AND MUD

Generally any soil which yields to the application of pick and shovel or to phawra, rake or other, ordinary digging implement such as vegetable or organic soil, turf, gravel, sand, silt, loam, clay, peat, cobble stone, mud etc.

3.2 SOFT / DISINTEGRATED / WEATHERED ROCK (NOT REQUIRING BLASTING)

Rock or boulder which may be quarried or split with crowbar. This will also include laterite and hard conglomerate.

3.3 HARD ROCK (REQUIRING BLASTING)

Any rock or boulder for the excavation of which blasting is required.

3.4 HARD ROCK (BLASTING PROHIBITED)

Hard rock requiring blasting as described under cl. No. 3.3 above, but where blasting is prohibited for any reason(s), breaking up of rock shall be done by chiselling, wedging or by using Hydraulic Splitter and chemical substances mixed in an appropriate proportion.

4.0 BACKFILLING MATERIAL

4.1 Backfilling material shall be as approved by the Engineer-in-Charge.

4.2 Backfilling of excavation in trenches, foundations and elsewhere shall consist of one of the following materials as shown on drawing, or directed by the Engineer-in-Charge.

- a. Soil
- b. Selected earth from heaps or brought from borrow areas.

4.3 In case a. or b. are not available, the Engineer-in-Charge may approve use of any of the following: Stone/gravel

- c. Sand

d. CNS material.

- 4.4 The material shall be free from rubbish, roots, hard lumps and any other foreign organic material

5.0 SETTING OUT

- 5.1 The Contractor shall be responsible for the true and proper setting out of the work in relation to original point's lines and levels of reference and for the correctness of the levels, dimensions and alignment of all parts of the work. If at any time during progress of the work any error appears or arises in the position of level, dimension, or alignment of part of the work, the Contractor at his own expense shall rectify such errors to the satisfaction of the Engineer-in-Charge. The checking of any line or level by the Engineer-in-Charge shall not in any way relieve the Contractor of his responsibilities.
- 5.2 The Contractor shall lay out and construct one or more permanent bench marks in some central place before the start of the work, from which all important levels for the excavations will be set.
- 5.3 These permanent bench marks shall consist of masonry pillars with top neatly plastered and levelled as per the directions of the Engineer-in-Charge. Bench marks shall be well connected with triangular grid system or any other bench mark approved by the Engineer-in-Charge.

6.0 EARTHWORK IN EXCAVATION

- 6.1 Excavation shall be carried out in any material met on the site to the lines, levels and contours shown on the detailed drawings and the Contractor shall remove all excavated materials to spoil heaps on site or transport for use in filling on the site or stack them for reuse as directed:
- 6.2 Excavated material shall not be deposited within 1.5m from the top edge of the excavation.
- 6.3 The sides of the excavation may be cut sloping, or shored and strutted to hold the face of earth as per site requirements and as directed by the Engineer-in- Charge.
- 6.4 Foundation pits/trenches shall not be excavated to the full depth unless construction is imminent. The last fifteen (15) cm depth of the excavation shall not be done until concreting work is imminent. The full depth may at the discretion of the Engineer-in-Charge be excavated and the bed covered with a fifty (50) mm (minimum) thick (or as indicated on drawing) layer of lean concrete 1:5:10 mix (1 cement: 5 coarse sand: 10 crushed stone aggregate) or as specified in schedule of rates/shown on drawing, after watering if required, and consolidating the bed.
- 6.5 If the bottom of any excavation has been left exposed by the Contractor and in the opinion of the Engineer-in-Charge, that has become badly affected by the atmosphere or by water, then the Contractor shall remove such portions of the deteriorated material as the Engineer-in-Charge may direct and shall make good with lean concrete

- 1:5:10 mix (1 Cement: 5 Coarse Sand: 10 Crushed Stone Aggregate). All expenses for such additional concrete and excavation shall be borne by the Contractor.
- 6.6 Where excavation is made in excess of the depth required, the Contractor shall, at his own expense, fill up to required level with lean concrete 1:5:10 mix (1 Cement : 5 Coarse Sand : 10 Crushed Stone aggregates) or as decided by Engineer-in-Charge.
- 6.7 The Contractor shall provide suitable drainage arrangement to prevent surface water from any source entering the foundation pits at his own cost.
- 6.8 The Contractor shall make all arrangements for dewatering during excavation and subsequent works, the accumulated water from any source (including subsoil water) in the excavated pits/trenches and keeping the excavated pits/trenches dry for subsequent works.
- 6.9 The Contractor shall make necessary arrangements for lighting, fencing and other suitable measures for protection against risk of accidents due to open excavation.
- 6.10 Where the excavation is to be carried out below the foundation level of an adjacent structure, the precaution to be taken such as under pinning, shoring and strutting etc. shall be determined by the Engineer- in-Charge. No excavation shall be done unless such precautionary measures are carried out as per directions of the Engineer-in-Charge. The payment for such precautionary measures shall, however, be made separately.
- 6.11 Loose or soft bed ground encountered in excavation at the required depth shall on the Engineers-in-Charge's instructions be excavated to a firm bed and difference made up to the required level with lean concrete 1:5:10 mix (1 Cement: 5 Coarse Sand: 10 Crushed Stone Aggregates).
- 6.12 In those cases where during excavation, side slips occur for reasons not attributable to the Contractor (e.g. side slips which take place on their own but not due to surcharge of earth kept near the edge of excavation and cracking of excavation top strata due to clay drying out leading to collapse of excavation sides), the Engineer-in-Charge shall admit payment at his discretion.
- 6.13 Any obstacle encountered during excavation shall be reported immediately to the Engineer-in-Charge and shall be dealt with as instructed by him. Removal of buried pipes or cables shall not be done without prior permission of the Engineer-in-Charge and the Contractor shall provide all measures to protect the same. Costs of such protective measures are deemed to be included in the rates for various items of excavation.
- 6.14 The Contractor shall not undertake any concreting in foundation until the excavation pit/trench is approved by the Engineer-in-Charge.
- 6.15 The specification for earth work shall also apply to excavation in rock in general.
- 6.16 In case of hard rock requiring blasting, the provisions mentioned below shall be strictly followed.

6.16.1 GENERAL

Where hard rock is met with and blasting operations are considered necessary, the Contractor shall intimate about the same to the Engineer-in-Charge, and obtain his approval in writing for resorting to blasting operation.

The Contractor shall obtain license from the district authorities for undertaking blasting work as well as for obtaining and storing the explosive as per Explosive Rules 1983, corrected up to date. He shall purchase the explosives, fuses, detonators etc. only from a licensed dealer. He shall be responsible for the safe custody and proper accounting of the explosive materials. The Engineer-in-Charge or his authorized representative shall have the access to check the Contractor's store of explosive and his accounts.

In case where explosives are required to be transported and stored at site, relevant clauses of the Explosive Rules, 1983 as amended subsequently, shall apply.

The Contractor shall be responsible for any accident to workmen, public or property, due to blasting operations.

6.16.2 PRECAUTIONS

Blasting operations shall be carried out under the careful supervision of a responsible, authorized and licensed blaster of the Contractor (referred subsequently as "blaster" only) during specified hours, as approved in writing by the Engineer-in-Charge. The blaster shall be fully conversant with the rules of blasting.

Proper precautions for safety of persons shall be taken. Red flags shall be prominently displayed around the area to be blasted and all the people on the work except those who actually light the fuses shall withdraw to a safe distance of not less than 200 meters from the blast. Precautions as per Explosive Rules 1983 with amendment shall be followed.

6.16.3 FUSES

All fuses shall be cut to the lengths required before being inserted into the holes. Joints in fuses shall be avoided. Where these are unavoidable, a semicircular niche shall be cut in one piece of fuse about 2 cm. deep from the end and the end of other piece inserted into this niche, and the two pieces then wrapped together with a string. All joints exposed to dampness shall be wrapped with rubber tape. Fuse and detonators shall be kept separated from the explosives.

6.16.4 BLASTING WITH GUN POWDER

Blasting shall normally be done with gun powder. Dynamite, gelatine or any other high explosive shall only be used in special cases with the written permission of the Engineer-in-Charge.

In case of blasting with gun powder, the position of all bore holes to be drilled shall be marked out in circles with white paint. The bore holes shall be jumped or drilled in the rock face. The depth of bore hole shall be about the same as that of the line of least

resistance and its size shall be such that the cartridges can easily pass down to the bottom. The bore holes must be dried before being charged and these shall be inspected by the Contractor's agent.

Gun powder may be used in the form of pellet blasting cartridges or as powder or granules. Cartridges are provided with tapered central hole. One end of fuse is passed through the narrow end of the hole and a sufficient length of the fuse is doubled back so that when the fuse is pulled, it is held tight in the tapered hole of the cartridge. Other cartridges are then inserted in the fuse to make up the required charge. The cartridge along with the fuse is lowered down in the bore hole, placed in position and gently filled and pressed home with dry hay or turf. The rest of the bore shall then be filled with dry clay, which shall be tamped with copper or brass rod until it becomes compact. Care shall be taken to avoid any possibility of an air space around the fuse. The safety fuses shall be taken to the required distance so as to allow the blasting to take place after the person lighting the fuse has withdrawn to a safe distance.

Where gun powder is used in the form of powder or granules it shall be introduced in the bore hole by means of funnel or copper tube. The bore holes shall be loaded with two thirds of the quantity of charge required, and safety fuse then directly introduced over the charge. Remaining one third charges shall then be introduced, and gently filled and pressed home with dry hay or turf. The rest of the bore hole shall be filled with dry clay in the same way as for cartridges, and the safety fuse taken to the required distance.

The charges shall be fired by igniting the fuse. The number of charges to be fired and the actual number of shots heard shall be compared, and the Contractor's blaster shall satisfy himself by examination that all the charges have exploded, before workmen are permitted to approach the site. The charge which has not exploded shall not be permitted to be withdrawn.

The tamping and charge shall be flooded with water and the holes marked with a red cross (X) over it. Another hole shall be jumped at a distance of about 45 cm from the old hole and fired in the usual way. This operation shall be continued, till the original and any subsequent unfired charges are exploded.

6.16.5 BLASTING WITH DYNAMITE OR ANY OTHER HIGH EXPLOSIVE

In case of blasting with dynamite or any other high explosive the position of all bore holes to be drilled shall be marked out in circle with white paint. These shall be inspected by the Contractor's blaster. Bore holes shall be of a size that the cartridge can easily pass down. After the drilling operation, the blaster shall reinspect the holes to see that the holes marked out by him have been drilled. He shall then prepare all charges necessary for the bore holes. The bore holes shall be thoroughly cleaned before a cartridge is inserted. Wooden tamping rods (not pointed but cylindrical throughout) shall be used, in charging holes. Metal rods shall never be used for tamping. One cartridge shall be first placed in the bore hole, gently pressed and not rammed down. Other cartridges shall then be added as may be required to make up the necessary

charge for the bore hole. The top most cartridges shall be connected to the detonator which shall in turn be connected to the safety fuse of required length.

The maximum of eight bore holes shall be loaded and fired on each occasion. The charges shall be fired successively and not simultaneously.

Immediately before firing a blast, due warning shall be given and the blaster shall see that all persons have retired to a place of safety. The safety fuses of the charged holes shall be ignited in the presence of the blaster, who shall see that all the fuses are properly ignited.

Careful count shall be kept by him and others of each blast as it explodes. After the blast the blaster shall inspect the work and ascertain that all the charged holes have been exploded. In case of misfired holes, he shall inspect the same after half an hour and mark red crosses (X) over the holes. During this interval of half an hour, no body shall approach the misfired holes. None of the drillers shall work near such holes, until one of the two following operations has been done by the blaster.

- a. Either the Contractor's blaster shall very carefully (when the tamping is of damp clay) extract the tamping with a wooden scraper and withdraw the fuse, primer and detonator, after which a fresh detonator, primer and fuse shall be placed in the misfired holes and fired.

OR

- b. The hole shall be cleaned for 30 cm of tamping and its direction ascertained by placing a stick in the hole. Another hole shall then be drilled 15 cm away and parallel to it. This hole shall be charged and fired. The misfired hole should also explode along with the new one

Before leaving the work, the blaster of one shift shall inform another blaster relieving him for the next shift, of any cases of misfire, and shall point out their positions denoted by red crosses and also state the action, if any, to be taken in the matter.

The Engineer-in-Charge shall also be informed by the blaster of all cases of misfire, their causes and steps taken in that connection.

6.16.6 CONTROLLED BLASTING

Whenever required by the Engineer-in-Charge, rock blasting shall be carefully controlled so that vibrations generated during the blasting do not cause damage to the buildings and installation around. Similarly, the rock pieces should not fly off and endanger the buildings and installations around. Apart from the general precautions mentioned in the preceding paragraphs, following protective measures and limits for use of explosive are suggested as guidelines. Tenderers are requested to carefully check the site conditions and submit details of the scheme they propose to adopt for controlling the blast.

Following protective measures shall be adopted while carrying out blasting operations.

The hole shall be covered with mild steel plate of minimum 12mm thickness.

Reinforcement rod meshes not less than 20mm dia. at 150mm centre in both directions shall be placed over the steel plates.

Steel plate and reinforcement shall be inspected after every blasting operation and all twists shall be removed before reuse to the satisfaction of the Engineer-in- Charge.

Sand filled bags of 6 to 8 layers shall be placed over the mesh suitably covering the whole region under blasting operation.

The thickness of covering plate and the kind of dead weight is to be duly approved by the Engineer-in-Charge.

- 6.16.7 Hard rock requiring blasting as described under cl.no. 2.3 above, but where blasting is prohibited for any reason(s) breaking up of rock can be done by using Hydraulic Splitter and chemical substances of approved manufacturer (Lifton or equivalent) mixed in an appropriate proportion. The method involves drilling holes into rock and then inserting/injecting hydraulic splitter/chemical solvents into the holes. The breaking-up of rock takes place in a controlled fashion without much noise and spark.

6.17 PAYMENT

This clause shall apply to item rate tenders only.

- 6.17.1 Payment for earth work in excavation shall be made on cubic meter (m³) basis on the measurement of volume of pit/trench of excavation with working space as per relevant Indian Standards (IS: 1200) and slopes/stepping as permitted by the Engineer-in-Charge. The rate shall include cost of all the operations of blasting with explosives & accessories, making of all arrangements for dewatering the accumulated water from any source in the excavated pit or trench, removal and disposal of surplus excavated soil within a lead of 100m from construction areas. The rate shall also include setting out and line out work required for the excavation.
- 6.17.2 The following works shall not be measured separately and allowance for the same shall be deemed to have been made in the description of main item:
- a. Setting out works, profiles, etc.;
 - b. Site clearance, such as cleaning grass and vegetation;
 - c. Unauthorized battering or benching of excavation;
 - d. Forming (or leaving 'dead men' or 'tell-tales' in borrow pits and their removal after measurements;
 - e. Forming (or leaving) steps in sides of deep excavation and their removal after measurements;
 - f. Excavation for insertion of planking and strutting;

- g. Unless otherwise specified, removing slips or falls in excavations;
 - h. Baling out or pumping of water in excavation from rains;
 - i. Baling out or pumping of water in excavation from sub-soil water, and
 - j. Slings or supporting pipes, electric cables, etc, met during excavation.
- 6.17.3 Special pumping other than what is included in 6.17.2 (h and i) and well point dewatering where resorted to, shall each be measured separately, unless otherwise stated, in kilolitres of water against separate specific provision(s) made for the purpose.
- 6.17.4 The Contractor shall intimate to the Engineer-in-Charge as soon as different classification of soils are met with. The measurements of various soil classifications then shall be worked out by either of the following alternatives in the order of their decreasing importance.
- a. Joint levels shall be taken as to the levels of different soil classifications and volume worked out on the basis of levels only.
 - b. Where levels of different strata cannot be clearly marked and defined, the Contractor shall stack different soils of various classifications separately for measurement purpose and then dispose it off.
 - c. If the quantum of work involved in (b) above is extensively large & time consuming, then the total area may be divided into various zones and reasonably representative samples as in (b) above may be taken and quantities of soils of various classifications finalized for the entire zone based on the representative.

If soil of any classification other than that specified in the Schedule of Rates is met with during excavation, the decision of the Engineer-in-Charge as to the classification of soil, levels of the strata of different classifications and their location shall be binding.

In above case, the total quantity of excavation shall be computed from the measurement of the pit/trench excavated. The hard rock and soft rock shall be measured separately from the relevant stacks and each shall be reduced by fifty percent for voids, and paid under the relevant items. The balance, that is the total quantity of excavation minus the reduced (for voids) quantity of excavation for rocks shall be paid as soft/hard soil as per the direction of the Engineer-in-Charge (However, the maximum payment shall be limited to the volume of the excavated pit/trench as approved by Engineer-in-Charge).

7.0 SHORING AND STRUTTING:

- 7.1 The shoring and strutting of the sides to withhold the face of excavation pits/trenches shall be done when approved or directed by the Engineer-in-Charge.
- 7.2 The shoring shall be of close or open timbering type depending upon the site requirements and as directed by the Engineer-in-Charge whose decision shall be final and binding as to the type of shoring to be used.

7.3 The arrangement of the shoring and strutting shall be sound and safe and shall be got approved from the Engineer-in-Charge before installation. The approval shall not absolve the Contractor of his responsibilities of safety and any other requirements of the contract.

7.4 The shoring and strutting shall be kept in position till all the relevant work in the excavated area is completed and approved. It shall be dismantled and removed only after the permission to do so is obtained from the Engineer-in-Charge.

7.5 PAYMENT

This clause shall apply to item rate tenders only.

Payment for shoring and strutting by close and open timbering shall be made on square meter (m²) basis as separate items. In both the cases, the measurement shall be done on the basis of the surface area of the sides of the excavation actually shored and strutted.

The rate shall include all labour, materials, erection of the poling boards, wales, struts, ballies etc., fixing and keeping the same in position as required, dismantling and removing the same after the work is over as directed.

8.0 BACK FILLING AROUND FOUNDATIONS AND IN PLINTH

8.1 Back filling around completed foundations, structures, trenches and in plinth shall be done to the lines and levels shown on the drawings including any trimming of the surfaces, as may be necessary. This shall be done with selected and approved earth from excavation or otherwise with materials described under clause 3.2 as directed by the Engineer-in-Charge. Where sufficient suitable material is not available from the excavation, the Engineer-in-Charge may direct to import suitable earth from other sources. The filling shall be done in layers of thickness not exceeding 15 cm with watering, rolling and ramming by manual methods/mechanical compactors to grade and level as shown on drawings to obtain 90% laboratory maximum dry density.

8.2 The Contractor shall not commence filling in and around any work until it has been permitted by the Engineer-in- Charge.

8.3 Backfilling around liquid retaining structures and pipes shall be done only after approval of the Engineer-in- Charge is obtained.

8.4 PAYMENT

This clause shall apply to item rate tenders only.

Payment for backfilling with earth shall be based on volume in cubic meters (m³) of consolidated fill. This volume shall be derived from the difference between the volume of excavation and the structure or trenches as the case may be. The rate shall include cost of extracting suitable approved earth from available excavated soil from spoil heaps within a lead of 100m, placing, watering, rolling, ramming compacting in layers,

trimming and dressing finished surface and disposal of surplus material up to a lead of 100m.

However, backfilling done with materials other than earth shall be paid separately under relevant items.

9.0 TRANSPORTATION OF SURPLUS EARTH

9.1 Surplus earth and soil from excavation shall be removed from construction area to the area demarcated by the Engineer-in-Charge.

9.2 PAYMENT

This clause shall apply to item rate tenders only.

9.2.1 Payment shall be made only for the lead beyond initial 100m from construction area. Rate shall include re- excavation, loading, transportation, dumping, stacking or spreading (as per directions of the Engineer in Charge) the surplus earth and the soil in the area demarcated by the Engineer-in-Charge. Payment shall be made on cubic meter (m³) basis on the difference of measurements of the volume of the excavated pits and the measurement of the back filling. Quantity generated due to voids in back filled volume of earth shall also be removed by the Contractor at no extra cost and this disposal of earth shall not be measured and paid under any item.

9.2.2 In exceptional circumstances the Engineer-in-Charge may direct the Contractor to remove surplus earth, concrete debris or any other waste material from site to the areas of disposal on the basis of truck measurement. In such cases volume of material shall be calculated on the basis of truck volume reduced by 30% for voids in case of soft/hard soils and 50% for soft/hard rock. All other provisions of disposal such as spreading, levelling, grading shall apply in this case also.



Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR PLAIN AND REINFORCED CEMENT CONCRETE

VCS-SS-CS-6023

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ABBREVIATION

m	Metre
mm	Millimetre
m ²	Square metre
m ³	Cubic metre
Kg/m ²	Kilogram per Square Metre
Kg/m ³	Kilogram per Cubic Metre
IS	Indian Standard
BIS	Bureau of Indian Standards
BS	British Standard
PVC	Poly Vinyl Chloride

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1.0 SCOPE

This specification is applicable for Concrete Grade up to M55 and establishes the requirements of materials, mix proportioning, placing, curing, etc. of all types of cast-in-situ and precast concrete used in foundations, underground and over ground structures, floors, pavements etc. Any special requirements as shown or noted on the drawings shall supersede over the provisions of this specifications.

2.0 REFERENCE

Apart from this specification, construction of plain and reinforced concrete works shall be in accordance with the Indian Standard Code of Practice for "Plain and Reinforced Concrete" IS: 456 and other relevant codes mentioned therein.

- 2.1 For Liquid Retaining Structures relevant Specification shall be applicable.
- 2.2 For Structural Steel works Specification No. VCS-SS-CS-6024 & 6026 shall be applicable.
- 2.3 In case of conflict between the clauses mentioned in this specification and those in the Bureau of Indian Standards (BIS), this specification shall govern.

3.0 MATERIALS

- 3.1 Materials for concrete viz. cement, Pozzolanas, Fly Ash, Ground Granulated Blast Furnace Slag, sand, coarse aggregate, water, etc. shall be as described in Specification No. VCS-SS-CS-6021.
- 3.2 Materials for all reinforcements, embedment, inserts, water bars etc. shall conform to Specification No. VCS-SS-CS-6021.
- 3.3 Materials suggested to be used as additive to concrete shall conform to Specification No. VCS-SS-CS-6021.

4.0 GRADES OF CONCRETE

Characteristic Compressive strength for different grades of concrete shall be as per Table-1.

TABLE – 1	
GRADES OF CONCRETE	
Grade Designation	Specified Characteristic Compressive Strength of 150 mm cube at 28 days (N/mm ²)
M 15	15
M 20	20
M 25	25
M30	30
M35	35

M 40	40
M 45	45
M 50	50
M 55	55

Note for Table - 1: The characteristic strength is defined as the strength of material below which not more than five (5) percent of the test results are expected to fall.

5.0 TYPE OF CONCRETE MIX

5.1 Unless otherwise noted on drawings, all lean/plain and reinforced concrete shall be nominal mix and design mix types, respectively.

5.2 NOMINAL MIX CONCRETE

This concrete shall be made (without preliminary tests) by adopting nominal concrete mix with proportions of materials as specified in clause no. 9 of IS: 456.

5.3 DESIGN MIX CONCRETE

The mix shall be designed as per IS: 10262 & SP: 23 to produce the grade of concrete having the required workability and characteristic strength not less than appropriate values given in Table-1. The target mean strength of concrete mix shall be equal to the characteristic strength plus 1.65 times the standard deviation.

As long as the quality of materials does not change, a mix design done earlier but not prior to one year may be considered adequate for later work. However, in case the quality of materials changes or there is a break in the continuity of construction and the same work is allocated to a new contractor, the Engineer-in-Charge shall ask for a new design mix.

Irrespective of the grade of concrete required to be produced as per characteristic strength criteria, the minimum cement content and maximum free water cement ratio in the design concrete shall be strictly maintained as stipulated in Table 2 for the corresponding grade of concrete.

6.0 CONCRETE MIX PROPORTIONING

Proportioning, as used in this specification, shall mean the process of determining the proportions of the various ingredients to be used to produce concrete of the required workability when fresh/green and strength, durability and surface finish, when hardened. The following information shall be collected prior to design of the concrete mix:

- Grade designation.
- Type of cement.
- Maximum nominal size of aggregate.

- d. Minimum cement content.
- e. Maximum free water cement ratio
- f. Workability requirements.
- g. Exposure condition as per Table 3 & Table 4 of IS: 456
- h. Maximum temperature of concrete at the time of placing.
- i. Method of Placing.

The Engineer-in-Charge shall verify the strength of the concrete mix, before giving his sanction of its use. However, this does not absolve the Contractor of his responsibility as regards achieving the prescribed strength of the mix. If during the execution of the work, cube tests show lower strengths than required, the Engineer-in-Charge shall order fresh trial mixes to be made by the Contractor. No claim to alter the rates of concrete work shall be entertained due to such changes in mix variations. Any variation in cement consumption shall be taken into consideration for material reconciliation. Preliminary mix designs shall be established well ahead of start of work.

6.1 MAXIMUM DENSITY

Suitable proportions of sand and the different sizes of coarse aggregates for each grade of concrete shall be selected to give as nearly as practicable the maximum density. This shall be determined by mathematical means, laboratory tests, field trials and suitable changes in aggregate gradation. The contractor shall submit to the Engineer-in-Charge at least three sets of mix design and corresponding test results after varying the mix proportions and / or grading of aggregate so as to establish the maximum density of any particular grade of concrete.

6.2 CONSISTENCY

The concrete shall have a consistency such that it shall be workable in the required position and when properly vibrated it flows around reinforcing steel, all embedded fixtures, etc.

6.3 WORKABILITY

"Workability of Concrete" shall be as per clause no. 7 of IS: 456.

6.4 DURABILITY

For achieving sufficiently durable concrete, strong, dense aggregates, low water-cement ratio and adequate cement content shall always be used. Workability of concrete shall be such that concrete can be completely compacted with the means available. Leak-proof formwork shall be used so as to ensure no loss of cement-slurry during pouring and compaction. Cover to reinforcement shall be uniform and as shown on drawings. Concrete mix design shall always take into account the type of cement, minimum cement content irrespective of the type of cement and maximum free water

cement ratio and minimum grade of concrete conforming to the exposure conditions as given in Table-2.

TABLE-2 MINIMUM CEMENT CONTENT, MAXIMUM FREE WATER CEMENT RATIO AND MINIMUM GRADE OF CONCRETE FOR DIFFERENT EXPOSURE CONDITIONS						
Exposure	Plain Concrete			Reinforced Concrete		
	Minimum Cement Content (kg /m ³)	Maximum Free Water Cement Ratio	Minimum Grade of Concrete	Minimum Cement Content (kg / m ³)	Maximum Free Water Cement Ratio	Minimum Grade of Concrete
Mild	220	0.6	M 15	300	0.55	M 20
Moderate	240	0.6	M 15	300	0.50	M 25
Severe	250	0.5	M 20	320	0.45	M 30
Very Severe	260	0.45	M 20	340	0.45	M 35
Extreme	280	0.4	M 25	360	0.4	M 40

Note: Cement prescribed in this table is irrespective of grade of Cement and it is inclusive of pozzolanas, Fly Ash, Ground Granulated Blast Furnace Slag may be taken into account in the concrete composition within respect to the cement content and water-cement ratio if the suitability is established and as long as the maximum amounts taken into account do not exceed the limit of pozzolona and slag specified in IS: 1489 (part-1) and IS: 455 respectively.

Generally, the following types of cement shall be used for Plain and Reinforced concrete works:

- 33 Grade Ordinary Portland Cement conforming to IS: 269.
- 43 Grade Ordinary Portland Cement conforming to IS: 8112.
- Rapid hardening Portland Cement conforming to IS 8041.
- Portland Slag Cement conforming to IS: 455.
- Portland Pozzolana Cement (fly ash based) conforming to IS: 1489(Part 1)
- Portland Pozzolana Cement (calcined clay based) conforming to IS: 1489(Part-2).
- Sulphate Resisting Portland Cement conforming to IS: 12330

Sulphate Resisting Portland Cement shall be used only for specific requirements depending on environmental and process exposure conditions to which the structures may be subjected to like high sulphate concentrations, processes involving sulphur handling etc.

6.4.1 FREE WATER CEMENT RATIO

Once a mix, including its free water cement ratio, has been determined and approved for use by the Engineer-in-Charge, that free water cement ratio shall be maintained. The Contractor shall determine the water content of the aggregates frequently as the work progresses, and the amount of mixing water shall be adjusted so as to maintain the approved free water cement ratio. Maximum free water-cement ratio shall be as per Table-2 for different exposure condition.

The minimum cement content as mentioned in Table-2 shall be adjusted for aggregates other than 20mm nominal maximum size. The minimum cement content in the concrete mix shall be increased by 40kg/m³ and decreased by 30 kg/m³ for 10mm and 40mm nominal maximum size aggregates respectively.

For maximum cement content refer clause no. 8.2.4.2 of IS: 456.

6.5 LIMITS TO DELETERIOUS CONSTITUENTS

Careful selection of the mix and the constituent materials shall be made to limit the presence of deleterious constituents in concrete. The total acid soluble chloride content calculated from the mix proportion and the measured chloride content of each of the constituents shall not exceed 0.6 kg/m³ at the time of placing of concrete. The total water soluble sulphate content of the concrete mix shall not exceed 4 percent by mass of the cement in the mix.

7.0 BATCHING

Refer clause no. 10.2 of IS: 456.

8.0 CONCRETE MIXING

- 8.1 The mixing of concrete shall be strictly carried out in an approved type of mechanical concrete mixer. The mixer shall be fitted with water measuring devices. The mixing shall be continued until there is a uniform distribution of the material and the mass is uniform in colour and consistency. If there is segregation after unloading from the mixer, the concrete shall be remixed.

Use of Ready Mixed Concrete supplied by Ready Mixed Concrete Plants or from on/off-site batching plants (IS: 4926) shall be preferred for structural concrete.

All records and charts for the batching and mixing operations shall be prepared and maintained by the contractor as per the instructions of Engineer-in-Charge.

8.2 MIXER

- 8.2.1 Mechanical Mixers shall comply with IS: 1791 and 12119 and shall be maintained in satisfactory operating condition. These shall be used only for producing lean/ plain concrete and/ or nominal mix concrete wherever permitted.

8.2.2 MIXING TIME

Mixing time shall be as indicated in the following table. Excessive mixing requiring additions of water shall not be permitted. Time shall start when all solid materials are poured in the revolving mixer drum, provided that all of the mixing water shall be introduced before one-fourth of the mixing time has elapsed. The Engineer-in-Charge may, however, direct a change in the mixing time, if he considers such a change necessary.

MINIMUM MIXING TIME FOR MIXERS

Capacity of mixer	Minimum mixing time
2 m ³ or less	2 minutes
Above 2 m ³	3 minutes or as recommended by the mixer manufacturer.

8.3 HAND MIXING

Hand mixing of concrete shall not be permitted. However, for non-critical applications namely foundations for crossovers, isolated operating platforms etc., using concrete of maximum grade M20 and located at far away isolated places, this may be permitted by the Engineer-in-charge as a special case. Ten percent (10%) extra cement shall be added to the design proportion. Mixing shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. No extra payment shall be made to the Contractor for mixing by hand or for using extra cement due to hand mixing.

8.4 ADDITIVES

Additive in concrete shall be used only with the prior approval of the Engineer-in-Charge and shall comply with clause no. 5.5 of IS: 456. Any additive used for obtaining proper workability or leak-proofness of concrete or repair/rendering works of concrete due to non-conformance to the specifications, shall not be measured and paid for. All costs relating to such usage shall be borne by the Contractor.

9.0 TRANSPORTATION, PLACING AND COMPACTION

9.1 GENERAL

The entire concrete placing programme including transportation arrangements, deployment of equipment, layout, proposed procedures and methods, shall be submitted to the Engineer-in-Charge 24 hours prior to concreting for approval. No concreting shall be placed until his approval has been received. Approval of the Engineer-in-Charge for pouring concrete shall be taken as 'conveyed', when the concrete pour card is signed by him.

9.1.1 CHUTING

The use of long troughs, chutes and pipes for conveying concrete from the mixer to the forms shall be permitted only on written authorization from the Engineer-in-Charge. In case an inferior quality of concrete is produced by the use of such conveyors, the

Engineer-in-Charge may order discontinuance of their use and the substitution of a satisfactory method of placing the concrete. Open troughs and chutes shall be equipped with baffles and be in short lengths to avoid segregation. Chutes shall be designed so that the concrete is, to some extent, remixed at the lower end by passing down through a funnel shaped pipe or drop chute. Alternatively, they shall discharge into a storage hopper from which the concrete shall be transported to the point of placing by wheel barrows or other means. Where drop chutes are used, a sufficient number of these must be provided, so that the concrete discharged from the chute is not required to flow laterally more than 1.0 metre. Where a drop chute is swung from the vertical, the bottom two sections must be maintained in a vertical position to avoid segregation. The addition of water at any point in the system of transportation, to facilitate the movement of concrete shall not be permitted. All chutes, troughs and pipes, shall be kept clean and free from coatings of hardened concrete by thoroughly flushing them with water after each run; water used for flushing shall be discharged clear of the structure. Concrete shall not be normally permitted to fall freely from a height of more than 1.5 metre nor to strike the forms at an angle. However, a deviation from this normal practice may be allowed provided proper precaution is taken, while placing concrete into the forms to avoid segregation, to the satisfaction of the Engineer-in-Charge.

9.1.2 VIBRATORS

- a. Concrete shall be compacted with mechanical vibrating equipment supplemented, if necessary to obtain consolidation, by hand spreading, rodding and tamping. The vibrators shall be of immersion type with operational frequency ranging between 8,000 to 12,000 vibrations per minute. All vibrators shall comply with IS: 2505. Screed board concrete vibrators or concreting vibrating tables or form vibrators conforming to IS: 2506, 2514 and 4656, respectively, shall be used where specifically required and directed by Engineer-in-Charge.
- b. Immersion type vibrators shall be inserted in a vertical position at intervals of about 600mm, depending upon the mix, the equipment used, and experience on work. The vibrators shall be withdrawn slowly. The spacing shall provide some overlapping of the area vibrated at each insertion. In no case shall vibrators be used to transport concrete inside the forms. Over vibration or under vibration shall not be permitted as both are harmful. Hand tamping in some cases may be allowed subject to the approval of the Engineer-in-Charge.
- c. In placing concrete in layers which are advancing horizontally as the work progresses, great care shall be exercised to ensure adequate vibration, bonding and moulding of the concrete between the succeeding batches.
- d. The vibrator shall penetrate the layer being placed and also penetrate the layer below while the under layer is still plastic to ensure good bond and homogeneity between the two layers and prevent the formation of cold joints.
- e. Care shall be taken to prevent contact of vibrators against all embedded reinforcing steel or inserts. Vibrators shall not be allowed to come in contact with forms.

- f. The use of form vibrators shall not be permitted for compaction of in-situ concrete without specific authorization of the Engineer-in-Charge.
- g. The use of surface vibrators of screed board type shall not be permitted for consolidation of concrete under ordinary conditions. However, for thin slabs (of thickness less than 200mm) surface vibration by such vibrators may be permitted, upon approval of the Engineer-in-Charge.
- h. Whenever vibration has to be applied externally, the design of formwork and the disposition of vibrators shall be carefully planned to ensure efficient compaction and to avoid surface blemishes.

9.2 TRANSPORTATION

- 9.2.1 All concrete shall be conveyed from the mixer to the place of final deposit such as formwork as rapidly as possible using suitable buckets, dumpers, pumps, transit mixers containers or conveyors which shall be mortar leak tight. Care shall be taken to prevent the segregation or loss of the ingredients and maintaining the required workability. For structural concrete produced from Ready Mixed Concrete Plants as per clause no. 8.1, concrete shall be transported from the plants to the sites only by transit mixers.
- 9.2.2 During hot or cold weather, concrete shall be transported in deep containers. Other suitable methods to reduce the loss of water by evaporation in hot weather and heat loss in cold weather may also be adopted. All equipment used for transporting and placing of concrete shall be maintained in clean condition. All buckets, hoppers, chutes, dumpers and other equipment shall be thoroughly cleaned after each use.

9.3 PLACING AND COMPACTION

- 9.3.1 Before placing concrete, all soil surfaces upon which or against which concrete is to be placed shall be well compacted and free from standing water, mud or debris. Soft or yielding soil shall be removed and replaced, with lean concrete or with selected soils/sand and compacted to the density as directed by Engineer-in-Charge. The surface of absorptive soil (against which concrete is to be placed) shall be moistened thoroughly so that moisture is not drawn from the freshly placed concrete. Similarly, for concrete to be placed on formworks, all chippings, shavings and sawdust etc. shall be removed from the interior of the forms before the concrete is placed.
- 9.3.2 Concrete shall not be placed until the formwork, the placement of reinforcing steel, embedded parts; pockets etc. have been inspected and approved by the Engineer-in-Charge. Any accumulated water on the surface of the bedding layer shall be removed by suitable means before start of placement. No concrete shall be placed on a water covered surface.
- 9.3.3 Concrete shall be discharged by vertical drop only and the drop height shall not normally exceed 1.5 metre throughout all stages of delivery until the concrete comes to rest in forms. For continuous concreting operation windows of suitable size shall be kept in the formwork or chutes shall be used to avoid segregation of concrete.

- 9.3.4 Concrete shall be deposited as near as practicable in its final position to avoid rehandling. Concrete shall be placed in successive horizontal layers. The bucket loads, or other units of deposit, shall be placed progressively along the face of the layer with such over-lap as will facilitate spreading the layer of uniform depth and texture with a minimum of hand shoveling. Any tendency to segregation shall be corrected by shoveling coarse aggregates into mortar rather than mortar on the coarse aggregates. Such a tendency for segregation shall be corrected by redesign of mix, change in process or other means, as directed by the Engineer-in-Charge.
- 9.3.5 All struts, stays and braces (serving temporarily to hold the forms in correct shape and alignment pending the placing of concrete at their locations) shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. These shall not be buried in the concrete. Concrete shall be thoroughly compacted with vibrators and fully worked around the reinforcement, embedded fixtures and into corners of formwork before setting commences and shall not be subsequently disturbed. Methods of placing shall be such as to preclude segregation and avoid displacement of reinforcement or formwork. The formation of stone-pockets or mortar bondage in corners and against face forms shall not be permitted. Should these occur, they shall be dug out, reformed and refilled to sufficient depth and shape for thorough bonding as directed by the Engineer-in-Charge. Care shall be taken to avoid displacement of reinforcement and embedded inserts or movement of formwork.
- 9.3.6 Unless otherwise approved, concrete shall be placed in single operation to the full thickness of foundation rafts, slabs, beams and similar members. Concrete shall be placed continuously until completion of the part of the work between approved construction joints or as directed by the Engineer-in-Charge.
- 9.3.7 The method of placing and compaction employed in any particular section of the work shall be to the entire satisfaction of the Engineer-in-Charge.
- 9.3.8 During hot weather (atmospheric temperature above 40 degree Celsius) or cold weather (atmospheric temperature less than 5 degree Celsius, the concreting shall be done as per the procedure set out in IS: 7861).
- 9.3.9 Concrete that has set standing and becomes stiffened shall not be used in the work.
- 9.4 ITEMS EMBEDDED IN CONCRETE
- 9.4.1 Concreting shall not be started unless the electrical conduits, pipes, fixtures etc., wherever required, are laid by the concerned agency. The Contractor shall afford all the facilities and maintain co-ordination of work with other agencies engaged in electrical and such other works as directed by the Engineer-in-Charge.
- 9.4.2 Before concreting, the Contractor shall provide, fabricate and lay in proper position all metal inserts, anchor bolts, pipes etc. (which are required to be embedded in concrete members) as per relevant drawings and directions of Engineer-in-Charge.
- 9.4.3 All embedment, inserts etc. shall be fully held and secured in their respective positions by the concerned agencies to the entire satisfaction of Engineer-in-Charge so as to

avoid any dislocation or displacement during the concreting operations. The Contractor shall take all possible care during concreting to maintain these embedment/inserts in their exact locations

10.0 CONSTRUCTION JOINTS

- 10.1.1 Construction joints shall be provided in position as shown or described on the drawings or as directed by the Engineer-in-Charge. Such joints shall be kept to the minimum. These shall be straight and at right angles to the direction of main reinforcement and shall be placed at accessible locations to permit cleaning out of laitance, cement slurry and unsound concrete. Construction joints shall comply with IS: 11817
- 10.1.2 In a column, the joint shall be formed about 100mm to 150mm below the lowest soffit of the beams framing into it. Concrete in a beam and slab shall be placed throughout without a joint but if the provision of a joint is unavoidable, the joint shall be vertical and located within $\frac{1}{3}$ to $\frac{1}{4}$ of the span, unless otherwise shown on the drawings.
- 10.1.3 When stopping the concrete on a vertical plane in slabs and beams, an approved stop board shall be placed with necessary slots for reinforcement bars. The construction joints shall be keyed by providing a triangular or trapezoidal fillet nailed on the stop board. Inclined joints shall not be permitted. Any concrete flowing through the joints of stop board shall be removed soon after the initial set. When concrete is stopped on a horizontal plane, the surface shall be roughened and cleaned after the initial set and a triangular or trapezoidal groove shall be provided for keying with the new concrete later.
- 10.1.4 When the work has to be resumed on a surface which has hardened, such surface shall be cleared of any foreign materials and roughened to expose the tips of the coarse aggregate. This may be done by manual chipping of concrete, with a high pressure water jet or by any other appropriate means as per Engineer-in-Charge's directions. It shall then be swept clean and thoroughly washed and wetted before any new concrete is poured. Any set mortar or concrete sticking to the exposed reinforcing rods in and around such joints shall be thoroughly removed. The reinforcements shall be wire brushed and washed just before pouring any cement slurry or mortar. For vertical joints neat cement slurry shall be applied on the surface before it is dry. For horizontal joints the surface shall be covered with a layer of mortar about 10 to 15mm thick composed of cement and sand in the same ratio as the cement and sand in concrete mix. This layer of cement slurry or mortar shall be freshly mixed and applied immediately before placing new concrete.
- 10.1.5 Where the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgement of particles of aggregate. The surface shall be thoroughly wetted and all free water removed. The surface shall then be coated with neat cement slurry. On this surface layer of concrete not exceeding 150mm in thickness shall first be placed and shall be well rammed against old work, particular attention being paid to corners and close spots; work thereafter shall proceed in normal way.

11.0 SEPARATION JOINT

- 11.1 Separation joint shall be obtained by using an approved alkathene sheet stuck on the surface against which concrete shall be placed. Adequate care shall be taken to cause no damage to the sheet.

12.0 EXPANSION JOINTS/ISOLATION JOINT

- 12.1 Expansion/ isolation joints in structures shall be formed in the positions and to the shapes shown in the relevant drawings. Joints shall be filled with joint filling material as stipulated in the drawings/schedule of rates. Isolation joints shall be provided around all equipment foundations, columns, pedestals, trenches etc. on grade.

13.0 WATER STOPS

PVC water stops as per Specification No. SS-CV-021 for materials shall be accurately cut, fitted and integrally joined as per manufacturer's specifications to provide a continuous, watertight diaphragm at all points.

The water stops shall be located and embedded at expansion/contraction/ construction joints as indicated in the drawings or directed by the Engineer-in-Charge.

Adequate provision shall be made for the support and protection of water stops during the progress of the work. Damaged water stops shall be replaced and/or repaired as directed.

14.0 PROTECTION OF FRESHLY LAID CONCRETE

- 14.1 Newly placed concrete shall be protected, by approved means, from rain, sun and wind. Concrete placed below the ground level shall be protected from falling earth during and after placing. Surface shall be kept free from contact with such ground or with water draining from such ground during placing of concrete for a period of at least 3 days, unless otherwise directed by the Engineer-in-Charge. The ground water around newly poured concrete shall be kept to an approved level by pumping or other approved means of drainage and adequate steps shall be taken to prevent floatation and flooding. Steps shall be taken to protect immature concrete from damage by debris, loading, vibration, abrasion, mixing with deleterious materials that may, in the opinion of the Engineer-in-Charge, impair the strength and/or durability of the concrete.

15.0 CURING

- 15.1 Concrete shall be cured by keeping it continuously moist wet for the specified period of time to ensure complete hydration of cement and its hardening. Curing shall be started after 8 hours of placement of concrete in normal weather, and in hot weather after 4 hours. The water used for curing shall be of the same quality as that used for making of concrete.

Curing shall be assured by use of an ample water supply under pressure in pipes, with all necessary appliances such as hose, sprinklers etc. A layer of sacking, canvas, hessian, or other approved material, which will hold moisture for long periods and prevent loss of moisture from the concrete, shall be used as covering. Type of covering which would stain, disfigure or damage the concrete, during and after the curing period, shall not be used. Only approved covering shall be used for curing.

Exposed surfaces of concrete shall be maintained continuously in a damp or wet condition for at least the first 7 days after placing of concrete.

The Contractor shall have all equipment and materials required for curing on hand and ready to use before concrete is placed.

For curing the concrete in pavements, floors, flat roofs or other level surfaces, the ponding method of curing shall be used. For the first 24 hours after concreting the concrete shall be cured by use of wet sacking, canvas, hessian etc. The minimum water depth of 25mm for ponding shall be maintained. The method of containing the ponded water shall be approved by the Engineer-in-Charge. The ponded areas shall be kept continuously filled with water, and leaks, if any, shall be promptly repaired. Areas cured by ponding method shall be cleared of all debris and foreign materials after curing period is over.

Alternatively, membrane curing may be used in lieu of moist curing with the permission of the Engineer-in-Charge. Such compounds shall be applied to all exposed surfaces of the concrete by spraying or brushing as soon as possible after the concrete has set. Minimum film thickness of such curing compounds shall be as per the recommendation of the manufacturer so as to obtain an efficiency of 90% as specified by BS-8110. This film of curing compound shall be fully removed from the concrete surface after the curing period specified earlier. Engineer-in-Charge may not allow curing by curing compounds for those surfaces where use of curing compound may be detrimental to application of future finishes over the concrete. Impermeable membranes such as polyethylene sheeting closely covering the concrete surface may also be used.

- 15.2 For concretes containing Portland Pozzolana cement or Portland slag cement, the curing period as given in clause no. 15.1 shall be doubled. Curing by ponding shall, however, commence after the first 24 hours of concreting.

16.0 FIELD TESTS

16.1 Grading Test

Grading test on fine and coarse aggregates shall be carried out as per IS: 2386 at intervals specified by the Engineer-in-Charge.

The mandatory tests and their frequencies shall be done on sand and stone aggregates as given in Table-3

**TABLE - 3
MANDATORY TESTS ON SAND & STONE AGGREGATES**

S.No	MATERIAL	TEST	FIELD/LAB TEST	MIN. QTY. OF MATERIAL/WORK FOR CARRYING OUT THE TEST	FREQUENCY OF TESTING
1.	Sand	(a) Bulking of sand	Field	20 m ³	Every 20 m ³ or part thereof or more frequently as decided by the Engineer-in-Charge
		(b) Silt content	Field	20 m ³	
		(c) Particle size distribution	Field or Lab as decided by the Engineer-in-Charge	40 m ³	1) Every 40 m ³ of fine aggregate/sand required in RCC works only 2) Every 80 m ³ of fine aggregate/sand required for other items
2.	Stone aggregate	a) Percentage of soft or deleterious materials	General visual inspection, laboratory test where required by the Engineer-in-Charge or as specified	As required by Engineer-in-Charge	For all quantities
		b) Particle size	Field or lab. as required by Engineer-in-Charge	45 m ³	For every 45 m ³ or part thereof as decided by Engineer-in-Charge
		c) Ten percent value	Laboratory	45 m ³	Initial test and subsequent test as & when required by Engineer-in-Charge

16.2 VEE-BEE TEST/SLUMP TEST OF CONCRETE

16.2.1 For structural quality concrete (excluding pavements, flooring etc.) at least one Slump Test shall be made for every compressive strength test carried out. More frequent tests shall be made if there is a distinct change in working conditions or if required by the Engineer-in-Charge.

16.2.2 For structural quality concrete for pavements & floorings, measurement of workability shall be by determination of compacting factor. Value of compacting factor of 0.75 to 0.8 shall generally be acceptable.

16.3 STRENGTH TEST OF CONCRETE

16.3.1 Samples from fresh concrete shall be taken as per IS: 1199 and cubes shall be made, cured and tested at 28 days in accordance with IS: 516.

16.3.2 In order to get a relatively quicker idea of the quality of concrete, optional tests on beams for modulus of rupture at 72 ± 2 hours or at 7 days, or compressive strength tests at 7 days may be carried out in addition to 28 days compressive strength tests. For this purpose, the values shall be arrived at based on actual testing. In all cases, the 28 days compressive strength specified in Table-1 shall alone be the criterion for acceptance or rejection of the concrete.

16.3.3 PROCEDURE

A random sampling procedure shall be adopted to ensure that each concrete batch shall have a reasonable chance of being tested, that is the sampling should be spread over the entire period of concreting and cover all mixing units.

16.3.4 FREQUENCY OF SAMPLING

The minimum frequency of sampling of concrete for each grade shall be in accordance with Table-4.

**TABLE - 4
FREQUENCY OF CONCRETE SAMPLING**

Quantity of concrete in the work in m^3	Number of samples
1-5	1
6-15	2
16-30	3
31-50	4
51 & above	4 plus one additional sample for each additional $50m^3$ or part thereof.

At least one sample shall be taken from each shift. Where concrete is produced at continuous production units such as ready mixed concrete plants, frequency of sampling may be agreed upon mutually by Engineer-in-Charge.

16.3.5 TEST SPECIMEN

Three test specimens shall be made from each sample for testing at 28 days. Additional cubes may be required for various purposes such as to determine the strength of concrete at 7 days or at the time of striking the formwork or to check the testing error. Additional samples may also be required for testing samples cured by accelerated methods as described in IS: 9013. The specimen shall be tested as described in IS: 516.

16.3.6 IDENTIFICATION MARK ON CONCRETE TEST CUBES:

The following numbering system shall be adopted on each 150mm cube:

First line: ZZ (Alpha code assigned by the Engineer -in-Charge to the

Contractor for a particular contract starting with AA and progressing to AB, AC and so on).

Second line: XXXX (Unique integer in ascending order starting from 1).

Third line: DD-MM-YY (Date of casting of cube).

16.3.7 TEST RESULTS OF SAMPLE

The test results of the sample shall be the average of the strength of three specimens. The individual variation should not be more than ± 15 percent of the average. If the individual variation is more than ± 15 percent, the test results of the sample shall be considered invalid.

16.3.8 STANDARD DEVIATION

- a. Standard deviation based on test results of samples:
 - i. The total number of test samples required to constitute an acceptable record for calculation of standard deviation shall be not less than 30. Attempts shall be made to obtain the 30 samples, as early as possible, when a mix is used for the first time.
 - ii. For design of mix in the first instance, the value of standard deviation given in Table-8 of IS: 456 may be assumed.
 - iii. As soon as sufficient results of samples are available, actual calculated standard deviation shall be used and the mix design revised/ updated.

16.3.9 ACCEPTANCE CRITERIA

- a. Compressive Strength

The concrete shall be deemed to comply with the strength requirement when both the conditions as given in Table-11 of IS: 456 for that particular grade of concrete are simultaneously met. For working out standard deviation compressive test result of date wise serially logged 30 sample test result will be used.

b. Flexural Strength

The concrete shall be deemed to comply with flexural strength requirements when both the following conditions are simultaneously met:

- i. The mean strength determined from any group of four consecutive test results exceeds the specified characteristic strength by at least 0.3 N/mm².
- ii. For non overlapping consecutive compressive test result any one alternate set of four samples shall be used for verification of compliance to clause no 16.1.a of IS 456.
- iii. The strength determined from any test result is not less than the specified characteristic strength less 0.3 N/mm²

c. Quantity of Concrete Represented by Strength Test Results

The quantity of concrete represented by group of four consecutive test results shall include the batches from which first and last samples were taken together with all intervening batches. Acceptance of concrete shall be applicable for serially logged 30 samples. In case serially logged samples are less than 30 then standard deviation of adjoining previous sample sets standard deviation will be used for establishing acceptance criteria as per clause no 16.1.a of IS 456.

For the individual test result requirements given in Table 11 of IS: 456 or in item (ii) of 16.3.9 (b), only the particular batch from which the sample was taken shall be at risk.

Where the mean rate of sampling is not specified, the maximum quantity of concrete that four consecutive test results represent shall be limited to 60m³.

- d. If the concrete is deemed not to comply pursuant to 16.3.9 (c), the structural adequacy of the parts affected shall be investigated and any consequential action as needed shall be taken (Refer clause no. 17.0 & 18.0).
- e. Concrete of each grade shall be assessed separately.
- f. Concrete is liable to be rejected if it is porous or honey-combed, its placing has been interrupted without providing a proper construction joint, the reinforcement has been displaced beyond the tolerances specified, or construction tolerances have not been met. However, the hardened concrete may be accepted after carrying out suitable remedial measures and tests to the fullest satisfaction of the Engineer-in-Charge.

17.0 INSPECTION AND TESTING OF STRUCTURES

17.1 INSPECTION

To ensure that the construction complies with the design, an inspection procedure shall be set up by the contractor and duly approved by Engineer-in Charge covering materials used, receipt of materials, their test results, records, workmanship and construction etc.

- 17.2 Immediately after stripping the formwork, all concrete shall be carefully inspected and any defective work or small defects either removed or made good before concrete has thoroughly hardened.

17.3 TESTING

In case of doubt regarding the grade or soundness of concrete used, either due to poor workmanship or based on results of cube strength, compressive strength tests of concrete on the basis of clause no. 17.4 and/or load test as per clause no. 17.6 of IS: 456 shall be carried out.

The Engineer-in-Charge shall be the final authority for interpreting the results of all tests and shall decide upon the acceptance or otherwise. The decision of the Engineer-in-Charge shall be final and binding on the contractor. In case the results of the tests are unsatisfactory, the Engineer-in-Charge may instruct the contractor to demolish and reconstruct the structure or part thereof without any extra cost to the Owner.

17.4 MEMBERS OTHER THAN FLEXURAL MEMBERS

Members other than flexural members like columns etc. shall be referred to the designer to investigate the structural adequacy. The decision of the designer shall be final and binding on the contractor.

17.5 NON - DESTRUCTIVE TESTS

Non-destructive tests using Ultrasonic Pulse Velocity and Rebound Hammer methods shall be resorted to for checking the soundness of concrete placed and shall be as per the directions of Engineer-in-Charge. The testing shall be based on IS: 13311, Part-1. However, the Rebound Hammer test (IS: 13311, Part-2) shall only be used in combination with other tests (Destructive or Non-Destructive) for checking the concrete quality.

18.0 FINISHING OF CONCRETE

- 18.1 On striking the formwork, all surface defects such as bulges, ridges and honey-combing etc. observed shall be brought to the notice of the Engineer-in-Charge. The Engineer-in-Charge may, at his discretion allow rectification by necessary chipping and packing or grouting with concrete or cement mortar. However, if honey-combing or sagging is of such extent as being undesirable, the Engineer-in-Charge may reject the work totally and his decision shall be binding. No extra payment shall be made for rectifying these defects, demolishing and reconstructing the structure. However, quantity of cement actually used for this purpose may be considered for reconciliation of materials. All burrs and uneven faces shall be rubbed smooth with the help of carborundum stone.

The surface of non-shuttered faces shall be smoothened with a wooden float to give a finish similar to that of the rubbed down shuttered faces. Concealed concrete faces shall be left as from the formwork except that honey-combed surface shall be made good as specified above. The top faces of slabs not intended to be covered shall be levelled and floated to a smooth finish to the rises or falls shown on the drawings or as directed. The floating shall not be executed to the extent of bringing excess fine materials to the surface. The top faces of slabs intended to be covered with screed, granolithic or similar finishes, shall be left with a rough finish.

18.2 REPAIR AND REPLACEMENT OF UNSATISFACTORY CONCRETE

- 18.2.1 Repair shall be made as soon as possible after the forms are removed and before the concrete becomes too hard with prior permission from the Engineer-in-Charge, in writing. Stone pockets, segregation patches and damaged areas shall be chipped out and the edges undercut slightly to form a key. All loose material shall be washed out before patching. No excess water shall be left in the cavity, but the concrete shall be damp. A good bond between the patch and parent concrete shall be obtained by sprinkling dry cement on the wet surface or by throwing mortar with force on to the wetted concrete, or by brush in a coat of thick cement grout of about 1:1 (1 cement: 1 sand) just before applying the patching material. Before this has dried, the remainder of the patch shall be filled with mortar or concrete, depending on the extent of the repair.
- 18.2.2 Cement concrete/mortar used in repair of exposed surfaces shall be made with cement from the same source as that used in concrete and blended with sufficient amount of white Portland cement to produce the same colour as in the adjoining concrete. The proportions of ingredients shall be same as those used in parent concrete. The mortar shall be as dry as possible and well compacted into the cavity. All filling shall be tightly bonded to the concrete and shall be sound, free from shrinkage cracks after the filling has been cured and dried.
- 18.2.3 For larger repairs to hardened concrete, necessary formwork bearing tightly at the edges of the cavity shall be provided. Concrete shall be chipped out to a depth of at least 100mm and preferably 150mm. Mortar shall be scrubbed into all surfaces with a wire brush before placing the concrete. Damaged reinforcement shall be adequately spliced with new steel so as to maintain the original strength. Additional reinforcement, if required in the patch, shall be provided as per the instructions of Engineer-in-Charge.
- 18.2.4 In case in the opinion of the Engineer-in-Charge defects in the concrete is excessive or beyond repair, the contractor shall either redo the structure or take other remedial measures as instructed by the Engineer-in-Charge. The decision of the Engineer-in-Charge shall be final and binding to all in this respect.
- 18.2.5 Approved epoxy formulation for bonding fresh concrete used for repairs with already hardened concrete shall be used by the Contractor if asked by the Engineer-in-Charge. Epoxy shall be applied in strict accordance with instructions of the manufacturer.
- 18.2.6 All repair works due to non-conformance or non-adherence to specification, if allowed by the Engineer-in-Charge, shall be carried out free of cost to the owner.

18.3 CURING OF PATCHED WORK

Immediately after patching is completed, the patched area shall be covered with an approved non-staining water saturated material which shall be kept wet and protected against sun and wind for a period of 12 hours. Thereafter, the patched area shall be kept continuously wet by a fine spray or sprinkling for not less than 10 days.

19.0 CEMENT WASH

If not otherwise provided with protective coating due to architectural and/ or geo-technical requirements, all concrete elements (whether cast-in-situ or precast) exposed to atmosphere shall be provided with three coats of cement based waterproof paint as per IS: 5410. Prior to application of the paint, the surface shall be prepared to remove all foreign particles, loose materials, extra deposited concrete lumps, etc. using appropriate mechanical/ manual means.

20.0 FORM WORK

20.1 General

20.1.1 Forms for concrete shall be of plywood conforming to IS: 6461 or steel or as directed by the Engineer-in-Charge and shall give smooth and even surface after removal thereof.

20.1.2 If it is desired by the Engineer-in-Charge, the Contractor shall prepare, before commencement of actual work, design and drawings for formwork and get them approved by the Engineer-in-Charge. For details regarding design, detailing etc., reference may be made to IS: 14687.

20.1.3 Form work and its supports shall maintain their correct position and be to correct shape and profile so that the final concrete structure is within the limits of dimensional tolerances specified below, unless required otherwise, for functional/aesthetic reasons. The decision of the Engineer-in-Charge shall be final and binding in this regard.

- a. Deviation from specified dimensions of cross section of columns and beams. - 6mm to +12mm
- b. Deviation from dimensions of footings (see Note below)
 - i. Dimensions in plan -12mm to +50mm
 - ii. Eccentricity 0.02 times the width of the footing in the
 - 1. direction of deviation but not
 - 2. More than 50 mm.
 - iii. Thickness ± 0.05 times the specified thickness.

Note: These tolerances apply to Cast-in-situ concrete dimensions only, not to positioning of vertical reinforcing steel or dowels.

- c. Deviation in length (major dimension of single unit)
- | | |
|---|-------|
| up to 3m | ±6mm |
| 3m to 4.5m | ±9mm |
| 4.5m to 6m | ±12mm |
| Additional deviation for every subsequent 6m. | ±6mm |
- d. Deviation in straightness or bow (deviation from specified line) for a single or continuous member) e.g. beam, column or slab edge.
- | | |
|-------------------------------------|-------|
| Up to 3m | 6mm |
| 3m to 6m | 9mm |
| 6m to 12m | -12mm |
| Additional for every subsequent 6m. | -6mm |
- e. Deviation in squareness shall be measured taking the longer of two adjacent sides as the base line.
- The shorter side shall not vary in its distance from a perpendicular so that the difference between the greatest and shortest dimensions exceeds 6mm. For this purpose, any error due to lack of straightness shall be ignored. Squareness shall be checked with respect to the straight lines that are most nearly parallel with the features being checked. When the nominal angle is other than 90 degree, the included angle between check lines shall be varied accordingly.
- f. Deviation in twist shall be within a limit such that any corner shall not be more than the limit given below from the plane containing other three corners:
- | | |
|-----------------------------|------------------|
| Up to 600mm wide and up to | 6m in length-6mm |
| Over 600mm wide and for any | length -12mm |
- g. Maximum deviation in flatness from a 1.5m straight edge placed in any position on a nominally plain surface shall not exceed 6mm.
- h. The tolerance limits for concrete columns/pedestals shall be same as given in part A of ANNEXURE-A of Specification No. VCS-SS-CS-6024.

20.2 FORM REQUIREMENT:

- 20.2.1 The formwork shall be true, rigid and adequately braced both horizontally as well as diagonally. The forms shall have smooth and even surface and be sufficiently strong to carry, without deformation, the dead weight of the green concrete, working load, wind load and also the side pressure exerted by the green concrete. As far as practical, clamps shall be used to hold the forms together. Where use of nails is unavoidable

minimum number of nails shall be used. Projected part of nail shall not be bent or twisted for easy withdrawal.

- 20.2.2 Where through tie rods are required to be put to hold the formwork and maintain accurate dimension, they shall always be inserted through a precast concrete block (of same mix proportion as is to be used for concreting) with a through hole of bigger diameter. The Precast block shall tightly fit against in inner faces of formwork. The holes left after the withdrawal of tie rods shall be fully grouted with cement-sand mortar of same proportion as that used for concrete. However, use of such precast block shall in no case impair the desired appearance or durability of the structure. No such tie rods shall be used in any liquid retaining or basement structure.
- 20.2.3 Tie wires shall be permitted only upon approval of the Engineer-in-Charge and shall be cut off flush with the face of the concrete or counter sunk, filled and finished in the manner specified in clause 18.
- 20.2.4 Form joints shall not permit any leakage. The formwork shall be strong enough to withstand the effect of vibrations practically without any deflection, bulging, distortion or loosening of its components.
- 20.2.5 Forms for beams and slabs (span more than 6.0m) shall have camber of 1 in 500 so as to offset the deflection and assume correct shape and line after deposition of concrete. For cantilevers, the camber at free end shall be 1/100th of the projected length. Where architectural considerations and adjunctive work are critical, smaller form cambers shall be adopted as decided by the Engineer-in-Charge.
- 20.2.6 All vertical wall forms may be designed and constructed for the following minimum pressure. The pressures listed in Table-5 are intended as guide only and the Contractor shall ensure that the formwork is adequately strong and sturdy.

**TABLE-5
MINIMUM DESIGN PRESSURE FOR WALL FORMWORK**

Rate of pour in meter/hour	Pressure in KN/m ²	
	at 10° (in Celsius)	at 24° (in Celsius)
0.6	36.0	29.0
0.9	40.0	32.0
1.2	44.0	35.0
1.5	46.0	37.0

All horizontal forms shall be designed and constructed to withstand the dead load of the green concrete, reinforcement, equipment, material, embedment and a minimum live load of 2.0 kN/m².

20.3 INSPECTION OF FORMS

Temporary openings shall be provided at the base of column and wall forms and other places necessary to facilitate cleaning and inspection. Before concrete is placed, all forms shall be carefully inspected to ensure that they are properly placed, sufficiently rigid and tight, thoroughly cleaned, properly treated and free from foreign material. The complete

form work shall be inspected and approved by the Engineer-in-Charge before the reinforcement bars are placed in position. When forms appear to be unsatisfactory in any way, either before or during the placing of concrete, the work shall be stopped until the defects have been corrected as per the instructions of the Engineer-in-Charge.

20.4 CLEANING AND TREATMENT OF FORMWORK

The surfaces of forms that would come in contact with concrete shall be well treated with approved non- staining form release agents such as soft soap, oil, emulsions etc. Release agents shall be applied so as to provide a thin uniform coating to the forms without coating the reinforcement.

20.5 CHAMFERS AND FILLETS

All comers and angles shall be formed with 45 degree mouldings to form chamfers or fillets on the finished concrete. The standard dimensions of chamfers and fillets, unless otherwise detailed or specified shall be 25x25mm. For heavier work chamfers or fillets shall be 50x50mm. Care shall be exercised to ensure accurate mouldings. The diagonal face of the moulding shall be planed or surfaced to the same texture as the forms to which it is attached.

20.6 REUSE OF FORMS

Before reuse, all forms shall be thoroughly scrapped, cleaned, examined and when necessary, repaired and retreated, before resetting. Formwork shall not be reused, if declared unfit or un-serviceable by the Engineer-in-Charge.

20.7 REMOVAL OF FORMS/STRIPPING TIME

In the determination of time for removal of forms, consideration shall be given to the location and character of the structures, the weather and other conditions including the setting and curing of the concrete and material used in the mix.

Forms and their supports shall not be removed without the approval of the Engineer-in-Charge. Forms shall not be released until the concrete has achieved strength of at least twice the stress to which the concrete may be subjected at the time of removal. The formwork shall be removed without shock and methods of form removal likely to cause over stressing or damage to the concrete, shall not be adopted. Supports shall be removed in such a manner as to permit the concrete to uniformly and gradually take the stresses due to its own weight.

In normal circumstances when average air temperature exceeds 15 degree Celsius during the period under consideration after pouring of concrete and where ordinary Portland cement is used, forms may generally be removed after expiry of following periods.

a.	Walls, columns and vertical faces of all structural members	16 to 24 hours as may be decided by the Engineer-in-Charge.

- b. Slabs (props left under) 3 days.
- c. Beam Soffits (props left under) 7 days.
- d. Removal of props under slabs:
 - Spanning up to 4.5m. 7 days.
 - Spanning over 4.5m. 4 days.
- e. Removal of props under beams and arches:
 - Spanning up to 6m 14 days.
 - Spanning over 6m 21 days
- f. Cantilever Construction Formwork shall remain till structures for counter acting or bearing down have been erected and have attained sufficient strength (minimum 14 days).

Notes:

1. For other cements, the stripping time recommended for ordinary Portland cement shall be suitably modified as per the instructions of the Engineer- in-Charge.
2. The number of props left under, their sizes, supporting arrangement, and disposition shall be such as to be able to safely carry the full dead load of the slab, beam or arch as the case may be together with any live load likely to occur during curing or further construction.
3. Where the shape of the element is such that the formwork has re-entrant angles, the form work shall be removed as soon as possible after the concrete has set, to avoid shrinkage cracking occurring due to the restraint imposed.
4. For rapid hardening cement, 3/7 of the above mentioned periods shall be considered subject to a minimum of 16 hours.

20.8 STAGING/SCAFFOLDING

20.8.1 Staging/Scaffolding shall be properly planned and designed by the Contractor. Use of only steel tubes is permitted for staging/scaffolding. The Contractor shall get it reviewed by Engineer-in-Charge before commencement of work. While designing and during erection of scaffolding/staging, the following measures shall be considered:

- a. Sufficient sills or under pinning's in addition to base plates shall be provided particularly where scaffolding 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/staging 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 and effort 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 clamps/couplings are firmly tightened to avoid slippage.
- i. Erection work of a scaffolding/staging under no circumstances shall be left totally to semi-skilled or skilled workmen and shall be carried out under the supervision of a technically qualified civil engineer of the Contractor.

20.8.2 For smaller works or works in remote areas, wooden ballies may be permitted for scaffolding/staging by the Engineer-in-Charge at his sole discretion. The contractor must ensure the safety and suitability of such works as described under clause 20.8.1 above

21.0 EXPOSED/ARCHITECTURAL CONCRETE WORK

21.1 FORM WORK

Other things remaining same as per clause no. 20.0, formwork shall be of high quality. Care shall be taken to arrange the forms so that the joints between forms correspond with the pattern indicated in the drawings. The forms shall be butting with each other in straight lines, the corners of the boards being truly at right angles. The joints between the forms shall cross in the two directions at right angles. The size of forms shall be so selected as to exactly match with the pattern of forms impression on the concrete face indicated in the drawings. Maximum care shall be taken to make the form work watertight. Burnt oil shall not be used for treatment of forms. The Contractor shall be permitted reuse of forms brought new on the work for exposed concrete work as specified below.

Such reuses shall be permitted only if forms are properly cared for, stored, repaired and treated after each use.

- a. Plywood Forms 6 Reuses (max.)
- b. Steel Forms 10 Reuses (max.)

The Engineer-in-Charge may, at his absolute discretion, order removal of any forms considered unfit for use in the work irrespective of the number of uses specified above.

21.2 FINISHING

Repairing to exposed concrete work shall be avoided. Rendering and plastering shall not be done. Minor repairing, if unavoidable shall be done as specified in clause 18.0 with the written permission of the Engineer-in-Charge.

22.0 REINFORCEMENT

22.1 The Contractor shall develop the bar bending schedule for all RCC structures/ structural parts at no extra cost to the Owner and shall get it reviewed by the Engineer-in-charge. Reinforcement shall be cut and bent to shape as per dimensions shown in the bar bending schedule/drawings.

If protective fusion bonded epoxy coating is required to be applied on reinforcement bars, the same shall be done as per IS: 13620. All repairs to applied protective coating required due to mishandling and/ or bending of reinforcement bars shall also be done as per relevant clauses of IS: 13620.

22.2 STRAIGHTENING, CUTTING AND BENDING

Procedure for cutting and bending shall be as given in IS: 2502. In case bars are supplied in coils, they shall be smoothly straightened without any kinks.

Cold twisted deformed bars shall be bent cold. Bars larger than 25mm in size (except cold twisted deformed bars) may be bent hot at cherry red heat to a temperature not exceeding 850° Celsius as per the instructions of the Engineer-in-Charge. The bars shall be allowed to cool gradually without quenching.

Bars shall be bent in a slow and regular movement to avoid fractures. Bars which develops cracks or splits after bending shall be rejected. A second bending of reinforcement bars shall be avoided but when reinforcement bars are bent aside at construction joints and afterwards bent back into their original position, care should be taken to ensure that at no time is radius of the bend less than 4 times bar diameter for plain mild steel or 6 times bar diameter for high strength deformed bars. Care shall also be taken when bending back bars to ensure that concrete around the bars is not damaged. All bars shall be properly tagged for easy identification.

22.3 PLACING AND FIXING

All reinforcement shall be cleaned to ensure freedom from loose mill scale, loose rust, oil, form releasing agents, grease or any other harmful material before placing them in position. Reinforcement shall not be surrounded by concrete unless it is free from all such materials. Rough handling and dropping of reinforcement from a height shall be avoided.

All reinforcement shall be fixed in the correct position and shall be properly supported to ensure that displacement will not occur when the concrete is placed and compacted.

The uncoated reinforcement bars shall be tied at every intersection by two strands of 16 SWG black soft annealed binding wire. The Epoxy coated reinforcement bars shall be

tied with 2 strands of PVC coated GI 18 SWG wire at every intersection. Crossing bars shall not be tack welded for assembly of reinforcement. The reinforcement bars shall be kept in position by using the following methods:

- a. In case of beam and slab construction, precast cover blocks (having the same sand contents as the concrete which shall be placed) of size 40 x 40 mm and thickness equal to the specified covers shall be placed firmly in between the bars and forms so as to secure and maintain the specified covers over the reinforcement.

When reinforcement bars are placed in two or more layers in beams, the vertical distance between the horizontal bars shall be maintained by introducing spacer bars at 1 to 1.2m centre to centre.

- b. In case of thick rafts & pile caps having two or multilayer's of reinforcement, the vertical distance between the horizontal bars shall be maintained by introducing suitable chairs, spacers, etc.
- c. In case of columns and walls, the vertical bars shall be kept in position by means of timber templates with slots accurately cut in them. The templates shall be removed after the concreting has been done below it.
- d. Exposed portions of reinforcement bars shall not be subjected to impact or rough handling and workmen will not be permitted to climb on extending bars until the concrete has attained sufficient strength so that no movement of the bars in the concrete is possible.

22.4 SPECIAL REQUIREMENTS FOR HANDLING, STACKING, PLACING OF EPOXY COATED REINFORCING BARS.

Epoxy coated reinforcing bars shall be carefully handled and it shall be ensured that these do not rub on any hard surface or against another epoxy coated/uncoated reinforcing bar whether during conveying/transportation, stacking or placing.

During transportation and while stacking the epoxy coated reinforcing bars shall be placed on wooden planks not spaced farther than 600mm. When placed in stacks the epoxy coated reinforcing bars shall be neatly tied in bundles using PVC binding material.

The cut ends of bars shall be touched up with special touch up material of specifications as provided by the coating agency. After cutting of the bar the application of touch up material shall be completed within four hours.

While bending the bars the pins of work bench(s) shall be provided with a PVC or plastic sleeve. Each bending operation on epoxy coated reinforcing bar shall be completed in time not less than 90 seconds.

Epoxy coated reinforcing steel bar shall not be directly exposed to sun rays or rain, and shall be protected with opaque polyethylene sheets or similar means as approved by the Engineer in Charge.

While doing concreting the workmen or machinery shall not rest or move on the epoxy coated reinforcing bars. Wooden planks shall suitably be placed to create proper gang-way.

22.5 SPLICING/OVERLAPPING

Only bars of full length shall be used as shown in the drawings. But where this cannot be done, overlapping of bars shall be done as directed by the Engineer-in-Charge. Where practicable, the overlapping bars shall not touch each other, but these shall be kept apart by 25mm or 1.25 times the maximum size of the coarse aggregate whichever is greater. But where this is not possible, the overlapping bars shall be tied with two strands of 16 SWG black soft annealed binding wire for uncoated bars and with PVC coated GI 18 SWG wire for Epoxy coated bars. The overlaps shall be staggered for different bars and located at points along the span where neither shear nor bending moment is maximum.

22.6 WELDED JOINTS

Welding of reinforcing bars shall not be permitted without the written permission of the Engineer-in-Charge. If Fusion Bonded Epoxy coated bars are used, welding of reinforcing bars shall generally not be permitted. However, if permitted, the joint shall be coated with epoxy as per BS: 7295. Where welding of uncoated reinforcing bars is permitted, it shall be in accordance with the recommendations of IS: 2751 and IS: 9417. Welded joints shall be located at suitable staggered positions. Tests shall be made as directed by the Engineer-in-Charge to prove that the joints are of the full strength of the bars. Maximum one welded joint shall be allowed per bar.

22.7 MECHANICAL CONNECTIONS

The mechanical splices in reinforcement by means of couplers, clamps etc. shall be used (as per manufacturer's specifications) with the written approval of the Engineer-in-Charge. However, tests shall be made as directed by Engineer-in-Charge to prove that such connections are of the full strength of the bars on trial joints. Mechanical connections for Fusion Bonded Epoxy coated bars shall not be used.

22.8 TOLERANCES ON PLACING OF REINFORCEMENT

Unless otherwise directed by the Engineer-in-Charge, reinforcement shall be placed within the following tolerances:

- a. For effective depth 200mm or less $\pm 10\text{mm}$
- b. For effective depth more than 200mm $\pm 15\text{mm}$

22.9 SUBSTITUTION

When indicated diameter of reinforcement bar is not available, the Contractor shall use other diameter of reinforcement bars on written approval of the Engineer-in-Charge.

22.10 TOLERANCE TO COVER

The actual concrete cover shall not deviate from the required nominal cover by - 0 mm to +10 mm measured over the steel reinforcement including links.

23.0 PRECAST CONCRETE

- 23.1 Specifications contained in clauses above regarding concrete, formwork and reinforcement shall apply in addition to the clauses given as under. The Contractor shall get the precasting bed approved by the Engineer-in-Charge.
- 23.2 Necessary lifting hooks of suitable (but not less than 12mm dia) diameter M.S. rounds shall be provided for handling, as indicated in drawings or as directed by the Engineer-in-Charge.
- 23.3 Unless otherwise specified, the exposed surfaces of precast members shall be integrally finished smooth. For precast slabs or planks, the top surface shall be finished with 1:3 (1 cement: 3 sand) cement mortar. Surface used as walkways shall be given a non-skid finish.
- 23.4 The precast concrete units shall be marked clearly on top surface with the letter "T" for identification of surfaces at the time of erection and shall be stored properly until required for erection. The precast units shall be handled and erected by methods approved by the Engineer-in-Charge to protect them from damage.
- 23.5 Precast concrete elements shall not be removed from the casting bed until the concrete has developed its characteristic compressive strength based on cube test results.
- 23.6 The units shall be suitably handled, transported, stored and placed taking all necessary safety precautions to avoid development of undue stresses caused by vibrations, impact or lateral forces. During shipment and while in storage, the units shall be placed on suitable blocks to provide clearance from bed/ground.
- 23.7 The Contractor shall take all necessary precautions for safe handling during the course of erection. The Contractor shall replace at his own expense all such units which are damaged during the course of erection. Cement used for a damaged/rejected precast elements shall not be taken into account for material reconciliation.
- 23.8 The inspection for precast concrete units during casting shall be same as applicable to normal concrete works. However, additional inspection checks shall be made during and after erection of units to ensure its suitability for the required service as a structural member. These checks shall include inspection to detect chipping, cracks, warpages in the precast units etc due to improper handling and storage, improper jointing (if required) of the precast unit with the structure and improper finishing.

- 23.9 Fabricated precast concrete units containing defects originating due to use of improper materials or workmanship, excessive repair and not conforming to design drawings shall be rejected. Such rejected units shall not be taken into account for material reconciliation or payment.

24.0 CONTINUOUS CONCRETING

- 24.1 Where called out on the drawings, continuous concreting shall be done in a single operation as per the requirements of IS: 456 and IS: 2974. It shall be ensured that clause 8.3 of these specifications is not violated in case of continuous concreting. Sufficient "Windows" shall be left in the formwork for pouring & compaction of concrete and inspection. These windows shall be fixed tight once the level of concrete reaches their levels.

25.0 CONCRETING UNDER SPECIAL CONDITIONS

- 25.1 Work in extreme weather conditions during hot or cold weather, the concreting shall be done as per procedure set out in IS: 7861(Part 1) or IS: 7861 (Part2).

25.2 UNDER WATER CONCRETING.

Concreting shall be as per clause no. 14.2 of IS: 456.

26.0 PAYMENT

This clause shall apply to item rate tenders only.

26.1 PLAIN AND REINFORCED CONCRETE

- 26.1.1 Payment for plain and reinforced cement concrete (cast- in-situ) shall be made on cubic metre basis of the volume of the actual finished work done or as per approved construction drawings, whichever is less and shall be inclusive of providing pockets, openings, recesses of all sizes, chamfers, fillets, grooves, separation/ expansion/ isolation/ construction/ movement joints, cement wash, curing by normal moist curing or using curing compound etc. as directed by Engineer-in-Charge etc. The rates shall be deemed to include complete cost of getting the respective mix designs approved, making and testing concrete cubes and carrying out other tests including tests of various ingredients, as per specifications and as directed by Engineer-in-Charge. Payment shall, however, be separately made for tests on concrete cubes done by accelerated methods of curing as defined in IS: 9013.
- 26.1.2 No separate payment shall be made for any additive/ admixture used by the contractor for accelerating or retarding the strength of concrete or for achieving specified workability/water tightness. The rate quoted shall be deemed to be inclusive of all costs related to any such additive/ admixture.
- 26.1.3 The rate shall however be exclusive of reinforcement, metal inserts, pipe sleeves, formwork, water stops and any filler material in expansion/isolation joints.

- 26.1.4 Where the strength of concrete mix as indicated by tests, lies in between the strengths of any two grades given in Table-1 and it is accepted by the Owner/Engineer-in-Charge, such concrete shall be classified as a grade belonging to the lower of the two grades between which it lies. In case the cube strength shows higher results than those specified for the particular grade of the concrete, it shall not be placed in the higher grade nor shall the Contractor be entitled for any extra payment on such account. The concrete giving lower strength than specified may be accepted at reduced rates after satisfying the safety of the structure by checking it with tests as specified or rejected entirely at the discretion of the Engineer-in-Charge. The rejected concrete shall be dismantled at no extra cost to the owner and no payment or extension of time shall be granted for the concrete so rejected and the formwork and reinforcement used for the same. Cost of any material supplied by the Owner free of cost shall be recovered from the Contractor at double the prevailing market rate. In case the concrete of lower strength can be improved by carrying out some strengthening measures entirely at the discretion of the Engineer-in-Charge, then the said measures including all related tests shall be carried out by Contractor at his own cost. If the Contractor is able to make up the strength to the required grade by such improvement measures to the entire satisfaction of Engineer-in-Charge, payment shall be made for the grade achieved. However, if the strength of concrete is not made up to the strength of required grade, payment shall be made only for the lower strength if such concrete is accepted by the Engineer-in-Charge.
- 26.1.5 Deductions for openings, pockets etc. shall be as specified in relevant Indian Standard Codes.
- 26.1.6 Payment under continuous concreting item in the schedule of rates shall be made only where the total quantity of concrete between two consecutive construction joints specifically called-out on the drawings exceeds 250 cubic metres. For any foundation/structure involving concrete quantity upto 250 cubic metres between two consecutive construction joints shown on drawings, the concrete shall not be measured or paid for under this category (i.e. continuous concreting), although the same is required to be constructed in single pour. The rate quoted against this item shall be inclusive of all extra costs incurred by the Contractor for arranging continuous pouring of concrete and others as specified complete.

26.2 FORM WORK

Unless otherwise specified, payment for form work shall be on square metre basis of the actual area in contact with the concrete cast. The rates shall be inclusive of keeping the formwork for the full period as specified in the above clauses and removing the same after the period is over. No extra payment shall be made for providing scaffolding/staging/access/stairways/ladders etc.

The rates shall be inclusive of any provision to be made or kept in the formwork for providing dowels, inserts etc.

Superior quality formwork for exposed/architectural concrete work shall be measured and paid separately under the relevant item in the schedule of rates.

26.3 REINFORCEMENT

- 26.3.1 Payment for plain round mild steel reinforcement bars and high strength deformed steel bars shall be on the basis of weight of bare steel irrespective of any coating applied in metric tons. The weight of the bar shall be derived from the sizes and corresponding unit weights given in handbook of Bureau of Indian Standards. Standard hook lengths, chairs, spacer bars and authorized laps only shall be included in the weight calculated. Binding wire shall not be weighed nor otherwise measured. Measurements for weight shall not include cutting allowance etc.
- 26.3.2 Rate quoted for uncoated reinforcement shall include cost of supplying, decoiling, straightening, cleaning, cutting, bending, placing, binding, welding, if required, and providing necessary cover blocks of concrete.
- 26.3.3 Rate quoted for Fusion Bonded Epoxy Coated bars shall also include, apart from those mentioned in clause no. 26.3.2, cost of coating of the bars, all necessary tools and tackles and any repairs required due to damage to coating as per IS: 13620.
- 26.3.4 Payment for mechanical threaded couplers shall be made on number basis (each). The rate shall include supply of complete assembly, fixing, testing etc. all complete.

26.4 WATER STOPS/WATER BARS & EXPANSION/ISOLATION JOINTS

- 26.4.1 Payment for PVC water bars shall be made on running metre (RM) basis of the water stops provided in position. Rate shall include supplying cutting, fixing, jointing by vulcanising or any other approved method, wastage, etc. complete.
- 26.4.2 Payment for filler materials in Expansion/Isolation joints shall be made on running metre basis of the joint provided. For boards provided at expansion/isolation joints, the measurement shall be made on square metre basis. Rate shall be inclusive of supply, cutting, fixing, jointing, wastage etc. complete.

26.5 PRE-CAST CONCRETE

- 26.5.1 Payment for precast concrete members shall be made on cubic metre basis of the volume of the finished member. The rate quoted shall include cost of formwork, preparation of casting yard, finishing as specified, curing, handling, fixing in position, breaking masonry and/or concrete surfaces and making good the same etc. Reinforcement shall be paid separately under relevant items. Lifting hooks shall be paid on the same basis as reinforcement. Metal inserts shall be paid as per relevant clauses of Specification No. VCS-SS-CS-026 (Miscellaneous Steel Works).
- 26.5.2 The quoted rate shall be inclusive of providing pockets, openings, recesses of all sizes, chamfers, fillets grooves, holes, cement wash, curing (hot, cold or by using curing compounds). The rate shall be deemed to include complete cost of taking and testing concrete cubes and carrying out other tests including tests of various ingredients as per specification and as directed by the Engineer-in-Charge.
- 26.5.3 The rate shall however be exclusive of reinforcement, metal inserts, pipe sleeves. Where the strength of concrete mix as indicated by tests, lies in between the strengths

of any two grades given in clause 3.0 and it is accepted by the Owner/Engineer-in-Charge, such concrete shall be classified as a grade belonging to the lower of the two grades between which it lies. In case the cube strength shows higher results than those specified for the particular grade of the concrete, it shall not be placed in the higher grade nor shall the Contractor be entitled for any extra payment on such account. The concrete giving lower strength than specified may be accepted at reduced rates after satisfying the safety of the structure by checking it with tests as specified or rejected entirely at the discretion of the Engineer-in-Charge. The rejected concrete shall be dismantled at no extra cost to the owner and no payment or extension of time shall be granted for the concrete so rejected and the formwork and reinforcement used for the same. In case the concrete of lower strength can be improved by carrying out some strengthening measures entirely at the discretion of the Engineer-in-Charge, then the said measures shall be carried out by Contractor at his own cost. If the Contractor is able to make up the strength to the required grade by such improvement measures to the entire satisfaction of Engineer-in-Charge, payment shall be made for the grade achieved. However, if the strength of concrete is not made up to the strength of required grade, payment shall be made only for the lower strength if accepted by the Engineer-in-Charge.

26.6 CEMENT WASH

- 26.6.1 No payment shall be made for cement wash separately and is deemed to be covered in clause no. 26.1.1 & 26.5.2.

26.7 CONTINUOUS CONCRETING

Payment shall be made as per clause no. 26.1 of this specification. The rate shall be deemed to be inclusive of all extra cost related to labor, shuttering, staging and making all other arrangements for such continuous casting e.g. provisions for adequate movement and storage spaces, special gangways, scaffolding, additional construction equipments, adequate lighting and supervision while the work continues round the clock etc. The rate shall also be inclusive of all costs related to concreting in any thickness, shape and position and at any height or depth so as to avoid any cold joint between specified construction joints.



Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR STRUCTURAL STEEL WORKS

VCS-SS-CS-6024

					
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ABBREVIATION

m	Metre
mm	Millimetre
IS	Indian Standard
BIS	Bureau of Indian Standards

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1.0 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 and/or 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.

2.0 REFERENCE

2.1 BIS CODES

IS: 800	General Construction in steel-Code of practice
IS: 816	Code of practice for use of Metal Arc welding for General construction in mild steel
IS: 819	Code of practice for Residual spot welding for light assemblies in mild steel
IS: 822	Code of practice for Inspection of welds
IS: 919 (Part-I)	ISO system of limits and fits (Bases of tolerances, deviations and fits)
IS: 919 (Part-II)	ISO system of limits and fits (Tables of tolerances, grades and limit deviation for hole and shafts)
IS: 1024	Use of welding in bridges and structures subject to dynamic loading-Code of practice
IS: 1261	Code of practice for Seam welding in mild steel
IS: 1323	Code of practice for Oxy-Acetylene welding for structural works in mild steel
IS: 1477	Code of practice for painting of ferrous metals in buildings
IS: 1852	Specification for rolling and cutting tolerance for hot rolled steel products
IS: 2074	Ready mix paint, Air draying, Red oxide Zinc Chrome, painting specification
IS: 7205	Safety code for erection of Structural steel works
IS: 7215	Tolerance for fabrication of steel structures
IS: 7307	Approval tests for welding procedures

- IS: 7310 Approval tests for welders working to approved welding procedures
- IS: 7318 Approval tests for welders when welding procedures approval is not required
- IS: 9595 Metal Arc welding of carbon and Carbon manganese steel - Recommendations
- IS: 12843 Tolerance for Erection of Steel structure
and other relevant BIS Codes.

SP: 6(1)

2.2 SPECIFICATIONS

VCS-SS-CS-6021 Materials and Specification for Shop & Field Painting

- 2.3 In case of conflict between the clauses mentioned in this specification and those in the Indian Standards, this specification shall govern. Any special provision as shown or noted on the design drawings shall govern over the provisions of this specification.

3.0 MATERIALS

3.1 GENERAL

All materials shall conform to their respective specifications given in Specification no. VCS-SS-CS-6021. 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 Engineer-in-Charge shall 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 Engineer-in-Charge 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 the Engineer-in-Charge in this regard shall be final and binding.
- 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 Engineer-in-Charge. 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 manufacturers' 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 Engineer-in-Charge, at no extra cost, and submit the same to Engineer-in-Charge for his approval. The Engineer-in-Charge 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 Engineer-in-Charge. 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 Engineer-in-Charge shall be separately stacked and properly identified and shall not be used. These shall be removed from site forthwith.

4.0 FABRICATION DRAWINGS

- 4.1 Fabrication and erection drawings shall be prepared by the Contractor on the basis of "Approved for Construction (AFC)" design drawings, Standards issued to the Contractor. These drawings shall be prepared by the Contractor or by an agency appointed by the Contractor and approved by the Engineer-in-Charge.
- 4.2 Fabrication and erection drawings shall be thoroughly checked, stamped "Approved 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 Engineer-in-Charge 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 Engineer-in-Charge. The fabrication of such structures shall be done only as per the reviewed fabrication drawings.

The review of such drawings shall be restricted to the checking of the following only:

- a. Structural layout, orientation and elevation of structures/members.
- b. Sizes of members.
- c. 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:

- a. Reference to design drawing number (along with revision number) based on which fabrication drawing has been prepared.
- b. Structural layout, elevations & sections (with distinct erection marking of all members).
- c. Framing plans, member sizes, orientation and elevations.
- d. Layout and detailing of rain water pipes and gutters showing all necessary levels, connections and provisions wherever required.
- e. Detailing of shop/field joints, connections, splices, for required strength and erection.
- f. Location, type, size and dimensions of welds and bolts.
- g. Shapes and sizes of edge preparation for welding.
- h. Details of shop and field joints/welds.
- i. Bill of materials/D.O.D. Lists.
- j. Quality of structural steel, plates etc., welding electrodes, bolts, nuts and washers to be used.
- k. Erection assemblies identifying all transportable parts and sub-assemblies with special erection instructions, if required.
- l. 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:

- a. Provision for erection and erection clearances.
- b. Marking of members
- c. Cut length of members
- d. Matching of joints and holes.

- e. Provision kept in the members for other interconnected members.
 - f. Bill of materials/D.O.D. Lists.
- 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 Engineer-in-Charge along with the fabrication drawings.
- 4.7 Any substitution or change in section shall be allowed only when prior written approval of the Engineer-in-Charge 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 Engineer-in-Charge 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 Engineer-in-Charge for reference and record. The rates quoted shall include for the same.

5.0 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, IS: 9595 & 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 Engineer-in-Charge, 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 (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 shapes 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 seating's approved by the Engineer-in-Charge 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 practicable. Marking shall be done by placing the members on horizontal supports/pads in order to ensure accuracy. Marking accuracy shall be limited to + 1 mm.

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 Engineer-in-Charge.

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 & burrs, and should the Engineer-in-Charge 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 girder 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 16mm 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 Engineer-in-Charge.
- 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 & 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 & materials required for carrying out various tests such as dye penetration, magnetic particle, ultrasonic etc.

- d. Adequate protection against rain, dust, snow & 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 fulfill 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 Engineer-in-Charge. The tolerances on limits of gap, root face & included angle shall be as stipulated in IS: 9595.

- b. Cleaning

Welding edges and the adjacent areas of the members (extending up to 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 of plate thickness) before measuring the temperature.

- d. Grinding

- i. Column splices & butt joints of struts and compression members (depending on contact for load transmission) shall be accurately ground and close-butt over the whole section with a tolerance not exceeding 0.2mm locally at any place. In column caps & bases, the ends of shafts together with the attached gussets, angles, channels etc., shall be accurately 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 & 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.

- a. Manual Metal Arc Welding Process (MMAW)
- b. Submerge Arc Welding Process (SAW)
- c. Gas Metal Arc Welding Process (GMAW)
- d. Flux Cored Arc Welding Process (FCAW)

The welding procedure adopted and consumables used shall be specifically approved by the Engineer-in-Charge. 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 Engineer-in-Charge.

5.2.6.4 APPROVAL & TESTING OF WELDERS

The Contractor shall satisfy the Engineer-in-Charge 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 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 Engineer-in-Charge 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 Engineer-in-Charge. The test weld shall include weld details from the actual construction and it shall be welded in a manner simulating the most unfavorable instances of fit-up, electrode condition etc., which are anticipated to occur on the particular fabrication. Where material analyses 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 Engineer-in-Charge for his approval the welding procedure specification in standard format given in IS: 9595 before starting the fabrication.

5.2.6.6 SEQUENCE 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 & submit the same to the Engineer-in-Charge 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 as 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.
- 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 Engineer-in-Charge.

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 Engineer-in-Charge. Welds shall not be painted or otherwise obscured until they have been inspected, approved and accepted.

The Engineer-in-Charge or his 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 without not limited to the following objectives.

- a. To check the conformity with the relevant standards and suitability of various welding equipments and their performance.
- b. To witness/approve the welding procedure qualification.
- c. To witness/approve the welders performance qualification.
- d. 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 Engineer-in-Charge 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 & 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 grooves, 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 Engineer-in-Charge.

C. Magnetic Particle/Dye Penetration/Ultrasonic Examination:

The examination shall be done at random as directed by the Engineer-in-Charge. 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 Engineer-in-Charge. 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 Engineer-in-Charge by employing approved testing procedure in accordance with IS: 822. The Contractor shall fulfill all the statutory safety requirements while handling X-ray and Gamma-ray equipment and provide the Engineer-in-Charge 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 Faculty Welds

No repair of defective welds shall be carried out without proper permission of the Engineer-in-Charge and his approval for the corrective procedure.

Welds not complying with the acceptance requirements (as specified by BIS Codes & the Engineer-in-Charge), as revealed during inspection & testing of welds or erection or in-situ condition shall be corrected either by removing & replacing or as follows:

- a. Excessive convexity - Reduced to size by removal of excess weld metal.
- b. Shrinkage cracks, - Defective portions removed down to sound

	cracks in parent plates	metal and re-welded.
	and craters	
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 Engineer-in-Charge, is defective and/or beyond any corrective action shall be removed forthwith from the site as instructed by the Engineer-in-Charge without any extra claim. The owner reserves the right to recover any compensation due to any loss arising out of such rejections.

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 joist/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 member's up to a length of 6 to 7m. Maximum two numbers of splices shall be allowed for members exceeding this length.
- 5.2.9 MACHINING & 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 gusseted base and cap plates, the clearance between the parts joined shall not exceed 0.2mm at any location.

6.0 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.

7.0 SHOP ERECTION

The steel work shall be temporarily shop erected complete or as directed by the Engineer-in-Charge, so that the accuracy of fit may be checked before dispatch.

8.0 INSPECTION & TESTING OF STRUCTURES

- 8.1 The Engineer-in-Charge (or his authorized 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 & 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 Engineer-in-Charge or his authorized 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 Engineer-in-Charge and procedure laid down by him.
- 8.4 All necessary gauges and templates shall be supplied free to the Engineer-in-Charge by the Contractor whenever asked for during inspection. The Engineer-in-Charge, 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.

9.0 SHOP PAINTING

- 9.1 All components and members of steel work shall be given one shop coat of primer (conforming to relevant BIS codes) or any other primer as specified, in the tender, immediately after the surfaces have been properly prepared (i.e. degreased, de-rusted, descaled & cleaned) in accordance with IS: 1477 or IS: 800, as applicable. 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 a minimum film thickness as per table 29 of IS: 800 after drying, as applicable.
- 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).
- 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 de-slagging, inspection and approval by the Engineer-in-Charge.
- 9.5 Parts to be encased in concrete shall have only coat of primer and shall not be painted after erection.

10.0 PACKING

- 10.1 All items shall be suitably packed in case these are to be dispatched 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 on to their respective main members.
- 10.3 Bolts, nuts washers etc. shall be packed in crates.

11.0 TRANSPORTATION

Loading and transportation shall be done in compliance with transportation rules. In case, certain parts cannot be transported in the lengths stipulated on the drawings, the position details of such additional splice joints shall be got approved by the Engineer-in-Charge.

12.0 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 Engineer-in-Charge.

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 Engineer-in-Charge.

12.4 TOLERANCES

Tolerances for erection of steel structures shall be as per Annexure 'A'

13.0 SAFETY & 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 all 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 & 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 Engineer-in-Charge.
- 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.

14.0 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 bolt – where removed after final erection shall be plugged by welding. Alternatively erection bolts may be left and secured.

15.0 GROUTING

- 15.1 Prior to positioning of structural columns/girders/trusses over the concrete pedestals/columns/brackets, all laitance & loose material shall be removed by wire brushing & 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 and any excess water removed. Thereafter, the structural member shall be erected, aligned & 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 around and joints made tight to prevent leakage. Grouting (under the base plates/shoe plates including grouting of sleeves & 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, cross-over's, stairs & ladders. The thickness of grout shall be as shown on the drawings but not less than 25 mm nor more than 40mm in any case.
- 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 Engineer-in-Charge. 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 up 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.

16.0 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 Engineer-in-Charge. All necessary co-ordination and synchronization 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.

17.0 PAYMENT

This clause shall apply to Item Rate tender only.

- 17.1 Payment for structural steel works shall be made on the basis of admissible weight in metric tons (determined as described in clause 17.2 and 17.3) of the structure accepted by the Engineer-in-Charge. The rate shall include supplying (as per supply conditions given in the Tender) fabricating, erecting in position (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, preheating, 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 & bracing and removal of the same after erection, grouting with no shrink/ordinary grout as specified, preparation of fabrication & erection drawings, & erection schedule and getting them reviewed, preparation and submission of as built drawings, as built drawings, preparing the surfaces for painting, surface cleaning, wire brushing, removal of mill scale, dust, rust, oil or grease and applying coat of 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 Engineer-in-Charge 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 Engineer-in-Charge. The weight shall be calculated on the basis of BIS Hand Book wherever applicable. In case sections used

are different from BIS sections, then Manufacturers' 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 & security arrangements during erection and all plants & tools required for fabrication, transportation & erection.

18.0 PAINTING AFTER ERECTION

18.1 GENERAL

- 18.1.1 The scope of painting after erection shall be at the sole discretion of the Engineer-in-Charge 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 or IS: 800, as applicable) 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 Engineer-in-Charge's direction, if any, shall be followed at all times. Particular attention shall be paid to the following:
- a. Proper storage to avoid exposure & extremes of temperature.
 - b. Surface preparation prior to painting.
 - c. Mixing & thinning.
 - d. Application of paint and the recommended limit on time intervals between consecutive coats.
- 18.1.3 Painting shall not be done in frost or foggy weather, or when humidity is such as to cause condensation on 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 & finish coat paints shall be from the same manufacturer in order to ensure compatibility. Painting colour code shall be as per Annexure-'B'.

18.2 RUB DOWN & 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 or IS: 800, 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 as per table 29 of IS: 800 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 as per IS: 800 after drying, as applicable.

In case a different cleaning procedure & primer specifications are specified in the drawing/Tender, the same shall be adopted.

18.3 FINAL PAINT APPLICATION

After the primer is hard dry, the surfaces shall be dusted off and one coat of synthetic enamel paint of approved colour & shade (conforming to IS: 2932) or any other paint as per IS: 800, shall be applied by brushing/spraying so that a film free from "holidaying" is obtained. The colour & 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 as per IS: 800 after drying.

In case a different type of paint & painting procedure are specified in the drawing/tender, the same shall be adopted.

Color coding for structural steel shall be as per ANNEXURE "B".

18.4 INSPECTION & TESTING OF PAINTING WORKS

18.4.1 All painting materials including primers & 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 Engineer-in-Charge 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 & chemical analysis. All costs shall be borne by the Contractor.

18.4.3 The painting work shall be subject to inspection by the Engineer-in-Charge 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 preparation
- b. Primer application
- 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 Engineer-in-Charge 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 Engineer-in-Charge. 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 Engineer-in-Charge whenever asked for.

18.5 PAYMENT

This clause shall apply to Item Rate tender only.

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 Engineer-in-Charge.

The rate shall include supplying & applying two coats of synthetic enamel paint or any other paint specified in the tender of approved quality and shade over a coat of red oxide zinc chromate primer 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 & 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 Engineer-in-Charge.

ANNEXURE-'A'

(Clause 12.4)

Maximum Permissible Erection Tolerances

A. Columns

1. Deviation of column axes at foundation top level with respect to true axes.
 - i) In longitudinal direction ±5mm
 - ii) In lateral direction ±5mm
2. Deviation in the level of bearing surface of columns at foundation top with respect to true level ±5mm
3. Out of plumb (Verticality) of column axis from true vertical axis, as measured at top:
 - i) Up to and including 30m height ±H/1000 or ±25mm
Whichever is less.
 - ii) Over 30m height ±H/1200 or ±35mm
Whichever is less.
4. Deviation in straightness in longitudinal & transverse planes of column at any point along the height. ±H/1000 or ±10mm
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. ±5mm
6. Deviation in any bearing or seating level with respect to true level. ±5mm
7. Deviation in difference in bearing levels of a member on adjacent pair of columns both across & along the building. ±5mm

Note: 1. Tolerance specified under 3 should be read in conjunction with 4 & 5.

Note: 2. 'H' is the column height in 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 ±15mm 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 height of truss in mm or ±10mm whichever is less.
3.	Lateral shift in location of truss from its true position.	±10mm
4.	Lateral shift in location of purlin from true position.	±5mm
5.	Deviation in difference of bearing levels of truss from the true level.	±1/1200 of span of truss in mm or ±20mm whichever is less.

C. Gantry Girders & Rails

1.	Shift in the centre line of crane rail with respect to centre line of web of gantry girder.	$\pm \left[\frac{\text{web thickness (mm)}}{2} + 2\text{mm} \right]$
2.	Shift of alignment of crane rail (in plan) with respect to true axis of crane rail at any point.	±5mm
3.	Deviation in crane track gauge with respect to true gauge.	
i)	For track gauge up to and including 15m.	±5mm
ii)	For track gauge more than 15m.	±[5+0.25 (S-15)] Subjected to maximum ±100mm, where S in Metres is true gauge.
4.	Deviation in the crane rail level at any point from true level.	±10mm
5.	Difference in level between crane track rails (across the bay) at	
i)	Supports of gantry girders	15mm
ii)	Mid span of gantry girders	20mm
6.	Relative shift of crane rail surfaces (at a joining) in plan and elevation.	2mm

ANNEXURE-'B'

(Clause 18.3)

PAINTING COLOUR CODE FOR STRUCTURAL STEEL

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



Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR MISCELLANEOUS STEEL WORKS

VCS-SS-CS-6026

					
03	31.01.2022	NV	GDS	HK	GW
02	25.02.2020	NV	GDS	RKB	SK
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UNCONTROLLED COPY : If printed

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REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	05.07.2017	MA	MO	RKB	AD	Issued for use as Standard
01	16.10.2019	MA	MO	RKB	SK	
02	25.02.2020	NV	GDS	RKB	SK	New revision system updated.
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ABBREVIATION

m	Metre
mm	Millimetre
g/m ²	Gram Per Square Metre
MS	Mild Steel
BIS	Bureau of Indian Standards
Kg	Kilogram
RCC	Reinforced Cement Concrete
PCC	Plain Cement Concrete

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1.0 SCOPE

- 1.1 All materials supplied by the Contractor shall conform to their respective specifications given in Specification No. VCS-SS-CS-6021.
- 1.2 The Contractor shall 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 specification no. VCS-SS-CS-6024 Structural Steel Works.

2.0 REFERENCES

As mentioned in the respective clauses

3.0 MATERIAL

As mentioned in the respective clauses.

4.0 ANCHOR BOLTS

4.1 MATERIAL

Materials for anchor bolts, nuts, locknuts, washers, pipe sleeves and anchor plates shall conform to their respective specification given in Specification No. VCS-SS-CS-021.

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:

- a. For sleeved bolts, one tenth of the bolt nominal diameter.
- b. 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 tenders 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, 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 installation of anchor bolts/assembly.

5.0 METAL INSERTS

5.1 MATERIAL

Materials required for fabricating metal inserts shall conform to their respective specification given in Specification No. VCS-SS-CS-6021.

5.2 FABRICATION

Fabrication of inserts shall be done strictly as per drawings/standards and in compliance with the requirements given in Specification No. VCS-SS-CS-6024 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 coat of primer as per table 29 of IS: 800 as specified, after fabrication.

5.5 PAYMENT

This clause shall apply to item rate tenders 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, fixing 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 coat of primer as specified, etc. all complete.

6.0 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 clause 4.0 of Specification No. VCS-SS-CS-6024- 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 with 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 50mm length with a pitch of 150mm shall be used. Continuous sealing run of weld shall be provided along the junction of two consecutive chequered plates parallel to the span. For removable 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 coat of primer as per table 29 of IS: 800, as specified, on both surfaces.

6.6 PAYMENT

This clause shall apply to item rate tenders 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 Engineer-in-Charge.

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 all levels and locations, preparing detailed fabrication drawings, surface cleaning, removal of rust, scale, grease and applying coat of primer as per table 29 of IS: 800, as specified, etc. all complete.

In any stiffening sections are provided below the chequered plates for strengthening, the same shall be separately measured & paid under Structural Steel item (Viz. Specification No. VCS-SS-CS-6024

- 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 Engineer in Charge 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, and clips shall not be measured. The quoted rate shall be deemed to include the same.

7.0 GRATINGS

7.1 CATEGORIES

The gratings shall be of two categories:

- a. Category 'A' - Fabricated by the Contractor as per design drawings/standards.
- b. 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 given in Specification No. VCS-SS-CS-6021

7.3 FABRICATION DRAWINGS

Refer clause 4.0 of Specification No VCS-SS-CS-6024 - 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 notching in the flats shall be punched and not flame-cut. Continuous around 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 6mm whichever is minimum. The maximum clear size of voids in the grating shall be limited to 30mm x 55mm. Thickness of grating shall be 25mm. 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 Engineer-in- Charge. The Contractor shall submit sample gratings for inspection and approval by the Engineer-in-Charge 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 50mm and 150mm respectively where stitch welding is used for fixing along the lines of supports. The edges of two consecutive gratings shall be bolted with minimum two bolts on each side of the grating panel.

7.6 GALVANIZING

Gratings and the fixing clamps, bolts, nuts shall be cleaned with wire brush and galvanization shall be done in accordance with IS: 2629 and tested as per IS: 2633 & 6745. Quantity of zinc coating shall be minimum 900 gm/sq.m. of surface area (0.12mm uniform thickness).

7.7 PAYMENT

This clause shall apply to item rate tenders only.

7.7.1 Payment shall be made on the basis of admissible weight in metric tons (determined as described in clause 7.7.2) of the gratings accepted by the Engineer- in Charge.

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 coat of primer as per table 29 of IS: 800, as specified, or galvanizing 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 Engineer-in- Charge 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.

8.0 TUBULAR HAND RAILING

8.1 MATERIAL

Materials for fabrication and fixing of Tubular Hand Railing shall confirm to their respective specification given in Specification No. VCS-SS-CS-6021

8.2 FABRICATION DRAWINGS

Refer clause 4.0 of Specification No. VCS-SS-CS-6024 - Structural Steel Works.

8.3 FABRICATION

Hand railing 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 cold bent 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 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 coat of primer as per table 29 of IS: 800, as specified, after fabrication.

8.6 PAYMENT

This clause shall apply to item rate tenders 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 coat of primer as per table 29 of IS: 800, 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.

9.0 MILD STEEL RUNGS

MATERIAL

All materials shall conform to their respective specifications given in Specification No. VCS-SS-CS-6021

9.2 FABRICATION

Rungs shall be fabricated as per standards/drawings. Mild steel bars shall be straightened if required, cut, bent to shape and given coat of 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 tenders only.

- 9.4.1 Payment shall be made on the basis of actual weight in kilograms (Kgs.) of the M.S. rungs. The rate shall include supply of all materials handling, transporting, straightening if required, cutting to required size, bending to shape, tying/welding with reinforcement bars, fixing at all levels and locations, adjustment of formwork, applying coat of primer as per table 29 of IS: 800, as specified, and two coats of anti-corrosive paint or any other paint, as specified, on the exposed portion of rungs etc. all complete.

10.0 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 given in Specification No. VCS-SS-CS-6024

10.2 FABRICATION DRAWINGS

Refer clause 4.0 of Specification No. VCS-SS-CS-6024 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 coat of primer as per table 29 of IS: 800, as specified, after fabrication.

10.6 PAYMENT

This clause shall apply to item rate tenders only.

10.6.1 Payment shall be made on the basis of admissible weight in metric tons (determined as described in clause 10.6.2) of the structure accepted by the Engineer-in-Charge. The rate shall include supplying, fabricating, erecting, at all 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 Engineer-in-Charge, surface cleaning, wire brushing, removal of scale, rust, oil or grease and painting as per clause no. 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 shall 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 Engineer-in-Charge 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 weights of sections used are not covered in BIS Handbook. No allowance in weight shall be made for rolling tolerances.

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. Specification No. VCS-SS-CS-6024)

11.0 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 & 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)

- a. Ladders and stairs supports.
- b. Cables and cable trays supports.
- c. Electrical panels and fixtures.
- d. Hangers for pipes and cable trays.
- e. Pipe supports.

11.2.2 HEAVY DUTY (MILD STEEL/HIGH TENSILE STEEL)

- a. Platform supports (beam and columns)
- b. Knee brackets for pipes/multi tiers cable trays/walkways etc.

Note: - Expansion fasteners shall not be used for

- i. Members supporting equipment and pipes subjected to vibrations.
- ii. Cantilever connections designed to cater for effective cantilever spans greater than 1000mm and 1000Kgs. of concentrated load at the free end.

11.3 SELECTION

The Contractor shall submit to the Engineer-in-Charge 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.

11.4 TESTING

If so desired by the Engineer-in-Charge, 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 Engineer-in-Charge 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 pre-marked 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 Engineer-in-Charge 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 & covered with jute cloth so as to protect them from damage.

11.7 PAYMENT

This clause shall apply to item rate tenders only.

- 11.7.1** Payment for installing rust proof expansion fasteners shall be made on number basis (each). The rate shall include supply of complete assembly, handling, 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 re-drilling in case of any obstruction, making good any damage done to 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.



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STANDARD SPECIFICATION FOR BRICK MASONRY

VCS-SS-CS-6027

					
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REVISION RECORD						
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ABBREVIATION

m	Metre
mm	Millimetre
Cm	Centimetre
m ²	Square metre
m ³	Cubic Metre
Kg	Kilogram
IS	Indian Standard
MS	Mild Steel
C/C	Center to Center
RCC	Reinforced Cement Concrete
PCC	Plain Cement Concrete

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1.0 SCOPE

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: 2212.

2.0 REFERENCES

2.1 BIS CODES

IS: 2212 Brick works-code of practice

IS: 2250 Code of practice for preparation and use of masonry works

2.2 SPECIFICATIONS

VCS-SS-CS-6021 Materials

3.0 MATERIALS

Refer specification no. VCS-SS-CS-6021: Materials

4.0 GENERAL REQUIREMENTS

4.1 CEMENT MORTAR

Cement mortar shall meet the requirements of IS: 2250 and shall be prepared by mixing cement and sand by volume. Proportion of cement and sand shall be 1:6 (1 part of cement and 6 parts of sand), or as directed by the Engineer-in-Charge/shown on the drawing, for brick masonry of one brick thickness or more, while 1:4 cement mortar (1 part of cement and 4 parts of sand) shall be used for brick masonry of half brick thickness. The sand being used for mortar shall be sieved. The mortar shall be used as soon as possible after mixing and before it has begun to set and in any case within initial setting time of cement after water is added to the dry mixture. Mortar unused for more than initial setting time of cement, shall be rejected and removed from the site of work.

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.

4.1.2 MIXING

The mixing of mortar shall be done in a mechanical mixer operated manually or by power. The Engineer-in-Charge may, however, permit hand-mixing as a special case, taking into account the magnitude, nature and location of work. The Contractor shall take the prior permission of Engineer-in-Charge, in writing, for using hand-mixing before the commencement of work.

a. 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 at-least 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 at-least 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 at-least 300mm all-round the loaded wet mix area. Wet mix, so prepared, shall be utilized within initial setting time [thirty (30) minutes either for ordinary Portland cements conforming to IS: 269 or for Portland slag cement conforming to IS: 455] after addition of water. Mixer shall be cleaned with water each time before suspending the work.

b. 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.

5.0 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 plumb-ness 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, sufficient early, so that at the time of laying, they are 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)

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 10mm of cement mortar shall be spread on full width over a suitable length of lower course or the concrete surface. 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 30mm. 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 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) at 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. 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 up to 12mm, however, any gap between the finished brick work and soffit of roof slab/beam shall be suitably sealed with the mortar.

5.2.2 BRICK WORK (HALF BRICK THICKNESS)

For brick walls of half brick thickness, all courses shall be laid with stretchers. Wall shall be reinforced with 2 nos. - 6mm diameter mild steel reinforcement bars, placed at every fourth course. The reinforcement bars, shall be straightened and thoroughly cleaned. 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 12mm 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 150mm 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, 6mm 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 12mm. 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 50mm. The brick work on either side of cavity shall conform to the specifications already stated under clause no. 5.2.1 and 5.2.2. At the base of the cavity wall, the walls shall be solidly constructed up to 300mm above the ground level. The cavity wall shall be terminated 300mm 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 hay hands 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 leaves shall be tied by means of wall ties. Ties shall be of mild steel round bars of 8mm dia. 200 mm long with hooks at both the ends. These shall be placed not more than 750mm c/c horizontally and not more than 300mm 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 areas of vents to every 2.0 sq.metre area of the wall.

5.2.4 CIRCULAR BRICK WORK

The detailed specification for brick work covered under clause no. 5.2.1 & 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 5mm and 15mm.

5.3 JOINTING

Joints shall be restricted to a width of 10mm 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 12mm 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 sprinkling 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 at-least 10 days after completion. Proper watering cans with spray nozzles, rubber or PVC pipes shall be used for this purpose.

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 Engineer-in-Charge, 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 1:3:6 during 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 storey.

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 works or works in remote areas wooden ballies may be permitted for scaffolding/staging by the Engineer-in-Charge 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.

6.0 PAYMENT

This clause shall apply to Item Rate tender only.

6.1 GENERAL

The payment of brick masonry shall be inclusive of all labour, material, scaffolding/staging sampling and testing, soaking of bricks, laying of bricks, raking of joints, cutting of bricks, providing recesses and making rectangular or round openings, sealing the gap between brick masonry and soffit of beam/slab with and including cement mortar, curing, making of masonry platform for unloading the wet mix, embedding the fittings/fixtures including providing PCC(1:3:6) etc, all as specified for all heights and depths. Deduction for rectangular or circular openings shall be done as per relevant BIS Codes

- 6.1.1 Payment for brick masonry works of one or more brick thickness, including circular brickwork, shall be made on cubic metre basis of the work done
- 6.1.2 Payment for half brick masonry work shall be made on square metre basis on the area of works done and shall also include the cost of supplying and fixing of reinforcement bars in position

- 6.1.3 Payment for forming the cavity shall be in square metres and shall include the cost of laying of bitumen coated MS ties in position, labour required for keeping the cavity clear, providing air slots etc



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STANDARD SPECIFICATION FOR STONE MASONRY

VCS-SS-CS-6028

					
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ABBREVIATION

m	Metre
mm	Millimetre
m ²	Square metre
m ³	Cubic Metre
Kg	Kilogram
IS	Indian Standard
BIS	Bureau of Indian Standards
PVC	Poly Vinyl Chloride
PCC	Plain Cement Concrete

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1.0 SCOPE

This specification establishes the materials, dressing, laying, jointing, workmanship curing etc for stone masonry works and shall comply, with all the requirements of IS: 1597.

2.0 REFERENCES

2.1 BIS CODES

IS: 269	Ordinary Portland cement 33 grade-specification
IS: 455	Portland slag cement-specification
IS: 1129	Recommendation of dressing of Natural building stones
IS: 1597	Construction of stone masonry-code of practice
IS: 2250	Code of practice for preparation and use of masonry mortars
IS: 2750	Specification for scaffoldings

2.2 SPECIFICATIONS

VCS-SS-CS-6021: Materials

3.0 MATERIALS

Refer specification VCS-SS-CS-6021: Materials

4.0 GENERAL REQUIREMENTS

4.1 CEMENT MORTAR

Cement mortar shall meet the requirements of IS: 2250 and shall be prepared by mixing cement and sand by volume. Proportion of cement and sand shall be 1:6 (one part of cement and six parts of sand) or as specified. The sand being used, shall be sieved before use. The mortar shall be used as soon as possible after mixing and before it has begun to set and in any case within initial setting time of cement, after the water is added to the dry mixture. Mortar unused for more than initial setting time of cement shall be rejected and removed from the site of work.

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 metres. 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.

4.1.2 The mixing of mortar shall be done in a mechanical mixer operated manually or by power. The Engineer-in-Charge may however, permit hand mixing, as a special case, taking into account the magnitude, nature and location of work. The Contractor shall take the prior permission of the Engineer-in-Charge in writing, for using hand-mix, before the commencement of work.

a. 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 at-least one minute. Care shall be taken not to add more water than that which shall bring the mortar to the consistency of a stiff paste. Wet mix from the mixer shall be unloaded on water-tight masonry platform, made adjacent to the mixer. Platform shall be at least 150mm above the levelled ground, to avoid contact of surrounding earth with the mix. Size of the platform shall be such that it shall extend at-least 300mm around the loaded wet mix area. Wet mix, so, prepared shall be utilised within initial setting time of cement [thirty (30) minutes either for ordinary portland cement conforming to IS: 269 or for portland slag cement conforming to IS: 455] after addition of water. Mixer shall be cleaned with water each time before suspending the work.

b. Hand Mixing

The measured quantity of sand shall be levelled on a clean 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.

4.2 CURING

Green work shall be protected from rain, running water or accumulated water from any source, by suitable means. Masonry work, as it progresses shall be kept thoroughly wet by sprinkling 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 at least 10 days after completion. Proper watering cans with spray nozzles, rubber or PVC pipes shall be used for this purpose.

4.3 STAGING / SCAFFOLDING

4.3.1 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 Engineer-in-Charge, 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 supports shall be sound and strongly clamped with the horizontal pieces over which the scaffolding planks shall be fixed. The holes left in the masonry works for supporting the scaffolding shall be filled and made good with plain cement concrete of grade 1:3:6 during 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 all 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 stories.

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 vertical supports.
- 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, it shall be dismantled and re-erected afresh. Effort shall not be made to bring it in line with a physical force.
- h. All clamps and couplings shall be properly tightened with nuts and bolts to avoid slippage.
- i. Erection work of a scaffolding/staging under no circumstances shall be left totally to semiskilled or skilled workmen and shall be carried out under the supervision of contractor's technically qualified civil engineer.

- 4.3.2 For smaller works or works in remote areas, wooden ballies may be permitted for scaffolding/staging by the Engineer-in-Charge at his sole discretion. The contractor must ensure the safety and suitability of such works as described under clause 4.3.1 above.

4.4 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 of grade 1:3:6 at the required position as the work proceeds.

5.0 SPECIFIC REQUIREMENTS

5.1 RANDOM RUBBLE MASONRY

5.1.1 DRESSING

Stone shall be hammer dressed on the face, the sides and the beds to enable it to come in proximity with the neighboring stone. The "bushing" (projection) on the face shall not be more than 40mm on an exposed face and 19mm on the face to be plastered. It shall not have depression more than 10mm from the average wall surface. It shall also conform to the general requirements for dressing of stones covered in IS: 1129.

5.1.2 LAYING

All stones shall be wetted before laying to prevent absorption of water from mortar. The stones shall be laid so that the pressure is always perpendicular to the natural bed. The courses (if any) shall be built perpendicular to the pressure which the masonry will bear. In case of battered walls, the base of stone and plane of courses (if any) shall be at right angles to the batter.

The walls shall be carried up truly plumb or to the specified batter. Every stone shall be carefully fitted to the adjacent stones, so as to form neat and close joints. Vertical joints shall be staggered as far as possible.

Stones may be brought to level course at plinth, window sills and roof level. Levelling up at plinth level, window sills and roof level shall be done with concrete comprising of one part of the mortar as used for the masonry and two parts of graded stone aggregate of 20mm nominal size.

The bond shall be obtained by fitting in closely the adjacent stones. Transverse bonds shall be provided by the use of bond stones extended from the front to the back of the wall. At angular junctions the stones at each alternate course shall be well bonded into the respective courses of the adjacent wall.

Face stones shall extend and bond well in the back. These shall be arranged to break joints as much as possible, and to avoid long vertical lines of joints. The depth of stone from the face of the wall, inwards, shall not be less than the height or breadth at the face.

Where there is break in masonry work, the masonry shall be raked in sufficiently long steps for facilitating joining of old and new work. The stepping of the raking shall not be more than 45 degrees with the horizontal. The masonry work shall not be raised more than 1.2 metre per day. Toothed joints in masonry shall not be permitted.

5.1.3 HEARTING STONES

The hearting or interior filling of the wall shall consist of rubble stones which may be of any shape but shall not be less than 150mm on any face. These shall be carefully laid, hammered down with a wooden mallet into position and solidly bedded in mortar. The hearting should be laid nearly level with facing and backing, except that at about one metre intervals, vertical bond stones shall be firmly embedded to form a bond between successive courses.

5.1.4 INSERTION OF CHIPS

The chips and spalls of stones shall be used wherever necessary to avoid thick mortar beds or joints and it shall also be ensured that no hollow spaces are left anywhere in the masonry. The chips shall not be used below the hearting stone to bring these upto the level of face stones. The use of chips shall be restricted to the filling of interstices between the adjacent stones in hearting and this shall in no case exceed 20% of the quantity of stone masonry.

5.1.5 BOND STONE

Bond or through stone running across the thickness of wall shall be provided in the walls having thickness upto 600mm. If the walls are thicker than 600 mm, two or more bond stones overlapping each other by at least 150mm shall be provided in a line from face to back. Atleast one bond stone or a set of bond stones shall be provided for every 0.5 sq.m of wall surface. These shall be provided at 1.5m to 1.8m apart clear in every course and shall be staggered in subsequent course. An identification mark for the bond stones shall be given on both faces.

5.1.6 QUOINS

The quoins shall be of selected stones neatly dressed to the required angle and shall be of the same height as the course in which they occur and laid header and stretcher alternately. The quoin stone shall not be less than 0.03 cubic metres in volume.

5.1.7 JOINTING

Stones shall be so laid that all joints are fully packed with mortar. Face joints shall be minimum 20mm thick. The joints shall be struck flush and finished at the time of laying; when plastering and pointing is not required. If walls are to be plastered or pointed, joints shall be raked to a minimum depth of 20mm during the progress of work when the mortar is still green. For the faces of the wall which are not to be plastered, stone surfaces shall be cleared of mortar splashing to give uniform stone appearance.

5.2 COURSED RUBBLE MASONRY

5.2.1 DRESSING

Face stones shall be hammer dressed on all beds and joints so as to give them approximately rectangular shape. These shall be square on all joints and beds. The bed joints shall be chisel drafted for atleast 80mm back from the face and for the side joints atleast 40mm. No portion of the dressed surface shall show a depth of gap more than 6mm from a straight edge placed on it. The remaining unexposed portion of the stone shall not project beyond the surface of the bed and side joints. The bushing on the face shall not be more than 40mm on an exposed face and 10mm on the face to be plastered.

The hammer dressed stone shall also have a rough tooling for a minimum width of 25mm along the four edges of the face of the stone for the exposed stone masonry work.

5.2.2 LAYING

All stones shall be wetted before laying to prevent absorption of water from mortar. The stones shall be laid so that the pressure is always perpendicular to the natural bed. The courses shall be built perpendicular to the pressure which the masonry will bear. In case of battered walls, the base of stone and plane of courses shall be at right angles to the batter.

The walls shall be carried up truly plumb or to the specified batter. Every stone shall be carefully fitted to the adjacent stones, so as to form neat and close joints. All courses shall be laid truly horizontal and all vertical joints shall be truly vertical. The quoin stones shall be laid stretchers and headers alternately and shall be laid square on their beds, which shall be rough chisel dressed to a depth of atleast 100mm.

All courses shall be laid truly horizontal and all vertical joints shall be truly vertical. The stones shall be laid in horizontal courses and each course shall be of equal height of not less than 150mm and more than 300mm.

Levelling at plinth level, window sills and roof level shall be done with concrete comprising of one part of the mortar as used for the masonry and two parts of graded stone aggregate of 20 mm nominal size.

The bond shall be obtained by fitting in closely the adjacent stones. Transverse bonds shall be provided by the use of bond stones extended from the front to the back of the wall. At angular junctions the stones at each alternate course shall be well bonded into the respective courses of the adjacent wall.

Face stones shall extend and bond well in the back. These shall be arranged to break joints as much as possible, and to avoid long vertical lines of joints. The depth of stone from face of the wall, inwards, shall not be less than the height or breadth at the face.

Where there is a break in masonry work, the masonry shall be raked in sufficiently long steps for facilitating joining of old and new work. The stepping of the raking shall not be more than 45 degrees with the horizontal. The toothed joints shall not be permitted. The masonry work shall not be raised more than 1.2 metres per day.

5.2.3 HEARTING STONES

The hearting or the interior filling of the wall shall consist of flat bedded stone carefully laid on their proper beds in mortar. The use of chips shall be restricted to the filling of interstices between the adjacent stones in hearting and these shall not exceed 10% of the quantity of masonry. While using chips it shall be ensured that no hollow spaces are left anywhere in the masonry.

5.2.4 FACE STONES

Face stones shall tail into the work for not less than their heights and atleast one thirds of the stones shall tail into the work for a length not less than twice their height. These should be laid headers and stretchers.

5.2.5 BOND STONE

Same as for random rubble masonry given under clause no. 5.1.5 except that a bond stone or a set of bond stones shall be inserted 1.5 to 1.8 meter apart, in every course and shall be staggered in subsequent layers.

5.2.6 QUOINS

The quoins shall be of the same height as the course in which these occur and shall not be less than 450mm in any direction.

5.2.7 JOINTS

All bed joints shall be horizontal and all side joints vertical. All joints shall be full of mortar. Face joints shall not be more than 10mm thick. When plastering and pointing is not required to be done, the joints shall be struck flush and finished at the time of laying, otherwise the joints shall be raked to a minimum depth of 20mm during the progress of work when the mortar is still green. The joint shall be either flush or struck. Raised or cut pointing, shall be done with cement mortar 1:3 using wooden mould/template of minimum 12mm depth for uniformity.

6.0 PAYMENT

This clause shall apply to item rate tender only.

The payment for stone masonry works shall be inclusive of all labour, material, sampling and testing, scaffolding/staging, dressing, wetting out of stones, laying etc., raking of joints, curing, pointing, providing recesses and making circular or rectangular openings, sealing the gap between the masonry and soffit or beam/slab with and including cement mortar, making of masonry platform for unloading the wet mix, embedding fixtures/fittings including providing PCC(1:3:6) etc., for all heights and depths Deductions for circular or rectangular openings or for making pockets shall be as per relevant BIS Codes.

- 6.1.1 Payment for random rubble stone/course rubble masonry works shall be made on cubic metre basis on the volume of work done, to be measured as per relevant BIS Codes.



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VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR DEMOLITION AND DISMANTLING

VCS-SS-CS-6029

					
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ABBREVIATION

m	Metre
mm	Millimetre
Sqm	Square Metre
Cum	Cubic Metre

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1.0 SCOPE

This specification covers the procedure and safety requirements for demolition and dismantling of masonry (Brick & Stone), concrete (Plain /Reinforced), structural steel (sheeted / un sheeted) works.

2.0 REFERENCES

- 2.1 Specification No. VCS-SS-CS-6002, Earth work in site grading
- 2.2 VCS-SS-CS-6003, Earth work for Underground piping
- 2.3 VCS-SS-CS-6022, Earth work in foundations
for Earth work.

3.0 GENERAL

- 3.1 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 and General Conditions of Contract. Prior consent and approval of the Engineer-in-charge shall be obtained in writing before starting any dismantling works. Any restrictions imposed regarding working hours shall also be strictly followed by the Contractor.
- 3.2 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 Engineer-in-charge.
- 3.3 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 Engineer-in-charge, 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 the Engineer-in-charge at no extra cost to the Owner.

4.0 SAFETY PRECAUTIONS

- 4.1 The Contractor shall adhere to safe demolishing/dismantling practices at all stages of work to guard against accidents, hazardous and unsafe working procedures.
- 4.2 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.
- 4.3 Temporary enclosures made out of GI sheets, fencings, danger lights etc. shall be provided by the Contractor and got approved by the Engineer-in-charge before start of work to prevent accidents.
- 4.4 Contractor must ensure the availability of adequate firefighting equipment / arrangements before starting actual demolishing/dismantling works. These facilities

shall be made available throughout the entire operation of demolition and dismantling of structures.

- 4.5 All equipment's, pipes, fittings and instruments, underground utilities etc. located in the vicinity shall be protected by suitable means, as decided by the Engineer-in-charge, during demolishing, dismantling operations.
- 4.6 Roads and working spaces shall be kept free of any debris/dismantled materials at the end of day's work.
- 4.7 Necessary measures shall be taken to keep the dust and noise nuisance to minimum levels.
- 4.8 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 stuck-up due to corrosion etc. however the decision of Engineer-in-charge 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.

5.0 PROCEDURE

- 5.1 Entire work of demolishing & 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 & dismantling to the Engineer-in-charge 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.
- 5.2 Demolition and dismantling shall be restricted to the extent shown on drawings or as directed by the Engineer-in-charge.
- 5.3 Demolition of any structure shall be carried out in the sequence reverse to that followed at the time of its construction.
- 5.4 Dismantling shall be done in a systematic manner. All elements shall be carefully removed without causing any damage.
- 5.5 Blasting in any form shall not be permitted.
- 5.6 Chipping of concrete/grout shall be done with precision by chiseling. The finished surfaces shall be made true to the requisite size and shape.
- 5.7 Pockets/holes of specified size shall be made/cut by drilling/chiseling.

6.0 CLEANING & STACKING

- 6.1 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 Engineer-in-charge.

7.0 DISPOSAL

All unserviceable materials shall be disposed off in spoil heaps within or outside the plant boundary as per the directions of the Engineer-in-charge. Areas required outside the plant boundary for dumping of disposed material shall be arranged by the contractor and got approved by the Engineer-in-charge.

8.0 PAYMENT

This clause shall be applicable for item tender rate only.

8.1 GENERAL

Measurement of all works shall be taken prior to start of demolishing / chipping / dismantling works.

8.2 MASONRY/CONCRETE WORKS (DEMOLITION)

- 8.2.1 Payment shall be made on the basis of actual volume in cubic meters (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 & cleaning of reinforcement bars and other embedment's (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 Engineer-in-charge.

8.3 EXCAVATION & BACKFILLING

- 8.3.1 Excavation and backfilling shall be paid separately as per relevant clauses of specification No. VCS-SS-CS-6002, VCS-SS-CS-6003, VCS-SS-CS-6022 for Earth Work.

8.4 CHIPPING OF CONCRETE WORKS

Payment shall be made on the basis of admissible area in square meters (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, chiseling, 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.

8.5 MAKING POCKETS/HOLES IN CONCRETE WORKS

Payment shall be made on the basis of number (Each) of pockets/holes of sizes up to & 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, chiseling, drilling, handling, cutting or relocating reinforcement bars, cleaning, disposal of all unserviceable material etc. all complete as directed.

8.6 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 Engineer-in-charge.

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.

8.7 DISMANTLING OF ROOF & WALL SHEETING

Payment shall be made on the basis of dismantled sheeted area in square meters (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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VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR MISCELLANEOUS ITEMS

VCS-SS-CS-6030

					
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ABBREVIATION

m	Metre
mm	Millimetre
m ²	Square Metre
Kg/m ²	Kilogram Per Square Metre
IS	Indian Standard
BIS	Bureau of Indian Standards
RCC	Reinforced Cement Concrete

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1.0 SCOPE

The scope shall be as specified separately for different items below.

2.0 REFERENCES

2.1 BIS CODES

IS:73 Paving bitumen-specification

IS:383 Coarse and fine aggregates for concrete Specification

IS:6313 Code of practice Ant termite measuring in building

2.2 SPECIFICATIONS

VCS-SS-CS-6021, Materials

VCS-SS-CS-6023, Plain and Reinforced Cement Concrete

3.0 MATERIALS

The materials shall be as specified separately for different items below.

4.0 GENERAL REQUIREMENTS

4.1 The Contractor shall test the materials, where applicable, in approved laboratory as required by the Engineer-in-Charge and furnish test certificates for materials and obtain the approval of the Engineer-in- Charge prior to the use of such materials in the works. All tests shall be in accordance with relevant Indian Standards.

5.0 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 specification no. VCS-SS-CS-6021.

5.3 PROCEDURE FOR TREATMENT

5.3.1 The treatment shall be carried out by an approved agency specialized in the field. Apart from this t his specification, the work shall be carried out in compliance with IS: 6313. In case of any contradiction, this specification shall govern.

5.3.2 SITE PREPARATION

Prior to start of chemical treatment, area(s) shall be made free from logs, stumps timber, off cuts, leveling 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/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.
- b. On completion of construction of masonry foundations, the backfill in immediate contact with the substructure shall be treated in layers, of 300mm, with emulsion @7.5 litres/m² of the vertical surface of the substructure (i.e. $7.5 \times 0.300 = 2.25$ litres/meter of perimeter) for each side. The treatment shall be given after ramming of each layer of soil, by rodding the earth at 150mm 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.
- 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 750mm, 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 75mm deep at 150mm centres, both ways, shall be made on the surface with 12mm 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 30mmx30mm, by making rod holes 150mm apart (upto the ground level) in the channel and then by moving the rod backward and forward to break up the earth. The chemical emulsion shall be poured along the channel @7.5 litres/m² 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 150mm and to depth of 300mm. 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. $7.5 \times 0.300 = 2.25$ litres/metre of perimeter). After the treatment, the earth shall be tamped back into place.

5.4 PAYMENT

This clause shall apply to item rate tenders only.

Payment for pre-constructional anti-termite treatment shall be made on square metre (sq.m.) basis of plinth area of the building at ground floor only.

The rate shall include supplying all materials, spray pumps, tools, tackles & other accessories, labour, site preparation, rodding, tamping, mixing, spraying the specified chemical emulsion at prescribed dosage, storage facilities, handling, transporting etc. all complete as directed & specified.

6.0 DRESSING & TRIMMING

6.1 SCOPE

This specification covers the procedure for dressing, trimming and paving with earth the peripheral area around the completed building/structure.

6.2 PROCEDURE

The ground all around the completed building/structure for 3 metres width or as specified by the Engineer-in-Charge, 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 75mm.

6.3 PAYMENT

This clause shall apply to item rate tenders only.

Payment shall be made on square metre (sq.m.) basis of the actual area dressed and paved with earth.

The rate shall include supplying all materials, labour including cleaning, dressing the ground to required slope, spreading of earth, watering, ramming, consolidating etc. all complete as directed.

7.0 CUTTING PILE HEADS

7.1 SCOPE

This specification covers procedure for cutting pile heads of cast-in-situ RCC piles.

7.2 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 chiseling taking all necessary safety precautions. Care shall be taken that pile reinforcement is not cut or damaged during chiseling 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 Engineer-in-Charge 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.

7.3 PAYMENT

This clause shall apply to item rate tenders only.

Payment shall be made per pile basis for the actual number of pile heads cut.

The rate shall include supplying all tools and tackles, labour including disposal of debris, bending the pile reinforcements for proper anchorage within the pile cap etc. all complete as directed.

8.0 BUILDING-UP PILE HEADS

8.1 SCOPE

This specification covers requirements of materials and procedure for building-up of RCC Pile Heads.

8.2 MATERIALS

8.2.1 Concrete shall be of the same grade & specification as that for the pile.

8.2.2 Reinforcement shall be of the same grade and specification as that for the pile.

8.2.3 Type of cement shall be same as that used for the pile.

8.3 PROCEDURE

Concrete in existing piles shall be chiseled 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 chiseled off upto a length of 800mm.

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 Engineer-in-Charge. 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 Engineer-in-Charge.

8.4 PAYMENT

This clause shall apply to item rate tenders only.

Payment shall be made on cubic metre basis for the total quantity of concrete actually poured for achieving the level as shown on drawings.

The rate shall include supply of all materials (except reinforcement which shall be paid separately as per respective item) labour, cleaning, welding, shuttering, vibrating, finishing, curing etc. all complete. Cutting of pile heads and excavation including backfilling shall be paid separately as per respective item.

9.0 HARD CORE

9.1 SCOPE

This specification covers the requirements of materials and procedure for laying of hard core.

9.2 MATERIALS

Hard core shall consist of broken/crushed stones of 150mm and down size. Stones shall be sound, angular, hard and free from flakes, dust and other impurities.

9.3 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.

9.4 PAYMENT

This clause shall apply to item rate tenders only.

The hard core shall be measured on the basis of volume in cubic metres (cu.m.) of the compacted hard core laid. The rate shall include all labour, materials, consolidation by rammer/roller, watering, dressing etc. all complete.

10.0 SAND FILLING IN PLINTH/FOUNDATIONS

10.1 For specification of sand to be used for filling, reference shall be made to specification No. VCS-SS-CS-6002,

10.2 Filling shall be carried out in layers not exceeding 15cms 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.

10.3 Compaction by flooding may be accepted at the discretion of the Engineer-in-Charge, provided the required compaction is achieved.

10.4 The Contractor shall not commence filling in and around any work until it has been permitted by the Engineer-in-Charge.

10.5 PAYMENT

This clause shall apply to item rate tenders only.

Payment shall be made on cubic metre (cu.m.) basis of the finished compact volume. The rate shall include cost of sand for any compacted thickness, wastage if any, all handling, transport for all leads, tamping, watering, flooding, dressing etc. Any brick work required for ponding shall be paid separately under relevant item.

11.0 DAMP PROOF COURSE - (DPC)

- 11.1 All materials used for Damp Proof Course shall comply with specification No. VCS-SS-CS-6021.
- 11.2 The 40mm thick Damp Proof Course shall consist of plain cement concrete of grade M-20, unless otherwise specified.
- 11.3 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.
- 11.4 Before laying, the top surface of wall shall be thoroughly cleaned and watered. The D.P.C. shall be laid in layers of 20mm thickness retaining the edges by necessary formwork and shall be well tamped and trowelled 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/m². Over this, the second layer of 20mm 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/m² 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.
- 11.5 **PAYMENT**

This clause shall apply to item rate tenders only.

Payment shall be made on square metre (sq.m.) basis of the area laid. The rate shall be inclusive of formwork, curing, providing and laying bitumen, supplying and spreading sand over bitumen etc. complete.



Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR SOIL INVESTIGATIONS

VCS-SS-CS-6031

					
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ABBREVIATION

m	Metre
mm	Millimetre
Cm	Centimetre
Kg/cm ²	Kilogram Per Square Centimetre
IS	Indian Standard
Kg	Kilogram
°/sec	Degree /second

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1.0 SCOPE

- 1.1 These specifications cover the procedure for soil investigations for foundation
- 1.2 The work shall be carried out in accordance with the specification set out below and as directed by the Engineer-in-Charge, wherever necessary.

2.0 REFERENCE

- 2.1 These specifications conform to the Indian Standards on Soils and Foundations as given in ANNEXURE- A.
- 2.2 Reference to any code in these specifications shall mean the latest revision of the code unless otherwise mentioned. In the event of any conflict between the requirements in these specifications and the referred codes, the former shall govern.

3.0 SOIL INVESTIGATIONS

3.1 Boring

Boring shall be carried out in accordance with the provisions of IS: 1892 and as per the specifications given below:

3.1.1 AUGER BORING

- 3.1.1.1 Augers shall be of helical or post type and may be manually or power operated. Beyond 5 meters depth, below ground, only power operated rig shall be used. The diameter of the hole shall be minimum 100 mm and preferably 150 mm.
- 3.1.1.2 Uncased holes shall be permitted only upto a depth where the sides of the hole can stand unsupported. In case side fall is noticed, steps shall be taken immediately to stabilize the holes by using bentonite slurry or by casing pipes as directed by the Engineer-in-Charge.
- 3.1.1.3 No water shall be added while boring through cohesive soils and cohesion less soil above water table. While boring through cohesion less soil below water table, water in the casing shall always be maintained at or above the water table.
- 3.1.1.4 The cuttings brought up by the auger shall be carefully examined and soil descriptions duly record. Representative samples shall be preserved for laboratory testing.
- 3.1.1.5 Wherever in-situ tests are conducted and undisturbed samples are obtained at specified depths from the borehole, care shall be taken to ensure that the borehole is properly cleaned and free from foreign matters at the time of conducting these operations.
- 3.1.1.6 Water table in the borehole shall be carefully recorded and reported. One of the following methods shall be adopted for measuring the water table:
 - a. The water table in the borehole shall be allowed to stabilize after depressing the water level adequately by bailing. Stability of the borehole sides and bottom shall be ensured at all times.

- b. The borehole shall be filled with water and then bailed out to various depths. Observations shall be made at each depth to see if the water level is rising or falling. The depth at which neither a fall nor a rise is observed, shall be considered as the water table depth. This shall be established by three successive readings of water levels taken at intervals of 2 hours.

c. Hvorslev's Method

The water level shall be depressed by bailing (to say D below ground level) and shall then be allowed to rise. Water rise at suitable equal intervals of time shall be recorded. The distance of depressed water level from the actual water table shall be obtained by the following formula:

$$H_0 = h_1^2 / (h_1 - h_2)$$

Where

H₀ - distance of the depressed water level from actual water table, and h₁, and h₂ are two successive rises of water level in the borehole for the same time interval.

The water table depth (H_d) from ground level shall be determined as under: H_d = D - H₀

Three sets of observations shall be made and the average value of H_d determined.

Method (a) is suitable for permeable soil while methods (b) and (c) are suitable for both permeable and impermeable soils. The Engineer-in-Charge shall indicate the method to be followed.

- 3.1.1.7 Immediately on completion of a borehole, bore log shall be prepared in an approved Performa as given in ANNEXURE B to these specifications and submitted to the Engineer-in-Charge in triplicate.

3.1.2 SHELL AND AUGER BORING

- 3.1.2.1 Augers shall be of helical or post hole type and may be manually operated. The diameter of the hole shall be minimum 100 mm and preferably 150 mm.
- 3.1.2.2 Specifications set forth in clauses 3.1.1.2 to 3.1.1.7 for Auger Borings shall apply to Shell and Auger borings also.
- 3.1.2.3 Auger shall be used for soft to firm clay and for silty deposits at upper depths of 10 metres or up to the water table whichever is deeper. For deeper depths in such deposits and for every stiff to hard clays and dense sands located at any depth, use of shell may be made.
- 3.1.2.4 While boring in soft clays and in sandy deposits below water table, it shall be ensured that, the shell diameter shall be at least 25 to 50 mm less than the casing diameter. This is to ensure that suction is not created in the borehole during withdrawal of the shell with consequent "Caving in and blowing" in the boreholes.

3.1.3 ROTARY MUD CIRCULATION DRILLING

3.1.3.1 The drilling shall be carried out manually (as per IS: 1892) or by use of a suitable mechanical rig.

3.1.3.2 Drillings up to water table shall be done by auger and provisions of clauses 3.1.1.1 to 3.1.1.7 shall apply. Below the water table drilling by rotary and circulation shall be adopted.

3.1.3.3 Use of percussion tools may be permitted in very stiff to hard clays and dense sandy deposits.

3.1.4 BACKFILLING OF BOREHOLES

On completion of boreholes, backfilling shall be carried out with approved materials as and when directed by the Engineer-in-Charge. Unless otherwise specified, the excavated soil shall be used for the purpose.

3.1.5 TERMINATION CRITERIA

If very hard strata are met within the borehole at depths shallower than specified in tender documents, the borehole shall be advanced by chiseling. If in the opinion of the Engineer-in-charge, the rate of advancement of borehole is still low, coring may be resorted to subsequently.

3.2 TRIAL PITS

3.2.1 Trial pits shall be of min. 3m x 3 m size at base so as to permit easy access for a visual examination of the walls of the pit and to facilitate sampling and insitu testing operations.

3.2.2 Precautions shall be taken to ensure the stability of pit walls, if necessary even by the provision of shoring. Arrangements shall be made for dewatering, if the pit is extended below water table.

3.2.3 In-situ tests shall be conducted and undisturbed samples obtained immediately on reaching the specified depths, so as to avoid substantial moisture changes in the subsoil.

3.2.4 To ascertain the thickness of the black cotton soil layer existing at the top, trial pits shall be examined visually. Usually it is found that immediately after the black cotton soil, there exists a layer of calcareous (lime) nodules or the white patches which helps to determine the exact thickness of expansive clay layer. Generally, below this layer the possibility of existence of black cotton soil does not exist.

3.2.5 After completion of tests and examination the pits shall be suitably backfilled as directed, by the Engineer-in-charge. Unless otherwise specified the excavated soil shall be used for, this purpose.

3.3 IN-SITU TESTING

3.3.1 STANDARD PENETRATION TEST

- 3.3.1.1 The test shall be conducted at specified intervals or at a depth where the strata changes, whichever occurs earlier.
- 3.3.1.2 The test shall be carried out by driving a standard split spoon by means of 63.5 kg hammer with a 75 cm free fall. Detailed procedure of testing, as specified in IS: 2131, 'Method of Standard Penetration Test in Soils' shall be followed. The samples obtained in the split spoon shall be labeled and preserved for identification tests in the laboratory.
- 3.3.1.3 The standard penetration test shall be discontinued when N is greater than 75 blows for 30 cms of penetration.

3.3.2 VANE SHEAR TESTS

- 3.3.2.1 These tests shall be conducted in soft to firm clays and sensitive clays. These tests shall also be conducted in case of stiff fissured clays where samples cannot be taken.
- 3.3.2.2 Tests may also be conducted by direct penetration from ground surface.
- 3.3.2.3 The apparatus used for vane shear tests shall satisfy the requirements as per IS: 4434.

a. For test from bottom of borehole

- i. Vane shall consist of four mutually perpendicular blades as illustrated in Fig. 1. The height of the vane should be twice the overall diameter. It is recommended that the overall diameter of the vane should be 37.5, 50, 65, 75 or 100 mm. The design of the vane shall be such that it causes as little re-moulding and disturbance as possible to the soil when inserted into the ground for a test. The blades shall be as thin as possible, consistent with the strength requirements. The vane should not deform under the maximum torque for which it is designed. The penetrating edge of the vane blades shall be sharpened having an included angle of 90°. The vane blades shall be welded together suitably either directly or to a central rod, the maximum diameter of which should preferably not exceed 12.5 mm. The area ratio of the vane shall be kept as low as possible and shall not exceed 18 percent for the 37.5 mm vane and 12 percent for the 50, 65, 75 and 100 mm diameter vanes. The area ratio may be calculated using the following formula.

$$A, = (8t (D-d) + \pi d^2) / \pi d^2 \times 100 (\%)$$

Where A = area ratio in percent

t = thickness of vane blades in mm.

D = overall diameter of vane in mm and

d = diameter of central vane rod including any enlargement due to welding in mm.

Note 1: The vane selected should be the largest size suitable for the general soil conditions at a site.

The vane rod (the rod to which the vane blades are fixed) may be enclosed in a suitably designed sleeve from just above the blades and throughout the length it penetrates the soil to exclude the soil particles and the effects of soil adhesion. This sleeve shall commence above the blades at a distance equivalent to about two diameters of the vane rod.

Note 2: The vane shall be frequently checked for straightness.

- ii. Torque applicator - The torque applicator shall have a clamping device to rigidly secure it to the anchor casing and shall have an attachment to securely hold the string of rods connecting the vane.

The instrument shall be capable of applying a torque to the vane through the string of rods and to measure the same. It should also have a device to read the angular rotation of the upper end of the extension rod. The torque applicator shall be provided with speed control so that the rate of rotation may be maintained at $0.1^\circ/\text{sec}$. Friction exerted by the torque applicator shall be of negligible magnitude and shall be checked periodically. Depending upon the estimated shear strength of the soil the following table (Table I) may be used as a guide for the selection of torque applicator of capacity 60 N. m (600 kgf. cm)

**TABLE - 1
SELECTION OF TORQUE APPLICATOR**

Estimated Shear Strength in KN/m^2 (kgf/cm^2)	Vane size (dia) suitable for use with 600 kgf. Cm torque applicator
10 (0.1)	All sizes
20 (0.2)	All sizes except 100 mm size
30 (0.3)	All sizes except 100 mm size
40 (0.4)	All Sizes except 75 mm and 100 mm size
50 (0.5)	All sizes except 75 mm and 100 mm size
60 (0.6)	37.5 mm and 50 mm size.
70 (0.7)	37.5 mm and 50 mm size.

The capacity and accuracy of the instrument shall be one of the following as may be specified by the purchaser:

1. Measure torque upto 60 N.m (600 kgf.cm) to an accuracy of 1 N. m (10 kgf.cm),
or
 2. Measure torque upto 200 N.m (2000 kgf. Cm) to an accuracy of 2.5 N.m (25 kgf. cm)
- iii. Rod system - The string of torque rods connecting the vane to the torque applicator, called the rod system may be of quick coupling type or of the threaded type. The length of the rods shall preferably be 1 m with a few of smaller lengths. These rods shall have sufficient diameter such that their elastic limit is not exceeded when the vane is stressed to its capacity (see note 3). The threaded rods shall be so coupled that the

shoulders of the male and female ends shall meet to prevent any possibility of the coupling tightening when the torque is applied during the test. If vane housing is used, the torque rods shall be equipped with well-lubricated bearings where they pass through the housing. These bearings shall be provided with seals to prevent soil from entering them. The torque rods shall be guided so as to prevent soil so as to prevent friction from developing between the torque rods and the walls of casing or boring.

Note 3: If torque versus rotation curve is to be determined, it is essential that the torque rods be calibrated (prior to the use in the field). The amount of rod twist (if any) shall be established in degree per metre per unit torque. This correction becomes progressively more important as the depth of test increases. The calibration shall be made at-least to the maximum depth of testing anticipated.

- iv. Dummy Rod- of dimensions equal to that of the vane rod of the vanes used.
- v. Guides for Rod - of suitable type provided with ball bearing attachment so as to enable the rod to rotate freely (see Note iv.)

Note 4: During the test, it is essential that the rods and vane are placed centrally in the bore-hole. For this purpose guides shall be used at an interval in depth of not more than 5m.

- vi. Drilling equipment - the equipment shall provide a clean hole of the required diameter for insertion of the vane to ensure that the vane test is performed on undisturbed soil.
- vii. Jacking Arrangement - for pushing the shoe and vane (where required)

Note 5: The apparatus shall be checked and calibrated as and when required.

- b. For tests by Direct Penetration from Ground Surface
 - i. Vane - as specified in 3.3.2.3 (a. In addition the vane shall be suitably protected by a shoe (see Fig. 2)
 - ii. Rod System - as specified in 3.3.2.3 (a) and of suitable type.
 - iii. Extension Pipes - about one metre length with coupling on the outer face to ease the hole.
 - iv. Torque Applicator - as specified in 3.3.2.3 (a)

Note 6: The apparatus shall be checked and calibrated as and when required.

3.3.2.4 Tests from the bottom of a Bore Hole

- a. Sink the bore-hole upto the depth required and extends the casing up to the full depth. If the casing is loose, secure it so that it does not move during the tests. Fix the torque applicator anchor plate to the casing.
- b. Connect the vane of suitable size (see Note 1) to the rods and lower it to the bottom of the bore-hole, putting guides at suitable intervals but not more than about 5m as the

rods are extended. Push the vane with a moderately steady force up to a depth of 5 times the diameter of the bore hole below the bottom of the bore hole or shoe. Take precautions to make sure that no torque is applied to the torque rods during the thrust. No hammering shall be permitted. Fix the torque applicator with frame to the anchor plate and connect the rods to it. Tighten the torque applicator to the frame properly. A diagrammatic vane test arrangement for test from bottom of bore-hole is shown in Fig. 3

- c. Allow a minimum period of 5 minutes after insertion of the vane. Turn the gear handle so that the vane is rotated at the rate of $0.1^\circ/\text{s}$. Note the maximum torque reading attained. If necessary, note the torque indicator dial gauge readings at half minute interval and continue rotating the vane until the reading drops appreciably from the maximum.
- d. Just after the determination of the maximum, torque, rotate the vane rapidly through a minimum of ten revolutions. The re-moulded strength should then be determined (see c. above) within one minute after completion of the revolutions.
- e. Remove the vane testing assembly, continue boring and collect soil sample from the level of the vane testing for laboratory analysis to ascertain whether the deposit will behave as a purely cohesive soil.
- f. In case where a sleeve is not provided for the vane rod and the soil is in contact with the rod, determine the friction between the soil and the vane rod by conducting tests at appropriate depths using the dummy rod corresponding to that of the vane used in the test. The test should be conducted as with the vane except that the vane is replaced by dummy rod. The test should be conducted in an adjacent bore-hole at the same depth at which the vane tests were conducted. The dummy rod should be pushed in to the ground to the same distance as the vane rod at that depth.
- g. Following points shall, however, be carefully supervised in the field;
 - i. Straightness of vane shall be checked while the entire assembly of vane connected with rod is being lowered to the bottom of bore holes. Vane shall be pushed with a moderate steady force upto a depth of five times the borehole diameter below the bottom of boreholes. Precautions shall be taken to ensure that no torque is applied to the torque rods during the thrust. No hammering shall be done.
 - ii. An interval of 5 minutes shall be allowed to lapse after insertion of vane.
 - iii. Torque indicator readings shall be noted at intervals of 30 seconds until the vane readings drop appreciably from the maximum.
 - iv. Samples shall be collected from the levels at which the tests have been conducted.

3.3.2.5 Tests by Direct Penetration from Ground Surface-Rods shall remain tight when vane is lowered. Guides shall be placed at every 3m to centralize and reduce friction between rods and extension pipe.

3.3.2.6 Records-Records of vane test shall be maintained in the Performa given in ANNEXURE-C

3.3.3 DYNAMIC CONE PENETRATION TESTS:

3.3.3.1 Dynamic Cone penetration tests 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.

3.3.3.2 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 shall 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 provided with vents for flow of bentonite slurry.

The test shall be reported in a suitable tabular form giving blow counts for every 30cm. Penetration, supplemented by a graphical plot of blow counts versus depth.

3.3.3.3 Dynamic cone penetration tests shall be terminated when blow counts (Nc) exceed 150 for two successive penetrations of 30 cm each.

3.3.4 STATIC CONE PENETRATION TEST.

3.3.4.1 The equipment used for this test shall conform to the requirements of IS: 4968 (Part-III)

3.3.4.2 The capacity of the equipment to be used for test shall not be less than 3.0 tonnes but preferably 10.0 tonnes.

3.3.4.3 The test shall not be carried out on gravelly soils and for soils with standard penetration value 'N' greater than 50.

3.3.4.4 Test Procedure-Test procedure shall meet the requirements of IS: 4968 (Part III). Some of the important points of the procedure are given below:

- a. 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.
- b. Equipment shall be securely anchored to the ground at the test point for obtaining the required reaction.
- c. 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.

- d. 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 which is possible with the cone assembly available. During the pushing, the mean value of resistance as indicated by pressure gauges shall be noted ignoring erratic changes.
- e. For finding combined cone and friction resistance of the soil the sounding rod, shall be pushed to the extent, the cone has been pushed at the rate of 1 cm per sec noting mean resistance on the gauges.
- f. Above procedure shall be repeated after pushing the combined cone-friction jacket and mantle tube assembly to the next depth at which the test is to be performed.
- g. The sequence of operation of the equipment is shown in the figure 4.

3.3.4.5 The performa for record of results of static cone penetration test shall be as given in ANNEXURE-D.

3.3.5 PLATE LOAD TEST

3.3.5.1 Plate size and thickness

- a. For clayey and silty soils and for loose to medium compact sandy soils ($N < 15$) normally met with, chequered plate of 60cm x 60 cm shall be used. Alternatively, circular plate of equivalent area also may be used.
- b. For dense sandy or gravelly soils ($15 < N < 30$) the smallest size shall be 30 cm square and largest 75cm square. Circular plates of equivalent area may also be used.
- c. The minimum thickness of the chequered plate shall be 25mm.

3.3.5.2 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.

3.3.5.3 Placing of test plate

Plate shall be added to the soil by spreading fine sand in a layer not exceeding 5 mm 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.

3.3.5.4 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 as designed truss anchored to the ground at the two ends by soil anchors, loaded platform or any other suitable device. A typical arrangement is shown in Figures 5 and 6.

3.3.5.5 Application of load

- a. Loading shall be carried out in increments of $1/5$ design load or about 0.3 kg/cm^2 whichever is lower.
- b. Loading shall be carried out till one of the following conditions occurs:
 - i. Soil under the plate fails.
 - ii. Total settlement of the plate exceeds 40 mm .
 - iii. Load intensity equal to thrice the design load is reached.
 - iv. Load intensity 6.5 kg/cm^2 is reached.

3.3.5.6 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.

3.3.5.7 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.

3.3.5.8 Record

- a. Record shall consist of the following:
 - i. Load-settlement reading in tabular form.
 - ii. Time-Settlement curve for each load stage.
 - iii. Load-settlement curve in natural and log-log scale.
 - iv. Modulus of sub-grade reaction evaluated from test.
- b. In addition to above the record shall also contain the following:

- v. Date
- vi. List of personnel
- vii. Weather conditions
- viii. Irregularity in routine procedure, if any.

3.3.5.9 Post test requirements

- a. Backfilling of the pit shall be carried out in an approved manner and as per the directions of Engineer-in-Charge on completion of test.
- b. An auger bore hole 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.

3.4 PERCOLATION TEST

Percolation test to determine the soil absorption capacity shall be conducted in accordance with IS: 2470(Part-I) - Appendix A.

3.5 DYNAMIC SOIL TESTS

3.5.1 GENERAL

The following tests shall be conducted for the determination of elastic modulus and shear modulus of the soil and their variation with confining pressure for use in the design of foundation subject to vibratory loads:

3.5.1.1 Wave velocity measurements

3.5.1.2 Resonance tests

3.5.1.3 Cyclic plate load test

3.5.1.4 Repeated triaxial shear test.

3.5.2 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. Backfilling 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.

3.5.3 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 set up and method of conducting the tests shall conform to IS: 5249 (latest edition).

3.5.4 CYCLIC PLATE LOAD TEST

The test set up and plate size shall 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.

3.5.5 REPEATED TRIAXIAL SHEAR TEST:

This test shall be carried out for confining pressure ranging from 0.5 kg/cm² to 4.0 kg/cm². The triaxial 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.

3.5.6 Results of all the above tests shall be incorporated in the form of a plot of shear modulus V/s confining pressure for a range of pressure upto 4.0 kg/cm².

3.6 FOOTING LOAD TEST

3.6.1 This test shall be conducted on a concrete footing reinforced with 10 bars of 16 mm dia at 20 cm. spacing both ways and having a size of 2m x 2m and a minimum overall thickness of 0.50 m provided with a suitably reinforced pedestal of size 60 cm x 60 cm.

3.6.2 Method of loading, recording of settlement observations and reporting of results shall be as specified for plate load test (clause 3.3.5). Loading shall be carried out in stages of 0.5 kg/cm² or as specified upto a net loading intensity of 2.5 kg/cm² (including weight of foundation).

3.7 FIELD CBR TESTS

This test shall be done as per IS: 2720 part XXXI at specified depth after removing top soil, vegetation and organic matter.

3.8 SAMPLING

3.8.1 SAMPLING RECORD

All samples (disturbed and undisturbed) collected from the pit/bore hole shall be labeled in a manner shown in the ANNEXURE E. Label shall be attached to the top of sampler, in case of undisturbed samples. In case of samples collected in jar or other containers, the label should be properly pasted to the Jar/container.

3.8.2 UNDISTURBED SOIL SAMPLES FROM BOREHOLES

3.8.2.1 Samples for recovering undisturbed samples from cohesive soils at the specified depth shall conform to IS: 2132. However, use of samplers less than 70mm diameter shall not be permitted.

- 3.8.2.2 The sampling procedure shall conform to IS: 2132. Both the area ratio of the cutting edge, as well as recovery ratio of the cutting edge, as well as recovery ratio of the sample shall be measured and reported. For normal soils, area ratio of the sampling tubes, shall conform IS: 2132, that is, it may vary from 10.9 percent to 12.4 percent but for sampling in very hard and dense soils, use of thick walled sampling tubes with area ratio not exceeding 20% may be permitted subject to the approval of the Engineer-in-charge.
- 3.8.2.3 In order to reduce the wall friction, suitable precautions such as oiling inside and outside the sampling tubes shall be observed. The sampling tube shall have smooth finish.
- 3.8.2.4 In soft to firm clays, undisturbed samples shall be collected by pushing the tube continuously without impact or twisting. Driving of sampling tubes shall be permitted only if stiff to very stiff and hard deposits exists.
- 3.8.2.5 For highly sensitive soils, piston samples shall be employed.
- 3.8.2.6 For soft clays exceeding more than 15m depth from the ground level, collection of undisturbed samples shall be supplemented by the in-situ Vane Shear test.
- 3.8.2.7 The top and bottom of the sample shall be clearly marked on the sampling tube.
- 3.8.2.8 Undisturbed samples shall be tested within a period of two weeks of taking them from the bore holes or Trial pit.
- 3.8.2.9 If any space is left between the end of the tube and top of wax, the same shall be tightly packed with raw dust or any other suitable material. A close fitting lid or screwed cap shall then be placed on each end of the tube and held in position by adhesive tape.
- 3.8.3 **UNDISTURBED SOIL SAMPLES FROM TRIAL PITS**
- 3.8.3.1 Samples shall be obtained at specified depths from trial pits in a timber or steel box as under:
- A benching shall be made at the level where it is proposed to take the sample. A cube of 30cm size shall be formed by careful trimming with knife or any other suitable sharp instrument. A timber box having dimensions slightly larger than the soil cube shall be slipped on it so as to act as a container and the sample removed from the pit without causing any disturbance.
- 3.8.3.2 After recovery of the 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.
- 3.8.4 **Disturbed Soil Samples** - Disturbed soil samples shall be collected at every half a metre and at every change of strata from boreholes as well as from trial pits. Identification labels indicating depth, borehole number and visual soil classification shall be affixed on the containers.

3.8.5 WATER SAMPLES

- 3.8.5.1 Samples of ground water shall be obtained from the specified boreholes at the depths specified by Engineer-in-Charge.
- 3.8.5.2 At the specified depth water shall be bailed or pumped out so that fresh ground water flows into the borehole. Care shall be taken in avoiding any contamination with surface water at any time. Water sample shall be collected in a five litre polythene or glass container and labeled properly.

3.9 PIEZOMETERS

- 3.9.1 These may be installed in minimum 100 mm dia bore holes drilled by any suitable method.
- 3.9.2 INSTALLATION OF PIEZOMETERS:

Piezometers of Casagrande open stand pipe type shall be supplied and installed at locations and depth as indicated in the specific requirements. The piezometers shall be properly tested before installation to the entire satisfaction of Engineer-in-Charge. The details of the piezometer tips, size and diameter of stand pipe, RLs of tops of the standpipe and the tip of the piezometer and procedure of installation etc. shall be furnished in the report along with a sketch.

If the piezometers fail to show results or malfunction the contractor shall replace them at a specified location without any extra charge to the owner.

The contractor shall provide each piezometer with permanent enclosure/chamber made of steel or concrete or brick of plan area 50cm x 50 cm and height suitable for the projection of the piezometer with a lock and key system to protect the open end of the stand pipe. The arrangement shall also ensure that readings can be taken at regular intervals. The contractor shall arrange a qualified person to take readings of all these piezometers at regular as directed by the Engineer-in-Charge till all other works covered in the scope of this tender completed.

The item rate shall be inclusive of all those mentioned above and no extra cost is permissible on any account.

3.10 PRESSURE METER

3.10.1 PRESSURE METER TESTS/SUBSOIL DEFORMETER TESTS

The tenderer shall furnish, along with the bids, the details of the equipment and the procedure of testing.

The results of each test, necessary graphs and plots, and interpretation of results shall be included in the report.

The depth of each test shall be indicated at the time of conducting the tests.

The pressure meter should have the following minimum limiting pressure ranges for different types of soils.

Silt	0-7 kg/cm ²
Clay	0-12
Stiff Clay	18-40
Dense Silt	12-30
Loose Sand	4-8
Soft or weathered rock	10-30
Sand & Gravel	10-20
Dense Sand & Gravel	30-60

4.0 LABORATORY TESTING OF SOILS

4.1 SAMPLINGS RECORD

Details of sampling shall be entered in the performa given in ANNEXURE - F. The performa shall be submitted in triplicate to Engineer-in-Charge. One of the copies shall be returned by Engineer-in-Charge indicating the tests to be performed.

4.2 STORING OF SOIL SAMPLES IN LABORATORY

- 4.2.1 Soil samples shall be inspected and tested shortly after their arrival at the laboratory. Proper arrangement for storing shall be made in cases where testing of samples is not immediately after they are brought to the laboratory.
- 4.2.2 Bags of canvas, cans and bins can be used for storing large quantities of soil. The containers should have a label or tag which gives such data as soil type, project location, sampling data, boring number, sample depth, etc.
- 4.2.3 If the undisturbed 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 120° to 160°F. The wax coating can be applied by either dipping the soil sample 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 to heating to higher temperatures, tend to drive off more volatile hydrocarbons, thus making the wax more permeable and more brittle upon coating.
- 4.2.4 If the soil sample is to be stored for more than 15 days, a protective coating of wax, in more than one layer, is recommended with a total thickness of 12 mm to 18 mm.
- 4.2.5 A few selected soil samples shall be stored in the laboratory till the soil investigation report is finalized and approved by the Engineer-in-Charge.

4.3 HANDLING OF UNDISTURBED SAMPLES IN LABORATORY

- 4.3.1 The undisturbed samples shall be handled in the laboratory with due precaution to avoid disturbances and loss of moisture content which may adversely affect the test results.
- 4.3.2 Unprotected samples shall never be handled with bare hands because the hands foster disturbance and loss of moisture. The sample shall be protected by using Aluminium cellophane or wax paper before handling it.
- 4.3.3 When transporting a specimen it should be supported over its entire length by using a mould, plate or paper sling.
- 4.3.4 A chunk from an undisturbed sample collected from pit shall be cut with a wire saw which consists of a frame with a piano wire stung tightly across its. Any wax or other covering used to protect the sample shall be cut with a knife or hack saw. Care shall be taken when trimming the finished specimen. The wire in the wire sw used for final trimming shall be smaller in diameter than that used for preliminary cutting and the wire shall be cleaned prior to each out.
- 4.3.5 In case of samples taken in sample tubes, the samples shall be extruded from their tubes by a steady pushing process and not by a jerky or driving one. Prior to extrusion the plug, which protects the end of the soil shall be removed by scrapping it with a knife or sawing off that portion of the tube which contains plug. The extrusion shall employ the same direction of motion or motion of the soil with respect to the tube as existed during sampling, because a reversal of stress tends to cause disturbance.

4.4 PROCEDURES OF TESTING

All apparatus used for laboratory testing shall conform to the specifications laid down in the relevant Indian Standards.

- 4.4.1 All testing procedures shall conform to those laid down in relevant Indian Standards.
- 4.4.2 For proper interpretation, results of each laboratory test shall be presented either as given in relevant Indian Standard or as specified in specific requirements.

5.0 REPORT

- 5.1 The report shall state in brief the description of the test procedures employed.
- 5.2 The report shall also include wherever required a sample calculation with reference to formula used to evaluate the various parameters.
- 5.3 Report shall also contain the summary of various soil parameters evaluated, in a performa as shown in ANNEXURE-G.
- 5.4 Character and genesis of soil.
- 5.5 Procedure of investigation employed.

-
- 5.6 Detailed borelogs, subsoil sections, laboratory and field test results both in tabular as well as in graphical form and a plot plan showing locations and reduced levels of bore holes and other tests.
 - 5.7 Results obtained and their interpretation.
 - 5.8 Recommendation for type, depth, ultimate and safe bearing pressure and settlement of foundation for the following structures.
 - a. Process units, power plants etc. which carry a heavy unit load.
 - b. Non-plant structures such as administrative buildings etc, which are lightly loaded.
 - c. Storage tanks and other structures founded at or near ground surface.
 - 5.9 Recommendations shall also be given for allowable bearing pressure and settlements for foundations of sizes ranging from 1 to 10 metres placed at different depths ranging from surface to 3 metres below the ground surface.
 - 5.10 Aggressiveness of soil and soil water to reinforced concrete and steel and other building materials.
 - 5.11 Suitability of soil and degree of compaction of fill for the pavement and tank farms & recommendation for thickness of pavement for class AA and Class A loadings.
 - 5.12 Modulus of subgrade reaction for pressure ranging upto 3kg/cm². The recommended values shall include the effect of size, shape and depth of foundation.
 - 5.13 In case of poor soil conditions recommendations are to be made for the following.
 - a. Ground treatment method if considered necessary. If so type (s) of treatment method (s) recommended, depth of treatment and settlements and bearing capacity estimates after treatment.
 - b. Pile foundations if considered necessary, If so, types (s) of pile recommended, depth of pile, safe load capacity for different sizes of piles, p-y curves for lateral pile analysis shall also be submitted if specifically asked. Contractor shall also provide the ultimate pile load capacity curve with depth for various sizes of piles.
 - c. All recommendations shall be supported by back up calculations.
 - 5.14 Any other information of special significance encountered during investigation and likely to have a bearing on design and construction.
 - 5.15 Interim reports based on the data available shall be supplied to the Engineer-in-Charge on demand.

6.0 ANNEXURE – A

LIST OF INDIAN STANDARDS REFERRED

IS: 1498	Classification and Identification of Soils for General Engineering Purposes.
IS: 1888	Method of Load Tests on Soils
IS: 1892	Code of practice for Site Investigations for Foundations.
IS:2131	Method for Standard Penetration Test for Soils
IS: 2132	Code of Practice for Thin Walled Tube Sampling of Soils.
IS: 2470-Part-I	Code of Practice for Design and Construction of Septic Tanks-Small installations.
IS:2720	Method of Test for Soils (Relevant Parts)
IS: 4434	Code of practice for in Situ Vane Shear Test for Soils.
IS: 4968-Part-I	Method for subsurface sounding for soils Dynamic Method Using Cone without Bentonite Slurry.
IS: 4968-Part-II	Method for subsurface sounding for soils Dynamic Method Using Cone and Bentonite Slurry.
IS: 4968-Part-III	Method for subsurface sounding for soils static cone penetration test.

IS: 5249 Method of Tests for Determination of Insitu Dynamic
Properties of Soils.

7.0 ANNEXURE - B

RECORD OF BORING

Client.....
Ground Surface Level.....
Type of Boring.....
Diameter of Boring.....
Ground Water Level.....

Location.....
Boring No.....
Date Started.....
Date Completed.....
Site Engineer.....

Describe of strata	Soil Classification	Strata Thickness	Depth from G.L	R.L. of Layer	Samples			Insitu Test			Remarks
					Type	No .	Depth	Type	Depth	Value	

8.0 ANNEXURE-C

PROFORMA FOR FIELD VANE SHEAR TEST

GENERAL

Project

Bore-hole No.

Date of test

DETAILS OF BORING (IF ANY)

Location

Reference elevation

or

Ground elevation

Method of making the hole

Cased/Uncased

Level of ground water table

at the time of test

DETAILS OF VANE TEST

(a) Test from bottom of Bore hole

Vane size

Dia. of dummy rod (if used)

Conversion factor for torque measuring equipment

(b) Test by Direct Penetration from Ground Surface

Vane Constant

Depth

TIME-ROTATION READINGS

Time in Minutes	Depth					
	D	U	R	D	U	R

	D	U	R	D	U	R
Depth of vane tip below bottom of bore hole or vane shoe						
Time of failure						
Maximum reading in torque measuring equipment						
Maximum torque						
Number of revolutions for remoulding						
Shear strength of undisturbed soil KN/m ² (kgf/cm ²)						
Shear strength of remoulded soil KN/m ² (kgf/cm ²)						
Sensitivity						

D = Test with dummy, if used, or any other test for determination of friction of vane rod/torque rod.

U = Test with vane in undisturbed soil.

R = Test with vane in remoulded soil.

9.0 ANNEXURE -D

PROFORMA FOR STATIC CONE TEST

Project : Test point location

Site : Ground elevation

Borehole Reference : Ground water level

Static Cone Resistance

- Correction:
1. Mass of cone = m
 2. Mass of each sounding rod = m_1
 3. Cone area at base, $b = \text{cm}^2$
 4. *Plunger area
 5. Correction factor (to be added to the gauge reading)

$$= (m + nm_1) \times 10 \text{ KN/m}^2$$

$$= (m + nm_1)/10 \text{ Kgf/cm}^2$$

* The gauge reading shall be multiplied by the ratio of plunger area to the area of the base of

cone

Depth below	Gauge	Corrected value of
Ground level	reading	cone penetration
Resistance		
	(KN/m ²)	(KN/m ²)

Frictional resistance measured at particular depths with the help of friction jacket attached to the static cone.

Correction:

- 1) Mass of friction jacket $= m_f \text{ kg}$
- 2) Area of surface of friction jacket, $a = \pi dh \text{ cm}^2$
Where d = outer diameter of friction jacket and
 h = length of friction jacket
- 3) Cone area at base, $b = \text{cm}^2$
- 4) Correction factor (to be added) $= 100 m_f / a \text{ KN/m}^2$
 $= 1 \text{ KN/m}^2 (.01 \text{ kgf/cm}^2)$

Depth below ground level (m)	Total resistance KN/m^2 (kgf/cm^2)	Cone resistance (uncorrected) KN/m^2 (kgf/cm^2)	Total resistance-cone resistance KN/m^2 (kgf/cm^2)	Frictional resistance in KN/m^2 (kgf/cm^2)	Corrected frictional resistance KN/m^2 (kgf/cm^2)
m	X	y	x- y	$((x-y)b)/a=Z$	$Z+(100/a)m_f(Z+m_f/a)$

10.0 ANNEXURE-E

SAMPLE LABEL

Project _____

Location _____

Date _____

Sample No. _____

Soil Description _____

Boring/Trial No. _____

Depth of sample top _____

Elevation of ground surface _____

Type of sample _____

Disturbed/Undisturbed _____

Remarks _____



DOCNO: VCS-SS-CS-031
Rev No : 01

SAMPLE DATA FOR RECORD

IF COMPLETE _____

LOCATION _____

[illegible]



12.0 ANNEXURE G

LABORATORY TEST RESULTS

BOREHOLE/PT NO.	SAMPLE No.	DEPTH IN METERS	BRIEF DESCRIPTION	WATER CONTENT		DENSITY			LIMITS			MECHANICAL ANALYSIS				SHEAR TEST				CONSOLIDATION TEST			REMARKS
				%		DRY	WET		LIQUID	PLASTIC	PLASTICITY IND.	GRAVEL	SAND	SILT	CLAY	COMFINING OR NORMAL PRESSURE	DEVIATOR	C	Ø	PRESSURE RANGE	C _v	M _v	
					gm/cc	gm/cc						%	%	%	%	Kg/cm ²	Kg/cm ²	Kg/cm ²	Deg.	Kg/cm ²	cm ² /s	cm ² /kg	

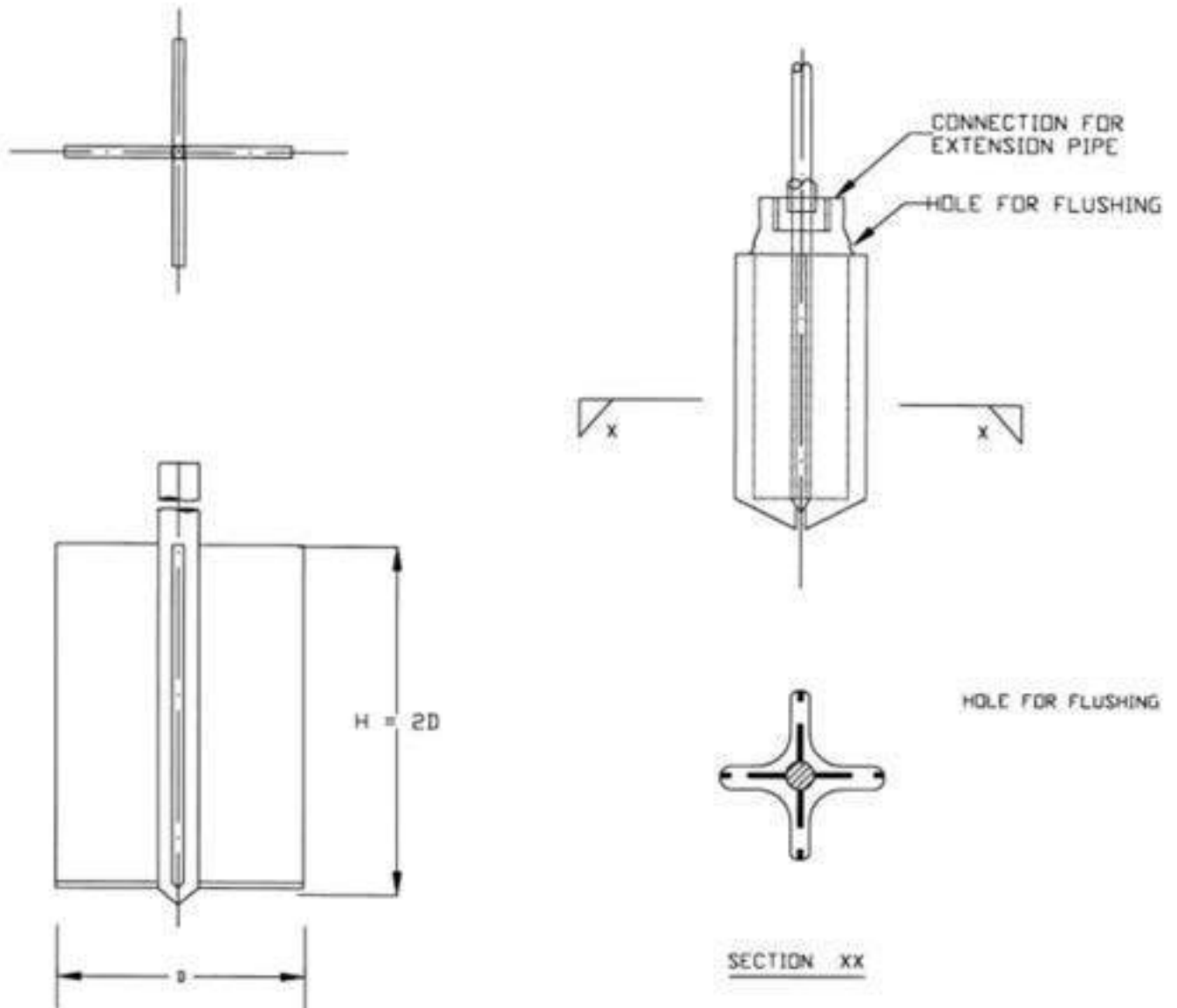


FIG. 1 GEOMETRY OF THE FIELD VANE

FIG. 2 TYPICAL VANE PROTECTING SHOE

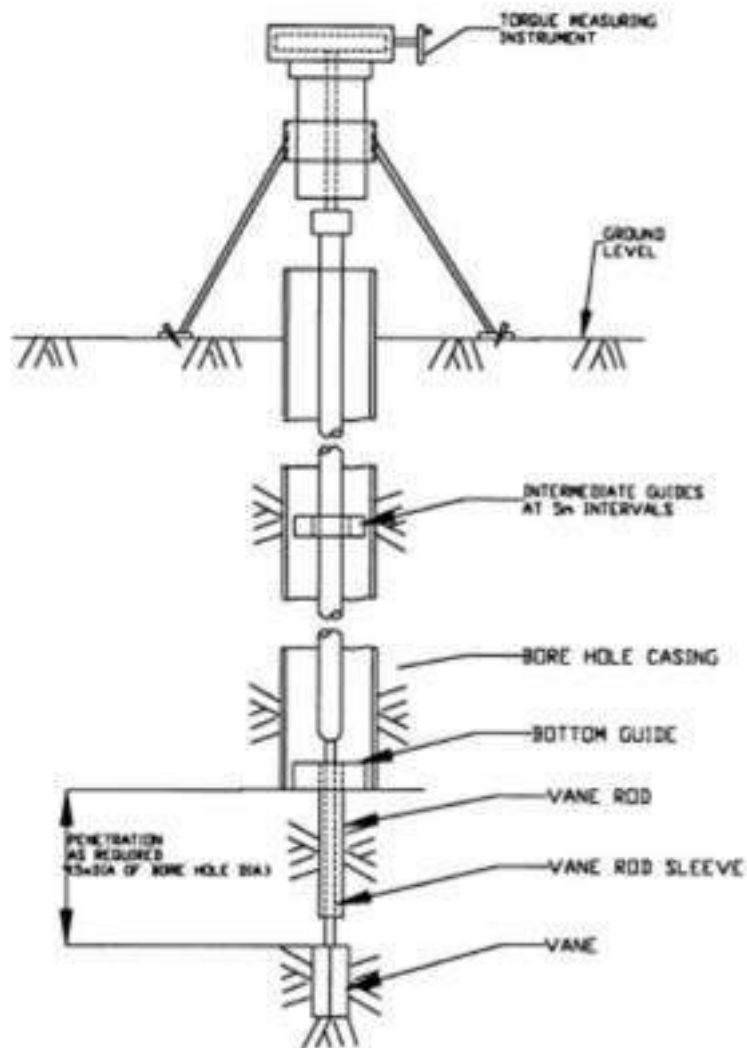


FIG. 3 DIAGRAMMATIC VANE TEST ARRANGEMENT
(FOR TEST FROM BOTTOM OF BORE HOLE)

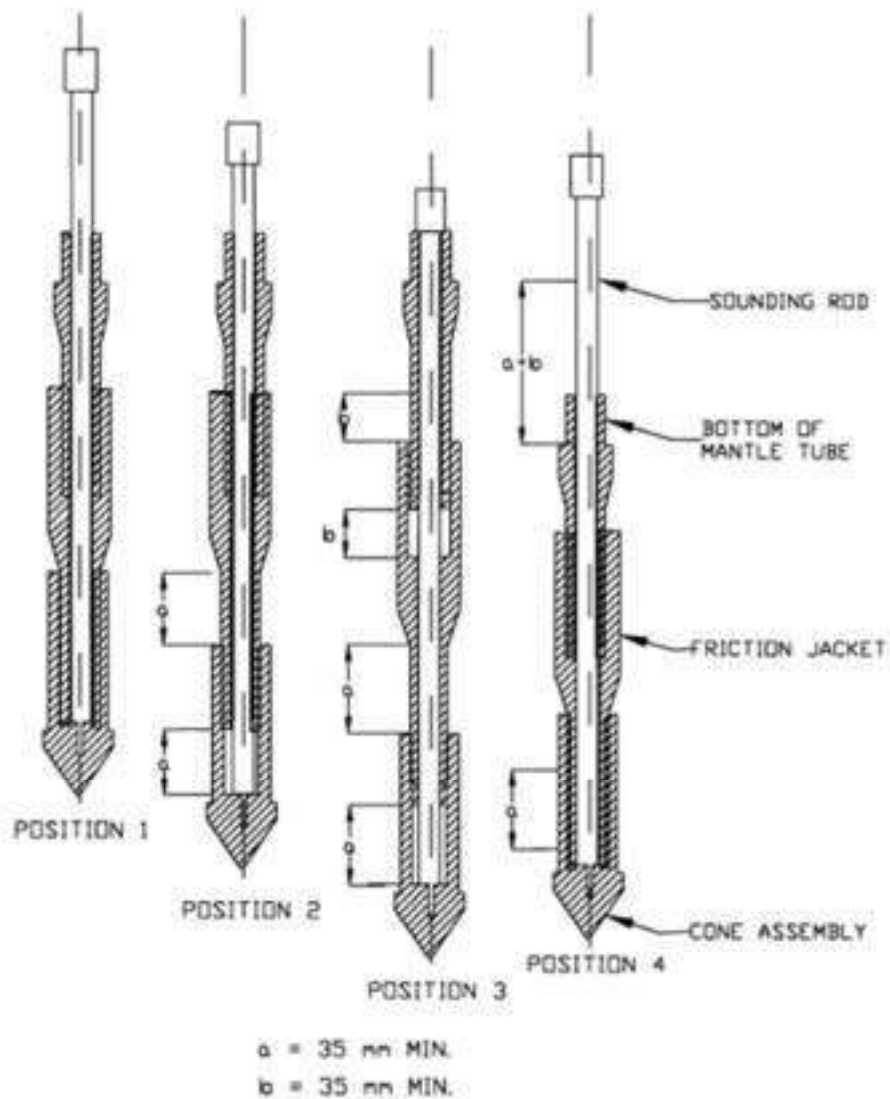
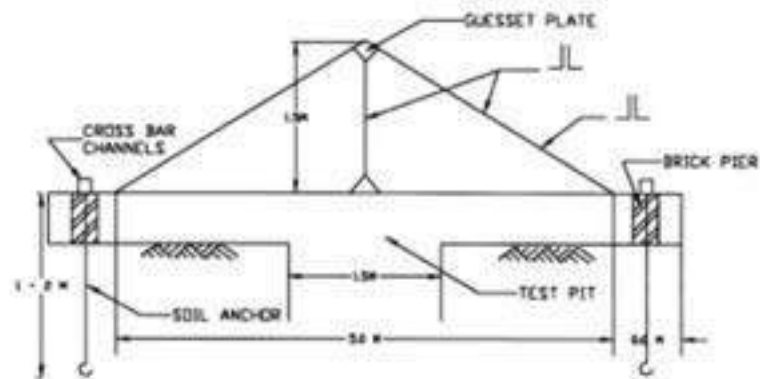
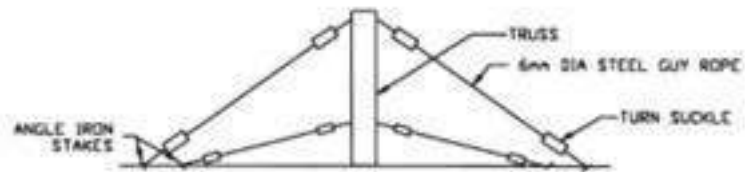


FIG. 4 FOUR POSITIONS OF THE SOUNDING
APPARATUS WITH FRICTION JACKET



FRONT VIEW



SIDE VIEW

FIG.5: LOADING TRUSS AND SOIL ANCHORS



Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR TESTING OF CONCRETE PILES

VCS-SS-CS-6034

					
03	31.01.2022	NV	GDS	HK	GW
02	28.02.2020	NV	GDS	RKB	SK
01	16.10.2019	MA	MO	AD	SK
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Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY	:	If printed
CONTROLLED COPY	:	If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	05.07.2017	MA	MO	RKB	AD	Issued for use as Standard
01	16.10.2019	MA	MO	RKB	SK	
02	28.02.2020	NV	GDS	RKB	SK	New revision system updated
03	31.01.2022	NV	GDS	HK	GW	VCS QMS Integration

ABBREVIATION

m	Metre
mm	Millimetre
cm	Centimetre
IS	Indian Standard
BIS	Bureau of Indian Standard
Kg	Kilogram

CONTENTS

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7.0	COMBINED VERTICAL AND LATERAL LOADING	10
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1.0 SCOPE

- 1.1 This specification covers the requirements and methods of testing of a single pile for evaluating its safe capacity in
- Vertical loading (Compression)
 - Lateral Loading
 - Pull Out
 - Combined Vertical and Lateral Loading
 - Special type of loading such as vibratory loadings
- 1.2 These specifications shall be applicable for all types of piles in general excepting sheet piles.
- 1.3 For specific work requirements or otherwise modifying or supplementing the provisions of this specification, refer to specific requirements. In case of conflict between requirements set forth in the specific requirements and the provisions of this specification, the specific requirements shall govern.

2.0 REFERENCE

- 2.1 Reference to Indian Standard Codes shall always mean reference to the latest issue of the relevant standards, including all the amendments upto date.

2.2 CODES

All testing shall be performed in accordance with the following codes and the provisions of these specifications

IS: 2911-(Part IV) - Code of Practice for Design and Construction of pile Foundations - Load Test on Piles.

3.0 REQUIREMENTS

- 3.1 The load test shall be required to provide data regarding the load deformation characteristics of the pile upto failure or otherwise specified and the safe design capacity.
- 3.2 Full details of the equipment proposed to be used and the test set up shall be submitted to the Engineer-in-Charge with detailed sketches for approval. Approval of the Engineer-in-Charge shall also be obtained after the test set up is complete, prior to commencement of loading.
- 3.3 All measuring devices shall be tested for satisfactory performance and accuracy at an approved institution and a certificate to that effect obtained and submitted to the Engineer-in-Charge prior to use.

- 3.4 The test pile shall be constructed using same equipment and technique as for the job piles.
- 3.5 A minimum time period of one week shall be allowed between the time of installation and testing in case of a precast pile and not less than four weeks from the time of casting in case of a cast-in-situ pile.

3.6 RECORDS

A full record giving all details of the test in the Performa shown in Appendix-1 shall be submitted in triplicate to the Engineer-in-Charge immediately on completion of each test. The record shall also include the plot of load time settlement characteristics of piles.

4.0 VERTICAL LOADING TESTS

4.1 EQUIPMENT AND TEST SET-UP

4.1.1 TEST PILE

- a. The test pile shall be decided by the Engineer-in-Charge. It may be one of the working piles or a separate test pile.
- b. The head of the test pile shall be brought to the proper level and provided with a pile cap with a level and plane surface and with adequate space for proper seating of a jack and dial gauges.
- c. Test pile surface shall be prepared for testing purposes on the expiry of one week after casting the pile.

4.1.2 LOADING SYSTEMS

- a. Loading shall be applied by the reaction method consisting of a hydraulic jack centrally against a loaded platform. Supports of the platforms shall be adequately designed. Special anchor piles or any other suitable type of anchorage systems may be used. However, use of the uplift capacity of neighbouring piles for providing the reaction shall normally not be permitted.
- b. The loading system shall be adequate to ensure that the test can be carried upto the specified limit. The reaction to be made available for the test shall be atleast 25% greater than the maximum jacking force required.

4.1.3 MEASURING SYSTEM

a. Loading on Piles

The load applied on the pile shall be recorded on a calibrated pressure gauge mounted on the jack.

b. Settlement of Pile

- i. Settlement of the pile shall be recorded by dial gauges suspended from datum bars. Four dial gauges of 0.01 mm sensitivity shall be positioned on four corners around the pile.
- ii. The datum bars shall have rigid supports preferably of concrete pillars or steel sections, embedded well into the ground. The supports shall be located more than three times the pile diameter, subject to a minimum of 1.5m, clear away from the pile face and also sufficiently away from the supports of the loaded platform to avoid any disturbance on these accounts. Movements near the supports of the datum bar shall be avoided while the test is in progress.

4.2 METHOD OF CONDUCTING TEST

The test shall be carried out by the direct method of loading in successive increments or by the cyclic loading method as specified and as directed by the Engineer-in-Charge.

4.2.1 DIRECT METHOD OF LOADING IN SUCCESSIVE INCREMENTS

The test shall be carried out as per the procedure outlined.

- a. The load shall be applied to the pile top in increments of about one fifth of the rated capacity of the pile or as specified. Settlement readings shall be taken before and after the application of each new load increment and at 2, 4, 8, 15, 30, 60 minutes and at every two hours until application of the next load increment.
- b. Each stage of loading shall be maintained till the rate of movement of the pile top is not more than 0.2 mm per hour or until two hours have elapsed, whichever is later.
- c. Further loading shall then be continued as in (a) above till one of the following occurs:
 - i. Yield of soil-pile system occurs causing progressive settlement of the pile exceeding a value of one tenth of the pile diameter.
 - ii. The loading on the pile top equals twice the rated capacity or as specified in the case of a separate test pile and 1.5 times the rated capacity of the pile in case of a working pile.
- d. Where yielding of the soil does not occur, the full test load shall be maintained on the pile head for 24 hours or more if necessary and settlement readings shall be taken at 6 hours interval during the period.
- e. Unloading shall be carried out in the same steps as loading. A minimum of half hour shall be allowed to elapse between two successive stages of load decrement. The final rebound shall be recorded 6 hours after the entire test load has been removed.
- f. If so directed by the Engineer-in-Charge, loading and unloading cycles shall be carried out for all load stages within the assumed working load.
- g. Assessment of Safe Load

The safe capacity of the pile shall be the least of the following values

- i. Load corresponding to settlement specified in specific requirements which is based on the nature and type of structure.
- ii. 50 percent of the final load at which the total displacement equals 10 percent of the pile diameter in case of uniform diameter piles and 7.5 percent of bulb diameter in case of under-reamed piles.

4.2.2 CYCLIC LOADING TEST

The test shall be carried out as per procedure outlined by IS: 2911-(Part-IV) and as described below

- a. The load shall be applied to the pile top in increments of about one fifth the estimated safe capacity of the pile or as specified. Settlement readings shall be taken before and after the application of each new load increment at 2, 4, 8, 15, 30, 60 minutes and at every two hours until application of the next load increment.
- b. Alternate loading and unloading shall be carried out at each stage and the total and net settlements recorded as specified. If so directed by the Engineer-in-Charge, more than one cycle of loading and unloading shall be carried out at any or all of the stages.
- c. Each stage of loading or unloading shall be maintained till the rate of movement of the pile top is not more than 0.2mm per hour provided that the minimum period is two hours for loading and one hour for unloading. The following load stages shall however be maintained for longer periods as given below
 - i. At load of 1.5 times assumed safe capacity (for routine test only) -24 hrs.
 - ii. At load of twice assumed safe capacity (for initial test only) - 24 hrs.

The loading shall be continued till one of the following occurs

- i. Yield of the soil pile systems occurs causing progressive settlement exceeding one tenth of the pile diameter.
 - ii. The loading on the pile top equals twice the estimated safe load in case of a separate test pile and 1.5 times the rated capacity of the pile in case of a working pile.
- d. Assessment of Safe Load

The safe capacity of the pile shall be the least of the following

- i. Load corresponding to settlement specified in specific requirements which is based on the nature and type of structure.
- ii. Half of the final load at which the total settlement equals one tenth of the pile diameter.

5.0 LATERAL LOADING TEST

5.1 EQUIPMENT AND TEST SET-UP

5.1.1 TEST PILE

The test pile shall be decided by the Engineer-in-Charge. It may be one of the working piles or a separate test pile.

The test pile shall be cut off at the proper level and provided with a cap with vertical plane sides having an adequate area for proper seating of the jack and dial gauges.

5.1.2 LOADING SYSTEM

Loading shall be applied by an hydraulic jack of adequate capacity, abutting the pile horizontally and reacting against a suitable system. The reaction may be provided by the wall of the excavated pit when the test is being conducted below ground level or by a neighbouring pile in which case thrust pieces shall be inserted on either end of the jack to make up the gap.

5.1.3 MEASURING SYSTEM

- a. Lateral load applied on the pile shall be measured by a calibrated pressure gauge mounted on the jack, having a least count of 500 kg.
- b. Deflection of the pile head shall be measured by dial gauges, fixed to datum bars and having a least count of 0.01 mm. The datum bars shall be provided with rigid supports as described in Clause 4.1.3 b (ii) above.

5.2 METHOD OF CONDUCTING TESTS

The test shall be carried out in accordance with the provisions of IS: 2911-(Part-IV) and as detailed below

5.2.1 Loading shall be applied in increments of 500 kgs or as specified.

5.2.2 Each stage shall be maintained for a period till the rate of movement of the pile head is not more 0.2 mm/hr or 1 hour whichever is greater.

5.2.3 LOADING SHALL BE CONTINUED TILL ONE OF THE FOLLOWING OCCURS

- a. Deflection of the pile head exceeds 12 mm.
- b. The applied load on the pile is twice the assumed lateral load capacity of the pile in case of a separate test pile and 1.5 times the rated capacity in the case of a working pile

5.2.4 ASSESSMENT OF SAFE LOAD

The safe load shall be the smaller of the following

- a. Half of the final load for which the total deflection is 12 mm.
 - b. Load corresponding to 5 mm total deflection
- Note: The deflection is at the cut off level of the pile.

6.0 PULL OUT CAPACITY OF PILES

6.1 EQUIPMENT AND TEST SET UP

6.1.1 TEST PILE

- a. The test pile shall be decided by the Engineer-in-Charge. The test shall be conducted on separate pile installed specifically for this purpose.
- b. The test pile shall be built upto the proper length and the head provided with suitable arrangements for anchoring the load applying system.

6.1.2 LOADING SYSTEM

Load shall be applied using an approved reaction system. Uplift force on the pile may be applied directly to the test pile or through a lever system. The reaction may be provided by neighbouring piles or blocks may be constructed for the purpose. A hydraulic jack shall be used for load application.

6.1.3 MEASURING SYSTEM

- a. Load applied by jack shall be measured by a calibrated pressure gauge with a least count of 1000 kgs.
- b. Movement of the pile shall be measured by dial gauges, fixed to datum bar and having a least count of 0.01 mm. A minimum of two dial gauges, placed diametrically opposite shall be used. Datum bars shall be provided with rigid supports as described in 4.1.3 b (ii) above.

6.2 METHOD OF CONDUCTING TEST

The test shall be conducted as outlined below

- 6.2.1 Loading shall be applied to the pile top in increments of one fifth the rated capacity of pile.
- 6.2.2 Each stage shall be maintained for a period till the rate of movement of the pile head is not more than 0.2 mm/hr or one hour, whichever is greater.
- 6.2.3 Loading shall be continued till one of the following occurs
 - a. Yield of soil pile system occurs causing progressive movement of the pile exceeding 12 mm.
 - b. The loading on the pile top equals twice the estimated safe load or as specified.

6.3 ASSESSMENT OF SAFE LOAD

The safe capacity of the pile shall be the least of the following:

- a. Two-thirds of load at which the total displacement is 12mm or the load corresponding to a specified permissible uplift, and
- b. Half of the load at which the load-displacement curve shows a clear break (downward trend).

7.0 COMBINED VERTICAL AND LATERAL LOADING

7.1 EQUIPMENT AND TEST SET-UP

- 7.1.1 The equipment and test set up shall be same as described in Clause 3. In addition a platform shall be constructed on the pile top, and loaded to 10 times the pile capacity in vertical loading.

The pile shall be first subjected to the full vertical load. The lateral load shall commence after all settlements due to the vertical load have ceased and while the full vertical load is in position.

- 7.1.2 The loading system, measuring system and recording of the results shall be the same as described in clause-5.0.

7.2 METHOD OF CONDUCTING TEST AND ASSESSMENT OF SAFE LOAD

This shall be in accordance with the provision of clause 5.2 above.

8.0 SPECIAL TYPE OF LOADING

This shall include evaluating the pile response to vibratory loads, both horizontal and vertical in nature. The test set up and method of conducting the test shall be covered under specific requirements.

APPENDIX 1

PILE LOAD TEST RECORD

Vertical/Lateral/Pull Out Test

Pile No..... Date of..... WT of Hammer.....

Type..... Driving..... AVR. Drop of Hammer.....

Diameter (Cm)..... Casting..... Total No of Blows.....

Length below Commence of Test Sum of Temporary
G. L(M) Compression in curs.....

Location..... Completion of Test..... Ground level.....

Type of Test : Direct/Cyclic Loading

Date	Time	Total load (Hr.)	Load on (T)	Load off (T)	Total load (t)	Settlement (deflection) Gauge mm		AVR. Settlement (deflection)mm		Rebound mm	Remarks
						I	II	Total	Net		



Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR FLOOR FINISHING

VCS-SS-CS-6040

					
03	31.01.2022	NV	GDS	HK	GW
02	28.02.2020	NV	GDS	RKB	SK
01	16.10.2019	MA	MO	AD	SK
00	05.07.2017	MA	MO	AD	SK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY	:	If printed
CONTROLLED COPY	:	If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	05.07.2017	MA	MO	RKB	AD	Issued for use as Standard
01	16.10.2019	MA	MO	RKB	SK	
02	28.02.2020	NV	GDS	RKB	SK	New revision system updated
03	31.01.2022	NV	GDS	HK	GW	VCS QMS Integration

ABBREVIATION

m	Metre
mm	Millimetre
m ²	Square Metre
m ³	Cubic Metre
Kg	Kilogram
IS	Indian Standard
BIS	Bureau of Indian Standards
PVC	Poly Venile Chloride
RCC	Reinforcement Cement Concrete
PCC	Plain Cement Concrete

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1.0 SCOPE

This specification covers the general requirements for all types of floor finishing in all type of building.

2.0 REFERENCES

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 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 unbacked 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 and finishing of concrete flooring tiles.
IS: 5491	:	Code of practice for laying in situ granolithic concrete floor topping.
IS: 4441	:	Code of practice for use of silicate type Chemical resistant mortars.
IS: 4443	:	Code of practice for use of resin type chemical resistant mortar.
IS: 1196	:	Code of practice for laying Bitumen Mastic flooring.

3.0 CEMENT CONCRETE FLOORING

3.1 GENERAL

Cement concrete flooring shall in general conform to IS: 2571. Cement concrete flooring shall consist of a sub base (laid on the compacted earth or sand fill in case of ground floor only) a base course laid on the sub-base and then finishing layer of floor finishing. In case of ground floor, the filled and compacted bed on which the sub-base is to be laid, shall be as per structural drawings and specifications.

The bed for flooring shall be prepared either level or sloped as per drawings and as instructed by Engineer-in-charge.

3.2 WORKMANSHIP

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.

3.2.2 BASE COURSE

Base course shall be 25mm thick 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 Sqm. 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.

3.2.3 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 Sqm. 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 25mm unless otherwise mentioned.

3.2.4 CURING

Each finished portion of floor, on completion shall be kept wet with ponding for a minimum period of 7 days.

4.0 CEMENT CONCRETE GRANOLITHIC FLOORING

Workmanship shall in general conform to IS: 5491.

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 (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 Sqm. 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:

- a. 40mm thick flooring = 25mm thick
- b. 50mm thick flooring = 35mm thick

4.2.3 WEARING TOP LAYER

The top 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.

4.2.4 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 Sqm. 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 up to a radius of 25mm unless otherwise mentioned.

4.2.5 CURING

Each finished portion of floor, on completion shall be kept wet with ponding for a minimum period of 7 days.

5.0 HEAVY DUTY FLOORING

5.1 GENERAL

Heavy duty Flooring shall consist of a sub-base, a base course and a finishing layer of floor finish.

5.2 WORKMANSHIP

5.2.1 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.

5.2.2 BASE COURSE

Base course shall consist of one layer of 35mm thick cement concrete (1 cement: 1.5 Coarse sand : 3.5 stone aggregates of 10mm to 6mm size by volume) laid on sub-base in panels in accordance with, clause no. 3.2.2.

5.2.3 FLOOR FINISH

Finishing layer shall be of cement, hardener and stone aggregate mix of 15mm 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. This dry

mixture shall be mixed with stone grit of 6mm 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.

6.0 PRECAST HYDRAULICALLY PRESSED CEMENT TILES

6.1 MATERIALS

6.1.1 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 20mm thickness and approved shade.

6.1.2 PIGMENTS

Pigments to be admixed with mortar or for grouting the joints shall conform to Table -1 of IS: 2114.

6.1.3 CEMENT MORTAR

Cement mortar shall be in accordance with civil structural specification and following schedule

a. For flooring	: 20mm thick, cement mortar (1 cement : 6 coarse sand by volume)
b. For skirting/dado/riser	: 12mm thick, cement mortar (1 cement:3 coarse sand by volume)

6.2 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 Sqm. 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 10mm at any place. The top of the mortar shall be kept rough so that cement slurry can be absorbed. Laying shall be from centre & proceed outwards in two directions at 90°. Cut tiles of uniform sizes shall be laid along periphery, if necessary. Neat cement slurry @ 4.4 kg. of cement per Sqm. 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 1.5mm 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 15mm 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 Sqm. 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.

6.3 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.

6.4 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 gm/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 refitted or replaced and properly jointed and polished.

7.0 CEMENT PLASTER SKIRTING

7.1 MATERIAL

Cement plaster skirting shall be laid with cement mortar (1 cement: 3 coarse sand by volume) as per clause no. 6.1.3 and shall be of specified thickness (6mm/12mm/18mm) as per item description.

7.2 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 25mm if not otherwise mentioned.

While the mortar is still green, cement @ 2.75kg per square metre shall be mixed with water to form 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.

8.0 CAST-IN-SITU TERRAZZO FINISH

8.1 MATERIALS

8.1.1 BASE COURSE (UNDERLAYER)

Base Course for Cast-in-situ terrazzo flooring shall be 25mm thick cement concrete (1 cement: 2 coarse sand: 4 stone aggregate, 10mm nominal size by volume).

In case of vertical surfaces, the base course shall be 13mm thick cement mortar (1 cement: 3 coarse sand by volume)

8.1.2 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 10mm nominal size. Marble powder to be used in 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 Engg. - in - charge/ as specified.

8.1.3 PIGMENTS

Pigments to be used in terrazzo shall be of permanent colour and shall conform to IS: 2114, table-1.

8.2 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 15mm.

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. Sufficient 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. 3.2.2. 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 @ 2.75Kg of cement per Sqm. 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.

8.3 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.

8.4 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. 6.3. 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 acid solution and dried. Floor polishing machine fitted with felt on hessian bobs shall then be run over it until the floor shines.

In case of polishing, wax 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-situ Terrazzo in skirting, dado and risers shall be of specified thickness and of same shade as that of the flooring.

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 12mm thick and underlayer shall be 13 mm thick. Terrazzo topping shall be laid on the under layer in accordance with clause no. 8.2. Other details shall be same as for flooring excepting grinding which shall be manual and panels dividers are required

9.0 PRECAST HYDRAULICALLY PRESSED TERRAZZO TILES

9.1 MATERIALS

9.1.1 TERRAZZO TILES

Terrazzo tiles shall be of specified thickness and shade and shall generally conform in all respects to IS-1237. The tiles shall be made with 10mm down size stone aggregates, white & ordinary cement mix (1 white cement: 6 ordinary cement by volume) and pigments conforming to IS: 2114, Table -I.

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

a.	For flooring	-	20mm thick cement mortar (1 cement: 4 coarse sand by volume).
b.	For skirting/dado/riser	-	12mm thick cement mortar (1 cement: 3 coarse sand by volume).

9.2 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 Sqm. 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 10mm at any place. The top of the mortar shall be kept rough so that cement slurry can be absorbed. Laying shall be from centre & proceed outwards in two directions at 90°. Cut tiles of uniform sizes shall be laid along periphery, if necessary. Neat cement slurry @ 4.4 kg. of cement per Sqm. 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 1.5mm 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 15mm 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.

9.3 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.

9.4 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 refitted or replaced and properly jointed and polished.

10.0 TILE WORK

10.1 MATERIALS

10.1.1 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:

a. White/ coloured glazed vitreous tiles

200mm x 100mm x 6mm

200mm x 150mm x 6mm

200mm x 300mm x 6mm

300mm x 300mm x 8mm ($\pm 5\%$)

b. Ceramic Tiles

300mm x 300mm x 8mm ($\pm 5\%$)

200mm x 100mm x 6mm

10.1.2 PIGMENTS

Pigments to be admixed with mortar or for grouting the joints shall conform to Table -1 of IS: 2114.

10.1.3 CEMENT MORTAR

Cement mortar shall be in accordance with civil structural specification and following schedule

a.	For flooring	: 20mm thick, cement mortar(1 cement : 6 coarse sand by volume)
b.	For skirting/dado/riser	: 12mm thick, cement mortar (1 cement:3 coarse sand by volume)

10.2 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.

10.3 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.

11.0 KOTA STONE FINISH

11.1 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. For flooring and skirting/dado/riser the thickness of the stone slabs shall be 25mm and 18mm 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 Engineer-in-charge.

11.2 WORKMANSHIP

11.2.1 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.

11.2.2 PREPARATION OF SURFACE

Cement mortar in accordance with clause no. 6.1.3 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 Sqm. of area to receive the mortar.

The mortar shall be laid for fixing one slab at a time. Cement mortar shall be 15mm thick (1 cement: 4 coarse sand by volume) for flooring and 12mm thick (1 cement: 3 coarse sand by volume) for skirting/dado/riser.

11.2.3 LAYING

The slab shall be washed clean before laying. It shall be laid over cement mortar bedding on top, pressed, and 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 Engineer-in-Charge.

The slabs shall be laid in patterns as per drawings and size shall not be less than 310mm X 310mm which shall be uniform. Cut size may be used along periphery as required.

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. 6.4, except that cement slurry shall not be applied on the surface before each polishing.

12.0 MARBLE STONE FLOORING

12.1 MATERIALS

12.1.1 MARBLE SLABS

The Marble slabs shall be 20mm 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 Engineer-in-Charge.

The slabs shall be machine cut to the requisite dimensions.

12.1.2 PIGMENTS

Pigments to be admixed with mortar or for grouting the joints shall conform to Table -1 of IS: 2114.

12.1.3 CEMENT MORTAR

Cement mortar shall be in accordance with civil structural specification and following schedule

a.	For flooring	:	20mm thick, cement mortar(1 cement : 6 coarse sand by volume)
b.	For skirting/dado/riser	:	12mm thick, cement mortar (1 cement:3 coarse sand by volume.

12.2 WORKMANSHIP

Same as clause no. 11.2 except that cement mortar shall be 20mm thick (1 cement: 6 coarse sand by volume) for flooring.

12.3 CURING

The floor shall be cured for a minimum period of 7 days by wetting.

12.4 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. 6.4, except that cement slurry shall not be applied on the surface before each polishing.

13.0 P.V.C. FINISH

13.1 MATERIALS

13.1.1 P.V.C. ROLL/TILES

P.V.C. Roll/tile shall be 2mm thick homogenous, unbacked, flexible type of approved texture, colour and pattern, conforming to IS: 3462/3461.

13.1.2 ANTISTATIC PVC ROLL/TILE

Antistatic P.V.C, roll/tile shall conform to B.S.2050, Table-2 in addition to IS: 3462,

13.1.3 ADHESIVE

Adhesive shall be neoprene based rubber adhesive of approved make.

13.2 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 P.V.C. rolls/tiles.

P.V.C. rolls/tiles shall be brought to the temperature of the area in which it is to be laid and stacked suitably near the site for a period of about 24 hours.

The layout of P.V.C. 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 if so required owing to size of the room area.

PVC rolls in flooring shall be continued for 100mm high skirting without any joints and with 50mm 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

14.0 ACID RESISTANT TILES

14.1 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 :-

S.No.	Property	Values	Norms
1	Water Absorptions	±0.5%	ASTM C 373
2	Scratch Resistance	≥ 6	ASTM C 373
3	Chemical Resistance	Unaffected	ASTM C 650
4	Abrasion Resistance	≥ 100	ASTM C 501
5	Breaking strength	1400 kg/sq.cm	ASTM C 648
6	Density	≥ 2.0 Gm/CC	

14.2 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 as per clause no. 6.2 and IS:4443.

Tiles shall be fixed on the prepared surface over a bitumen priming layer, bitumen mastic layer and resin 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.

15.0 EPOXY COATING

15.1 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.

15.2 MATERIALS

15.2.1 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 resin 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 3mm thick.

15.2.2 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.

15.3 WORKMANSHIP

15.3.1 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.

15.3.2 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 resin 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.

16.0 MEASUREMENT AND RATE (THIS CLAUSE SHALL BE APPLICABLE FOR ITEM RATE TENDERS ONLY)

Measurement and rate for flooring for item rate tenders shall be in Sqm. in general unless otherwise mentioned.



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VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR WOOD WORK

VCS-SS-CS-6041

					
03	31.01.2022	NV	GDS	HK	GW
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01	16.10.2019	MA	MO	AD	SK
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REVISION RECORD						
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ABBREVIATION

m	Metre
mm	Millimetre
Cm	Centimetre
Sqm	Square Metre
Cum	Cubic Metre
Cm ²	Square Centimetre
Kg/m ²	Kilogram Per Square Metre
C/C	Center to Center
IS	Indian Standard

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1.0 SCOPE

This specification covers the general requirements for all types of wood work in doors, windows, ventilators, partitions, etc.

2.0 REFERENCES

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 specification shall override.

IS: 2202 Part-I	:	Specifications for wooden flush door shutters (solid core type) particle board and hard board face panels.
IS: 2202 Part-II	:	Specification for wooden flush door shutters (solid Core type) plywood face panels.
IS: 1003 Part-I	:	Specification for Timber paneled and glazed shutters –Door shutters.
IS: 3087	:	Specification for Wooden particle boards (Medium Density) for general purposes.
IS: 309	:	Specification for veneered particle boards.
IS: 848	:	Specification for synthetic resin adhesives for Plywood (phenolic and amino plastic)
IS: 205	:	Specification for nonferrous metal butt hinges.
IS: 2338	:	Code of practice for finishing of wood and wood Based materials. (Part I & 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.

3.0 MATERIAL

3.1 TIMBER

3.1.1 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 sqcm. 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.

3.1.2 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.

3.1.3 MOISTURE CONTENT IN TIMBER

The maximum permissible percentage of moisture content for well seasoned timber shall be as per IS: 287.

3.1.4 WORKMANSHIP OF WOOD WORK

Workmanship for wood and joinery shall be as per IS: 1200 and IS: 4021.

3.1.5 PAINTING/POLISHING OF WOOD WORK

Painting/polishing of wood work shall be in accordance with specification No. VCS-SS-CS-6045

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.

3.2 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 lignocellulose fibres bonded with BWP type phenol formaldehyde synthetic resin conforming to IS: 848. It shall be categorized as class 1 for 'Surfaces of very low flame spread' as per IS: 1642.

3.3 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 12mm thickness shall be fixed to the exposed edges of the boards.

3.4 VENEERS

Veneers shall conform to class-1 of IS: 303 and BS: 476 Part-7.

3.5 FITTINGS & FIXTURES

3.5.1 HINGES

Hinges shall be of Extruded Aluminium Alloy and butt type conforming to IS: 205. Size of hinges shall be minimum 125mm long. Maximum spacing of hinges shall not exceed 600mm c/c

3.5.2 OVERHEAD HYDRAULIC DOOR CLOSER

Overhead hydraulic door closers shall be of heavy duty type and shall conform to IS: 3564.

3.5.3 FLOOR MOUNTED DOOR CLOSER

Floor mounted door closers shall be of heavy duty type and hydraulically operated and shall conform to IS: 6315.

3.5.4 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.

3.5.5 DOOR HANDLES

Door handles shall be of pressure die cast zinc alloy and shall be chromium plated.

3.5.6 ALDROP

Aldrop shall be of anodized Aluminium in bronze colour and shall be 300 mm long and 19.05mm dia.

3.5.7 TOWER BOLTS

Tower bolts shall conform to IS: 204 and shall be of anodized Aluminium in Bronze colour.

3.5.8 DOOR STOPPER

Door stoppers shall consist of heavy duty rubber shoes spring loaded type with zinc alloy pressure die cast chromium plated holders.

3.5.9 TOILET DOOR LATCH

Toilet Door latch shall be of Anodized Aluminium and shall be 75mm long with Vacant/occupied indicator.

3.5.10 COAT & HAT HOOK

Coat & Hat hooks for Toilet doors shall be of chromium plated brass body.

3.6 GLAZING

Glass sheets for glazing shall be i) 4 mm thick plain glass (wt. 7.2 kg/m²) 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.

4.0 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 join 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 No VCS-SS-CS-6045.

Before any surface treatment is applied, the wood work shall be got approved by the Engineer-in-charge. The frames shall be fixed to the masonry by 300mm x 25mm x 6mm MS hold fasts embedded in M-15 grade concrete block of 350mm x 100mm x 100mm in the hole of masonry. In case of concrete, frames shall be fixed by 96mm long, 12mm dia metallic dash fasteners.

5.0 DOOR SHUTTERS

Door shutters shall be complete with all operational fittings & fixtures like hinges, overhead hydraulic door closers, Tower bolts, Locking device, handles, door stopper etc.

5.1 BLOCK BOARD FLUSH SHUTTER

Block board flush shutter shall conform to IS: 2202. The shutter shall be 35mm thick and shall be made of solid core block board. *T* type Teak wood beading of minimum 12mm 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. 3mm 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 1mm thick teakwood veneering conforming to IS:303, BS:476, part 7 or

- c. 1mm thick approved quality lamination of approved shade.

The edges of the shutters shall either be painted with synthetic enamel paint or French polished.

5.2 PANEL DOOR SHUTTER

Panel door shutter shall be 35mm thick and shall consist of 100mm x 35mm teakwood stiles & top rail, 200mm x 35mm bottom rail and 150mm x 35mm lock rail and 12mm thick particle board infill panels. The infill panels shall be fixed with adhesive and moulded Teakwood headings (minimum 12.5mm x 12.5mm 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.

5.3 GLAZED WOODEN DOOR SHUTTER

Glazed wooden door shutter shall be 38mm thick and shall consist of 100mm x 38mm Teakwood stiles and top rail, 200mm x 38mm bottom rail and 150mm x 38mm thick lock rail. 4mm thick plain glass or 5.5mm thick toughened glass panels shall be fixed in the stiles & rails with neoperene adhesive and 12.5mm x 12.5mm 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.

5.4 FLYMESH DOOR SHUTTER

Fly mesh door shutter shall be 38mm thick and shall consist of 100mm x 38mm Teakwood stiles and top rail, 200mm x 38mm bottom rail and 150mm x 38mm thick lock rail and net of galvanised MS wire gauge of IS gauge designation 856 & dia 0.56mm fixed with 12.5mm x 12.5mm moulded Teakwood beading. The shutter including wire mesh shall be painted with 2 coats of approved shade synthetic enamel paint or polyurethane paint as specified over a coat of primer.

6.0 MEASUREMENT & RATE

This clause shall be applicable for item rate tenders only.

For item rate tenders wood work in door/window frames shall be measured in Cum. Door/window shutters shall be measured in Sqm. Hardwires 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 Sqm. and 0.001 Cum.

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.



Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR STEEL/ALUMINIUM DOORS, WINDOWS AND VENTILATORS

VCS-SS-CS-6042

					
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REVISION RECORD						
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ABBREVIATION

m	Metre
mm	Millimetre
Cm	Centimetre
IS	Indian Standard
Kg/m ²	Kilogram Per Square Metre
MS	Mild Steel

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1.0 SCOPE

This specification covers the general requirements for aluminium glazed doors, windows and ventilators. The work shall be in accordance with the latest IS codes and to the satisfaction of the Engineer-in-Charge. The Contractor shall be responsible for the proper arrangement of material, labour, tools, etc., as may be required for the completion of the works, though not specifically mentioned in the specification.

2.0 REFERENCES

Reference shall be made to the following Indian Standards for further information etc. not covered in the specification. In case of any conflict/contradiction the provisions of the 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.

3.0 PRESSED STEEL DOOR/WINDOW/VENTILATOR FRAME

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 25mm x 6mm 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 for hinges, locking arrangement and other hardware's 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).

4.0 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 40mm 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 (35mm wide) @ 500 mm max. and fixed by flush riveting. 3mm thick MS pad plates shall be welded inside at required locations for fixing of hardwires such as tower bolt, aldrop etc.

For double shutter doors, an MS angle 25mm x 45mm x 3 mm thick shall be welded to one of the shutters providing a minimum 25mm wide rebate for the other shutter at the meeting point during closed condition.

The shutter surfaces shall be painted with electrostatic ally 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 150mm size conforming to table 6 of IS 1341 @ 600mm.

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 drgs.

The shutters shall be provided with locking device, handle and other hardware's as specified.

5.0 STEEL WINDOWS & VENTILATORS

Steel windows, ventilators shall in general conform to IS: 1081, IS: 1038 and IS: 7452.

5.1 MATERIALS

5.1.1 ROLLED STEEL SECTION

Rolled steel sections for the fabrication of steel windows, ventilators shall conform to IS: 7452.

5.1.2 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.

- a. 4mm thick transparent sheet glass conforming to IS: 2835 (wt. 7.2 kg/Sqm)
- b. 5.5 mm thick wired glass conforming to IS: 5437.
- c. 6.3 mm thick laminated safety glass conforming to IS:2553.

5.2 WORKMANSHIP

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 flash 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 open able units a push fit weather bar shall be provided.

Before glazing, 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 then shall be cushioned into the bedding and shall be fronted with front putty in a manner so as to enable the painting to be done upto the sight line. The

back putty oozing out over the glazing rebate shall be cut off square and smoothed down.

For panels exceeding 600 x 300 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 and shall not be removable easily after glazing. 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.

6.0 ALUMINIUM GLAZED DOORS/WINDOW/VENTILATORS

6.1 GENERAL

Aluminium glazed doors/window/ventilators shall be of specified sectional size, dimension and profile as per drawing.

6.2 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 electro statically powder coated to min. 25 microns as specified.

Glass used for glazing shall be of following types as specified.

- a. 5.5 mm thick wired glass conforming to IS:5437.
- b. 6.3 mm thick laminated safety glass conforming to IS:2553.
- c. 5.5 mm thick transparent sheet glass conforming to IS:2835 (wt.7.2 kg/Sqm.)

6.3 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 and shall be mounted on a handle plate rivetted to the opening frames. The handles shall have same finish as that of the window sections. The handles shall have a two point nose which shall engage with an aluminium striking plate on the fixed frame. The striking plate shall be finished in the same manner as for the handle.

In case of top hung shutters, aluminium alloy cast hinges and peg stays shall be provided.

Centre hung shutters shall be hung on the two pairs of cup pivots of aluminium alloy of IS designation NS-4 of IS 737 and 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 plated 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 hardware's 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 galvanized.

The windows/ventilators/doors shall be checked to ensure smooth operation, perfect level and plumb.

7.0 MEASUREMENT & RATE

This clause shall be applicable for item rate tenders only.

Measurement & rates for item rate tender shall be on Sqm. 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 meeting points of various designations shall be equally distributed to all such designations for measurement and rates.

Rate shall include cost of all materials, specified hardware's, 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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STANDARD SPECIFICATION FOR PLASTERING AND POINTING

VCS-SS-CS-6043

					
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ABBREVIATION

m	Metre
mm	Millimetre
Cm	Centimetre
Kg	Kilogram
Sqm	Square Metre
RCC	Reinforced Cement Concrete
IS	Indian Standard

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1.0 SCOPE

This specification covers the general requirements for all types of plastering & pointing in all type of building.

2.0 REFERENCES

IS: 1542	Sand for plaster -Specification
IS: 460	Specification for test sieves
IS: 2645	Integral water proofing compounds for cement mortar and concrete –Specification
IS: 2386	Method of test for aggregates for concrete

3.0 MATERIALS

3.1 CEMENT

Cement shall conform to Specification No. VCS-SS-CS-6023.

3.2 SAND

Sand for plaster and pointing shall consist of natural sand, crushed stone sand or crushed gravel sand or a combination of any of these and shall conform to IS: 1542. Sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain any appreciable amount of silt, clay or pellets. Sand shall not contain harmful impurities such as iron pyrites, coal particles, lignite, mica shale etc in such form or in quantities as to affect adversely the hardening, strength or durability of the mortar.

The maximum quantities of clay, fine silt, fine dust and organic impurities in the sand shall not exceed the following limits:

- a. Clay, fine silt and fine dust when determined in accordance with IS 2386 (Part 2).
In natural sand or crushed gravel sand & crushed stone sand
: Not more than 5% by mass
- b. Organic impurities when determined in accordance with IS 2386 (Part 2):
: Colour of the liquid shall be lighter than that indicated by standard specified in IS 2386 (Part-2)

Grading of sand for use in Plaster shall conform to IS 1542 (as below)

IS sieve designation	Percentage passing
10mm	100

4.75mm	95 to 100
2.36mm	95 to 100
1.18mm	90 to 100
600 micron	80 to 100
300 micron	20 to 65
150 micron	0 to 15

3.3 WATER

Water for plastering and pointing shall conform to VCS-SS-CS-6021

3.4 CEMENT MORTAR

Preparation of cement mortar shall conform to Specification No VCS-SS-CS-6021 and unless otherwise mentioned.

3.5 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 clause No. 3.4

4.0 WORKMANSHIP

4.1 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 well wetted before the plaster is applied.

4.2 SEQUENCE OF OPERATIONS

For external plaster, the plastering operations shall be started from the top floor and carried downwards. 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 'Preparation of background surface' in clause no 4.1

The first under layer 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 para's, depending upon the type of mortar, the secondary layers if required shall be applied. After a further suitable time interval 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 25mm, such rounding off shall be complete along with the finishing coat to prevent any joint marks showing out later.

4.3 SCAFFOLDING/STAGING

Scaffolding/staging for plastering/pointing shall be as per 'Technical Specification for Civil and Structural Work'.

4.4 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 Engineer-in-charge.

4.5 CHICKEN WIRE MESH

150mm wide, closely knit , 20 gauge chicken wire mesh stretched tight and fixed with G.I. "U" type nails shall be provided at all the brick/stone masonry and RCC joints.

5.0 PLAIN CEMENT PLASTER

5.1 PREPARATION OF MORTARS

The mortars of specified mix. shall be used as per the specifications of 'Cement Mortar' described in clause no. 3.4

5.2 APPLICATION OF PLASTER

5.2.1 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 troweling 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.

5.2.2 TWO LAYER PLASTER WORK

a. First or Under Layer

The first or under layer of the specified thickness shall be applied as described in clause no. 5.2.1. 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.

b. Second or Finishing Layer

The second layer shall be complete to the specified thickness in the same manner as for first layer.

5.3 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 Engineer-in-charge. The date of execution of plastering shall be marked on the plastering to ensure the proper duration of curing.

6.0 SAND FACE PLASTER

6.1 PREPARATION OF MORTAR

The mortar of specified mix shall be used as per the specifications of cement mortar described in clause no. 3.4.

6.1.1 APPLICATION OF PLASTER

Sand face plaster shall consist of 13 mm thick (1 cement: 4 coarse sand by volume) under layer and 7 mm thick (1 cement: 2 coarse sand, granule size 2 to 2.5mm by

volume) top layer. Application of plaster shall be as described in "two coat plaster work" in clause no. 5.2.2.

The surface of the sand face plaster shall be finished rough with sponge or as directed by the Engineer-in-charge.

6.1.2 CURING

Curing shall be described in clause 5.3

7.0 EXPOSED AGGREGATE FINISH

7.1 PREPARATION OF MORTAR

The mortar of specified mix shall be used as per the specifications of cement mortar described in clause no. 3.4. White and coloured marble chips shall be of 6 mm to 12mm 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.

7.1.1 APPLICATION OF PLASTER

Exposed aggregate finish plaster shall consist of 12mm thick plain cement plaster under layer (1 cement: 4 coarse sand by volume) finished rough and 20 mm thick top layer. Under layer shall be applied in accordance with "One layer plaster work" described in clause no. 5.2.1.

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 6mm to 9mm 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 M x 1.2M or as per drawing with 12mm x 20mm grooves in between formed by holding removable wooden battens of 12mm x 25mm 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.

7.1.2 CURING

Curing shall be as described in Clause no. 5.3

8.0 POINTING

Pointing shall be of the type specified such as flush, cut or weather struck, raised and cut etc.

8.1 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.

8.1.1 MORTAR

Mortar shall be in accordance with the specifications of cement mortar described in clause no. 3.4

8.1.2 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.

8.1.3 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.

8.1.4 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 & coursed rubble masonry.

8.1.5 RAISED AND CUT POINTING

This type of pointing shall project from the wall facing with its edges cut parallel so as to have a uniformly raised band about 6 mm and width 10 mm more as directed. The pointing shall be finished to a smooth but hard surface.

8.1.6 CURING

Curing shall be as described in clause no. 5.3

9.0 MEASUREMENT & RATE

The description of each item, unless otherwise mentioned includes wherever necessary all material, conveyance and delivery, handling, loading/unloading, storing, fabrication, hoisting, all labour for finishing the work, preparation of background surface, staging/scaffolding, application, finishing, removal of staging/scaffolding, curing and other incidental charges. The rate for item rate tenders shall be for all heights and at all heights of work.

9.1 PLASTERING & POINTING

Thickness of the plaster shall be the minimum thickness at any point on a surface and shall be exclusive of the key i.e. grooves or open joints in masonry. No extra payment shall be allowed for extra thickness of plaster done by contractor, drip moulds, rounding of edges etc.

For item rate tenders, all plastering/pointing shall be measured in square meters unless otherwise specified. Length, breadth and height shall be measured correct to 0.1 meters. Soffits of stairs shall be measured as plastering on ceiling. Ceiling with projected beams shall be measured over beams and plastered side of beam shall be measured and added on ceiling.

Deductions and additions shall be made in the following manner.

- a. No deductions shall be made for ends of joists, beams, posts, openings not exceeding 0.5 Sq.m. area and no addition shall be made for reveals, jambs, soffits etc. of these openings mortar finish to plaster around ends of joists, beams, posts etc.
- b. Deductions for openings exceeding 0.5 Sq.m but not exceeding 3 Sq.m each shall be made as follows and no addition shall be made for reveals, jambs, soffits etc. of these openings.
 - i. When both faces of wall are plastered with same type of plaster, deduction shall be made for one face only.
 - ii. When two faces of wall are plastered with different types of plasters or if one face is plastered and the other pointed, deduction shall be made from the plaster or pointing on the side of frame for door, window etc. on which width of reveals is lesser, but no deduction shall be made on the other side. Where widths of reveals on both faces of wall are equal, deduction of 50% of area of opening on each face shall be made.
 - iii. When only one face is plastered, full deduction shall be made from plaster if width of reveal on plastered side is lesser. But if widths of reveal on both sides are equal or more on unplastered side, no deduction shall be made.
- c. In case of openings of area above 3 Sq.m each, deduction shall be made for openings but jambs, soffits, and sills shall be measured.



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STANDARD SPECIFICATION FOR ROOF TREATMENT

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ABBREVIATION

m	Metre
mm	Millimetre
Kg/sqm	Kilogram Per Square Metre
gm/Sqm	Gram per Square Metre
Sqm	Square Metre
PCC	Plain Cement Concrete

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1.0 SCOPE

This specification covers the general requirements for all types of roof treatment in all type of building.

2.0 REFERENCES

As mentioned in the respective clauses.

3.0 POLYURETHANE (PU) WATERPROOF COATING

3.1 MATERIAL

PU waterproof coating shall consist of 2 pack clear/pigmented Aliphatic Polyurethane using Polyether Polyols (Polyester or Castor oil based Polyols are not acceptable) with Iso-cynorate for rendering flame resistant characteristic. The 2 pack system consisting of pigment and the solvent (Xylene/Toulene, no filter) shall be mixed in definite ratio by weight strictly as per approved Manufacturers specification for preparing the coating for application. The coating shall have physical features like high resistance to impact, abrasion and cracking, superior tensile strength (80 Kg/Sq.cm after 4 weeks at ambient temperature) and perfectly smooth, dust free glossy finish retained at least up to 3 years. It should also be resistant to acid, alkalies and have a very low water absorption rate (0.5 % maximum at ambient temperature after 7 days)

The packs shall not be older than 9 months after the date of manufacture and packing.

3.2 WORKMANSHIP

3.2.1 PREPARATION OF SURFACE

The roof surface shall be thoroughly cleaned with a wire brush and all foreign matter etc. shall be removed. Well defined cracks on the surface shall be cut to "V" section, cleaned and filled up with a paste of 2 component Polyurethane based crack filling compound and white cement in a ratio of 1:2.

3.2.2 PRIMER COAT

It shall consist of 2 packs Polyurethane. Primer coat shall be mixed in the ratio as per Manufacturer's specification. A single coat of this primer shall be applied by brush over the prepared bed as an adhesion coat. The primer shall be allowed to dry for a minimum of 8 hours time before the successive finishing coats of PU are applied.

3.2.3 FINISHING COAT

The finishing coats shall consist of three successive pigmented sealing coats each of 2 packs Polyurethane mixed in the ratio as per Manufacturer's specification. Application shall be with brush to a smooth and even finish. The overall dry film thickness shall be 450 microns or minimum covering capacity shall be 160 gm/Sqm per coat. Each coat shall be allowed to dry for minimum 12 hours before applying next coat. Care shall be taken for quick application after mixing the 2 pack primer in view of short pot life of the

mix and shall be fully consumed within the stipulated period as per Manufacturer's specification (maximum 60 minutes at 30 deg. C).

The PU coating shall be continued up the parapets/walls for a minimum of 150mm over the finished roof surface. It shall be continued into rain water pipes by at least 100mm. The final coat of PU when tacky shall be sprinkled with 300 micron layer of clean sand. Plain cement concrete (1:2:4) of 25mm minimum thickness with 24 SWG chicken wire mesh shall be laid to slope in panels of maximum 1.2m x 1.2m size over this. The joints between panels shall be raked out neatly (after stipulated curing period) to a minimum 6mm X 6mm V groove and filled up with an approved quality elastomeric compound sealant. Drain outlet shall be provided for all spouts/rain eater pipes by suitable rounding, filling and sloping of PCC as per drawing. At the junction of the roof and parapet or any other vertical surfaces, a fillet of 75mm radius shall be formed in cement concrete (1:2:4).

4.0 MEASUREMENT & RATE

This clause shall be applicable for item rate tenders only

The finished work shall be measured in Sqm. of area for the purpose of payment in item rate.



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STANDARD SPECIFICATION FOR WHITE WASHING, COLOUR WASHING, DISTEMPERING, PAINTING AND POLISHING

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ABBREVIATION

m	Metre
mm	Millimetre
Sqm	Square Metre
Kg	Kilogram
gm	Gram
IS	Indian Standard

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1.0 SCOPE

This specification covers the general requirements for all types of white washing, colour washing, distempering, painting and polishing.

2.0 REFERENCES

Reference shall be made to the following Indian Standards for further information etc. not covered in the specification. In case of conflict/contradictions provisions of the 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	:	Specification for building limes.
IS: 55	:	Specification for Ultramarine blue for paints.
IS: 63	:	Specification for whiting for paint and putty.
IS: 427	:	Distemper, dry, Colour as required- Specification
IS: 428	:	Washable Distemper Specification
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-Specifications
IS: 2524	:	Code of practice for painting nonferrous metals in buildings.
IS: 384	:	Brushes, paints and varnishes, flat-Specifications
IS: 486	:	Specification for 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.

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.

3.0 WHITE WASHING

White washing in general shall conform to IS: 6278.

3.1 WORKMANSHIP

3.1.1 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.

3.1.2 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.

3.1.3 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. The whole solution shall be stirred thoroughly before use.

3.1.4 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.

3.1.5 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.

4.0 COLOUR WASHING

4.1 WORKMANSHIP

4.1.1 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.

4.1.2 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, cracks, patches etc. not exceeding 0.1 Sqm. 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.

4.1.3 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 3.1.3. Mineral colours of approved shade and quality not affected by lime shall be added to the white wash solution in proportions as directed by Engg.in-charge. Solid lumps etc. in the colour powder shall be ground to fine powder, sieved and mixed evenly and thoroughly to the white wash solution.

4.1.4 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.

4.1.5 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.

5.0 DRY DISTEMPERING

5.1 WORKMANSHIP

5.1.1 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.

5.1.2 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, efflorescence shall be treated in accordance with IS: 2395.

5.1.3 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.

5.1.4 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 liters 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.

5.1.5 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.

5.1.6 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.

6.0 OIL BOUND DISTEMPERING

6.1 WORKMANSHIP

6.1.1 SCAFFOLDING

Same as in clause no. 5.1.1

6.1.2 PREPARATION OF SURFACE

Preparation of surface shall in general be in accordance with clause no. 5.1.2 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.

6.1.3 PRIMER COAT

The primer coat shall be alkali resistant primer or distemper primer and shall be of the same 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.

The application of primer coat shall be in accordance with 5.1.3

6.1.4 PREPARATION OF OIL BOUND DISTEMPER

The distemper shall conform to IS: 428 and shall be diluted with water or any other prescribed thinner recommended by the manufacturer.

6.1.5 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 wahsed in hot water with soap solution and hung down to dry.

6.1.6 PROTECTIVE MEASURES

Same as in clause no. 5.1.6

7.0 WATERPROOF CEMENT PAINT

7.1 WORKMANSHIP

7.1.1 SCAFFOLDING

Same as in clause 5.1.1

7.1.2 PREPARATION OF SURFACE

Preparation of surface shall be in accordance with clause no. 5.1.2. The surface so prepared shall be thoroughly wetted with clean water before the paint is applied.

7.1.3 PREPARATION OF PAINT

Waterproof cement paint of approved make 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.

7.1.4 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 shall 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.

7.1.5 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.

7.1.6 PROTECTIVE MEASURE

Same as in clause in 5.1.6

8.0 PLASTIC EMULSION PAINTING

8.1 WORKMANSHIP

8.1.1 SCAFFOLDING

Same as in clause 5.1.1

8.1.2 PREPARATION OF SURFACE

Same as in clause 6.1.2 under specification of oil bound distempering.

8.1.3 PREPARATION OF PAINT

Plastic emulsion paint shall conform to IS: 5411 (Part-1) and shall be of approved shade. Preparation of paint shall be as per manufacturer's instructions.

8.1.4 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.

8.1.5 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.

8.1.6 PROTECTIVE MEASURES

Same as in clause 5.1.6

9.0 ACRYLIC COPOLYMER AGGREGATE FINISH

9.1 MATERIAL

It shall be an acrylic based textured wall coating consisting of quartz and silica aggregate, inorganic pigments and other additives to form a crack free, flexible, tough, waterproof coating.

9.2 PREPARATION OF SURFACE

The surface to be coated shall be cleaned and all dirt, dust, grease and loose particles shall be removed. Any old textured surface shall be removed with removing agent as per manufacturer's instructions.

9.3 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 requires, by a plastic trowel.

10.0 PAINTING OF WOOD WORK

10.1 PREPARATION OF SURFACE

Preparation of wood surface shall conform to IS: 2338 (Part-1) 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.

10.2 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 atleast 2 coats of primer. Type of primer shall be in accordance with Table-1 and Table-2 of IS: 2338 (Part-II).

10.3 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.

10.4 APPLICATION OF UNDERCOAT

Under coat 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).

10.5 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)

10.6 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

10.6.1 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.

10.6.2 STAINING

10.6.2.1 Spirit Stains

Spirit stains are solutions of spirit soluble dyes in Industrial methylated spirit.

10.6.2.2 Oil Stains

Oil stains are solutions of oil soluble dyes in linseed oil, but, usually consist of insoluble, semi-transparent pigments ground in linseed oil and thinned with turpentine or other solvent.

10.6.2.3 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.

10.6.2.4 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.

10.6.3 SEALING

A suitable sealer shall be applied on the filled 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.

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.

10.6.4 FINISHING

The stained surface shall be varnished, wax-polished or french polished as required after it is dried.

10.6.4.1. 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 a hard drying under coating or flattening varnish which shall be allowed to dry hard and then be flattened 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 or flattening 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.

10.6.4.2 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.

11.0 PAINTING OF STEEL AND OTHER METAL SURFACE

11.1 GENERAL

Reference shall be made to IS :2524 and IS: 1447.

11.2 PREPARATION OF SURFACE

The surface, before painting, 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 Sqm.) 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.

11.3 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.

12.0 MEASUREMENT AND RATE

This clause shall be applicable for item rate tenders only.

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 no. VCS-SS-CS-6043.

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.



Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR ROOFING

VCS-SS-CS-6046

					
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ABBREVIATION

m	Metre
mm	Millimetre
Kg/Sqm	Kilogram Per Square Metre
Sqm	Square Metre
IS	Indian Standard
°C	Degree Celsius

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1.0 SCOPE

This specification covers the general requirements for all types of roofing in all type of building.

2.0 REFERENCES

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	:	Galvanized 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 & fittings.
IS: 1626	:	Specification for asbestos cement building pipes and pipe fittings, gutter and gutter fittings and roofing fittings.
IS :1728	:	Specification for sheet metal rain water pipes up to 100 mm nom. size gutters, fittings and accessories.

The roof slope shall be as specified and in general not pitched flatter than 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.

3.0 MATERIALS

3.1 CORRUGATED GI SHEET (CGI) ROOFING/CLADDING

3.1.1 CORRUGATED GI SHEET

GI sheets shall be of specified thickness and of class-3 galvanized as per IS: 277 and shall be of approved brand.

3.1.2 GI RIDGES AND HIPS

These shall be of specified thickness and of class-3 plain galvanized and shall be bent to the required shape and dimensions as per drawings without damaging the sheet in the process of bending.

3.1.3 GI VALLEYS AND FLASHINGS

These shall be of specified thickness and of class-4 plain galvanized and shall be bent to the required shape and size as per drgs, without damaging the sheet in the process of bending.

3.1.4 GI GUTTERS

These shall be of specified thickness and of class-3 plain galvanized and shall be constructed to the required shape and size as per drawings.

3.1.5 WIND TIES

Wind ties of MS flats shall be of specified size, subjected to minimum size of 40mm x 6mm.

3.2 CORRUGATED ASBESTOS CEMENT (AC) SHEET ROOFING/CLADDING

3.2.1 ASBESTOS CEMENT SHEETS

These shall be of specified thickness and as per IS: 459 and shall be of approved brand.

3.2.2 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.

3.2.3 OTHER ACCESSORIES

Accessories such as flashing pieces, eaves filler pieces, north light and ventilator curves, barge boards etc. shall be of approved brand and shall be suitable to the location of items as specified.

4.0 WORKMANSHIP

4.1 CORRUGATED GI SHEET ROOFING

4.1.1 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.

4.1.2 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.

4.1.3 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.

4.1.4 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.

4.1.5 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.

4.1.6 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.

4.1.7 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.

4.1.8 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 end lap of ridges and hips shall be joined together by at least galvanized iron seam bolts and GI washers.

Ridges and hips shall fit squarely on the sheets.

4.1.9 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.

4.1.10 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.

4.1.11 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.

4.2 ASBESTOS CEMENT CORRUGATED SHEET ROOFING.

4.2.1 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.

4.2.2 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 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.

4.2.3 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.

4.2.4 MITRE

The length of the mitre shall be 150 mm. and width shall be equal to the width at the side lap.

4.2.5 LAPS

End laps shall be at least 150 mm, in cases of pitch flatter than 1:2 large & 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.

4.2.6 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 & 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 grip of the J or 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 & 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 75mm.
- 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.

4.2.7 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

4.2.8 WIND TIES

It shall be same as in case of CGI sheeting.

5.0 PRECOATED GALVANISED STEEL SHEET ROOFING/CLADDING

5.1 MATERIAL

The base metal of the roofing shall be Cold Reduced Steel Sheet conforming to IS-513. It shall be galvanized 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.

5.2 PROPERTIES

The precoated galvanized 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	: 1000 hours
Test Humidity Test	: 1000 hours
Temperature Resistance	: 150°C
Fire performance Profile	: Class I

5.3 PROFILE

The profiles shall have a depth of not less than 30mm and pitch of 198mm. Overall sheet thickness shall be 0.60mm. minimum weight shall be 5.24 kg/Sqm.

5.4 ACCESSORIES

All 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.

6.0 MEASUREMENTS AND

This clause shall be applicable for item rate tenders only.

6.1 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 Sqm. No extra shall be allowed for extra labour in cutting or wastage. For openings exceeding 0.40 Sqm. 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 1M girth shall be classified as hole, notches and shall be enumerated according to the following:
 - i. Those not exceeding 0.01 Sqm.
 - ii. Those exceeding 0.01. Sqm. but not exceeding 0.04 Sqm.
 - iii. Those exceeding 0.04 Sqm.

6.2 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.



Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR FALSE CEILING, FALSE FLOORING, UNDERDECK INSULATION & PARTITIONING

VCS-SS-CS-6047

					
03	31.01.2022	NV	GDS	HK	GW
02	28.02.2020	NV	GDS	RKB	SK
01	16.10.2019	MA	MO	AD	SK
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REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	05.07.2017	MA	MO	RKB	AD	Issued for use as Standard
01	16.10.2019	MA	MO	RKB	SK	
02	28.02.2020	NV	GDS	RKB	SK	New revision system updated
03	31.01.2022	NV	GDS	HK	GW	VCS QMS Integration

ABBREVIATION

m	Metre
mm	Millimetre
Sqm	Square Metre
IS	Indian Standard
BS	British Standard
C/C	Center to Center
Kg/m ²	Kilogram Per Square Metre
M.S.	Mild Steel
PVC	Poly Vinyl Chloride

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1.0 SCOPE

This specification covers the general requirements for all types of false ceiling, false flooring, underdeck insulation & partitioning in all type of building.

2.0 REFERENCES

IS: 3087	Particle Board of wood and other Lignocellulosic materials medium density for general purpose -Specification
IS: 1642	Code of practice for fire safety of building (General)
IS: 2095	Gypsum plaster Boards - Specifications
IS: 12406	Medium density fibre boards for general purpose
IS: 848	Synthetic Rasin adhesive for plywood
BS: 476	Fire test on Building and structural materials
BS: 4370	Method of test for rigid cellular materials

3.0 FALSE CEILING GRID SYSTEMS

3.1 GALVANISED STEEL GRID SYSTEM

Galvanized Steel grid system shall be erected for the purpose of supporting Mineral fibre false ceiling tiles.

3.1.1 MATERIAL

a. Main Runner

Main runner shall be of hot dipped galvanized steel and 'T' shaped of 24 mm x 38mm size and 0.33mm thickness with double rotary stitching with backed polyester coating (min 25 micron) on the cap of flange.

b. Cross Runner

Cross runner shall be of hot dipped galvanized steel and 'T' shaped of 24 mm x 30mm size, 0.25mm thickness, 1200mm long and 24 mm x 25mm size, 0.25mm thickness, 600mm long with double rotary stitching with backed polyester coating (min 25 micron) on the cap of flange.

c. Perimeter Section

Material shall be same as runners. Sections shall be 22mm x 22mm size of 0.45mm thickness. Exposed areas of all the metallic members shall be powder coated (25micron).

3.1.2 ERECTION

Main Runners shall be placed at the spacing of max. 1200 mm c/c. Cross runners shall be fixed @ max. 600 mm c/c to obtain a grid of 600mm x 600mm.

The grid shall be suspended by means of 4mm dia MS wire, 6mm thick MS cleat of 25mm x 25mm section, dash fasteners and level adjusters.

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.

3.2 ALUMINIUM GRID SYSTEM

Aluminum grid system for supporting false ceiling tiles shall be of approved make and shall be perfectly leveled, aligned at desired height and in accordance with the false ceiling pattern as per drawings.

3.2.1 MATERIAL

a. Main Runner

Main Runners shall be of extruded anodized (25 micron) aluminum Tee Sections of 25 mm x 35 mm size (approved make), 2.5mm thick.

b. Cross Runner

Cross Runners shall be of extruded anodized (25 micron) aluminum Tee Sections of 25 mm x 25 mm size (approved make), 2.5mm thick.

c. Perimeter Section

Perimeter sections shall be of extruded anodized (25 micron) aluminum angle Sections of required size.

3.2.2 ERECTION

The grid system shall be assembled by interlocking the main and cross runners @ 600 mm max. both ways by means of Aluminum angle cleats. The main runners shall be suspended from the ceiling by means of 3 mm thick MS flat clamp fixed to main runners @ 1200 mm max. 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 leveling nut and @ 1200 mm maximum. The MS hooks shall be suspended from the ceiling by means of slotting in 25 mm x 25mm x 3 thick MS angle, fixed to the slab by 12 mm dia Dash fasteners @ 1200 mm c/c.

The overall grid system shall be rigid, in accordance with false ceiling pattern, perfectly leveled and aligned at desirable height.

3.3 GI GRID SYSTEM

3.3.1 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 leveled, aligned at desired height in accordance with false ceiling pattern.

4.0 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 leveled and aligned, at desired height as per drawings.

Necessary Electrical & AC and other fixtures shall be provided as per drawing and in coordination with relevant construction activities.

4.1 MINERAL FIBRE TILES

Mineral fibre false ceiling tiles shall be with durable tegular edging having NRC value of min. 0.50, Light reflectance value of min. 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 mm 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.

4.2 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 and as per IS: 848, categorized 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 approved 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 600mm x 600 mm x 12 mm and all four edges of the tiles shall be painted with a coat of approved quality primer.

4.3 GYPSUM BOARD TILES

Gypsum board shall conform to IS: 2095. The Gypsum boards used for false ceiling shall have following properties.

a.	Thermal Conductivity	-	0.16W/mk
b.	Thermal Resistance.		
i.	For 9.5 mm thick board	-	0.06Sq.MK/W
ii.	For 12.5 mm thick board	-	0.08Sq.MK/W
iii.	For 15 mm thick board	-	0.09 Sq.MK/W
c.	Fire Propagation		
i.	Fire Propagation		
	Index of performance	-	Not exceeding 12 and a sub index not exceeding 6 (when each side is tested separately to BS 476, Part -6)
ii.	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 0.5mm thick lamination). The Gypsum board shall be screw fixed to the underside of false ceiling grid system with 12.5mm 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.

5.0 UNDERDECK INSULATION

5.1 MATERIAL

Underdeck insulation shall be of phenolic foam rigid slab of 25mm thickness and approx. 1000mm x 500mm size as specified and shall conform to IS: 13204. It shall have density of 32 kg / M3 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 I ' for surface spread of flame as per BS 476, part 7. It shall be prelaminated on both sides with kraft paper.

5.2 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/m² over the entire surface. Hot bitumen or CPRX adhesive shall then be applied on the insulation panel @ 1.5 kg/m². The panels shall be pressed in position and further secured by dash fasteners.

The underdeck insulation shall be fixed only after all fixtures like hooks, clamps, cleats etc. for light fixtures, ducts etc. have been fixed in the ceiling.

6.0 CAVITY (FALSE) FLOORING (WITH METAL TRAY)

6.1 MATERIAL

a. Pedestal base plate

Pedestal base plate shall be made of galvanized Mild steel and shall be of 100 mm x 100 mm size and 3mm thick. It shall have stiffening folds as per drawing.

b. Pedestal stud

Pedestal stud of 19 mm I.D. and 3 mm thickness shall be made of galvanized mild steel seamless pipe.

c. Top -head attachments

Top head attachments shall be made of pressure die cast aluminum alloy disc of 2.5 mm thickness, having channel shaped projections in all 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.

d. Channel stringers

Channel stringers shall be galvanized, machine cut, cold rolled mild steel channels of size 18.5 mm x 18.5 mm and 2.5 mm thickness.

e. MDF board floor panels

Floor panels shall be of dense, homogeneous, medium density fibre boards manufactured from agrobased lignocellulosic fibres conforming to IS-12406, exterior grade bonded with synthetic resin conforming IS: 848, BWP type and categorized as class-I for 'Surfaces of very low flame spread' as per IS-1642. It shall be of 18 mm thickness and of size 610 mm x 610 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.

6.2 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.

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 leveled, 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 dwg.

Necessary ramps, slopes, steps etc. shall be also provided for as per dwg.

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 up to 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/m².

7.0 CAVITY (FALSE) FLOORING (WITH PARTICLE BOARD)

7.1 MATERIAL

- a. Pedestal base plate

Pedestal base plate shall be made of galvanized Mild steel and shall be of 100 mm x 100 mm size and 8mm thick.

b. Pedestal stud

Pedestal stud of 30 mm dia shall be made of galvanized mild steel seamless pipe. The stud shall have threading at top and bottom for attaching the top head attachment and fixing to base plate.

c. Top-head attachments

Top head attachments shall be made of pressure die cast aluminum 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 threading in the stud allowing for adjustment upto 25mm up & down.

d. Channel stringers

Channel stringers shall be galvanized, machine cut, cold rolled mild steel channels of size 40 mm x 40 mm and 3.15 mm thickness.

e. 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 IS: 848 and categorized as class-I 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.

The floor panels shall be finished on the underneath side with 0.05mm thick Aluminum foil turned up and extended by minimum 12mm 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 lapping as per drawing.

12mm x 12mm x 75mm long, 2mm thick Aluminum channel cleats shall be provided on middle of four sides of the panels for lateral stability.

7.2 WORKMANSHIP

False flooring pattern shall be as per approved drawing. Pedestal base plates shall be fixed to the base floor by 6mm dia, 40mm 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 leveled, 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/Sqm.

8.0 PARTITIONING & PANELLING

8.1 MS FRAME

MS frame for Partitioning & Paneling shall consist of horizontal & vertical members of 18SWG 52mm X 38mm MS sections. The members shall be welded to each other at maximum 600mm c/c both ways. The frame shall be fixed to the floor/ceiling/wall with GI roullete plug, screw and washers & 300mm 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.

8.2 GYPSUM BOARD FOR PARTITIONING & PANELLING

Gypsum boards for partitioning & paneling shall be 12.5mm thick and same as specified in clause no. 3.3

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 headings.

8.3 LAMINATED PARTICLE BOARD FOR PARTITIONING & PANELLING

Particle board for partitioning/paneling shall be 12mm thick and shall be same as in clause no. 3.2.

Number of Particle 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.

9.0 MEASUREMENT AND RATES

This clause shall be applicable for item rate tenders only.

For item rate tenders, False ceiling/flooring, Insulation, Partition, Paneling shall be measured in Sqm. correct up to two places of decimal. Dimensions shall be measured correct upto 0.01m.

No deduction shall be done for cut outs for fixtures, cables etc. up to 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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STANDARD SPECIFICATION FOR ACID PROOF TILE LINING

VCS-SS-CS-6048

					
03	31.01.2022	NV	GDS	HK	GW
02	28.02.2020	NV	GDS	RKB	SK
01	16.10.2019	MA	MO	AD	SK
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00	05.07.2017	MA	MO	RKB	AD	Issued for use as Standard
01	16.10.2019	MA	MO	RKB	SK	
02	28.02.2020	NV	GDS	RKB	SK	New revision system updated
03	31.01.2022	NV	GDS	HK	GW	VCS QMS Integration

ABBREVIATION

m	Metre
mm	Millimetre
Sqm	Square Metre
IS	Indian Standard
BIS	Bureau of Indian Standards
ASTM	American Society for Testing And Materials

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1.0 SCOPE

This specification covers the requirement of material and laying of Acid Proof tile lining for flooring on acid storage areas.

2.0 REFERENCES

IS: 4832 (Part-I)	:	Specification for Chemical resistant mortar silicate type
IS: 4832 (Part-II)	:	Specification for Chemical resistant mortar Resin type
IS: 4860	:	Specification for Acid resistant bricks
IS:9510	:	Specification for Bitumen, Mastic Acid Resisting Grade
ASTM D41-94	:	Standard Specification for Asphalt Primer Used in Roofing, Damp proofing, and waterproofing

Note: - Latest edition of IS shall be followed.

3.0 MATERIAL

3.1 ACID PROOF TILES

The Tiles shall conform to IS: 4860 - Class I quality. All tiles shall be dense, homogeneous and manufactured out of special raw material which shall have low lime, flint, sand and iron contents. These shall be specially fired and vitrified at high temperature to have qualities of low absorption. The size of the tiles shall normally be 230mm x 115mm or as per IS: 4860. The thickness shall be as specified in the item.

3.2 ACID PROOF MORTAR

3.2.1 SILICATE MORTAR

It shall consist of selected potassium silicate solution and inert filter powder. Both mixed well to enable to set at ambient temperature. The mortar shall conform to IS: 4832 (Part - I). The mixing proportion and other instructions for use shall be as specified standard manufacturers."Cement Proctor S.W.K" manufactured by Corromondal Prodorite or equivalent may be used. This type of Mortar is resistant to most acids except hydro-fluoric acid and concentrated ortho-phosphoric acid; they are not resistant to alkalis of any concentration or to boiling water or stream.

3.2.2 RESIN MORTAR

The furane and phenolic mortar for jointing consist of inert powder synthetic resin syrup. No water shall be used during mixing. This mortar shall conform to IS: 4832 (Part - II). The mixing proportion and other instructions shall be as specified by standard manufacturers. "Furacin" and "Phencil" manufactured by Corromondal Prodorite or equivalent may be used. This type of Mortar has a good resistance to non-oxidizing mineral acids, and poor resistance to oxidizing mineral acids. They are fairly resistant to inorganic alkalis and water.

3.3 BITUMEN PRIMER

A bitumen primer is an asphalt based material thinned with petroleum solvent (conforming to ASTM D-41) should be applied over the surface. Primers from standard manufacturers only shall be used.

3.4 BITUMEN MASTIC

The bitumen mastic shall consist of a mixture of asphalt cement mineral filler, and mineral aggregate, which are acid alkali proof. The composition, preparation and properties of the bitumen mastic shall be as per IS: 9510 for resisting acid. The bitumen mastic shall be insoluble in Benzol and the matter soluble in diluted hydrochloric acid should not be more than five percent. "Prodorpalte" by Coromandal Prodorite or equivalent may be used.

4.0 LAYING

4.1 SURFACE PREPARATION

- a. All damaged or questionable areas should be chipped out and replaced.
- b. Adequate floor slope for good drainage is important.
- c. Low spot should be avoided because finished floor will follow contour or sub floor.
- d. Concrete should be dry, clean and well cured before application of membrane is started.

4.2 PRIMER APPLICATION

A bitumen primer should be applied over the prepared surface. It should be allowed to dry before applying the membrane material.

4.3 MEMBRANE APPLICATION

Bitumen mastic is used to build up the membrane. It is heated to 120-205°C and applied to the primed surfaces. Multiple coat application should be made to thickness requirements. The thickness of the mastic layer shall be to suit the acid concentration and expected load or as specified by the Engineer-in-charge. Each coat should be inspected for blisters and pinholes. If present, they should be broken and before applying subsequent coats. Bitumen mastic should not be used as the membrane material where solvents are involved.

4.4 REINFORCEMENT APPLICATION

Bitumen coated glass cloth can be used for membrane reinforcements at the corners, edges, walls, etc. depending on the requirements.

4.5 APPLICATION OF MORTAR AND BRICKS

There are two ways of lining Acid resisting linings:

4.5.1 WHEN BEDDING AND JOINTING MATERIAL ARE THE SAME.

A thin layer of about 3mm suitable resinous mortar is spread on the back of the acid proof tiles and the tiles are pressed down on the bed. Suitable joint thickness of about 3mm should be maintained. Jointing is done with suitable resin mortar.

4.5.2 WHEN BEDDING AND JOINTING MATERIAL ARE DIFFERENT

A thin layer of about 6mm suitable silicate type mortar is spread on the back of the acid proof tiles and the tiles are pressed down on the bed. Proper joint thickness of about 3mm should be maintained and filled up with suitable resin type mortar. In case of pointing the joint thickness should be 6mm and depth of the pointing should be 19mm.

In this case, joints with silicate mortar should be acid cured with 20 to 25 percent hydrochloric acid or with 30 to 40 percent sulphuric acid before applying the resin type mortar. After acid curing, the free acid in the joints shall be cleaned with water and sufficient time should be allowed for thorough drying. After curing resin mortar is used for filling up the joints.

5.0 GUARANTEE

The Vendor shall give material and performance guarantee for a period of minimum one year from the date of commissioning of the plant.

6.0 PAYMENT

This clause shall apply to item rate tender only.

6.1 Payment shall be on square meter basis of area covered.

6.2 The payment clause(s) as described in the clause no. 6.1 shall not be referred / applicable for LSTK Jobs.



Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR INSPECTION AND TEST PLAN(ITP) CIVIL-STRUCTURAL & ARCHITECTURAL WORKS

VCS-SS-CS-6100

03	31.01.2022	NV	GDS	HK	GW
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REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	05.07.2017	MA	MO	RKB	AD	Issued for use as Standard
01	16.10.2019	MA	MO	RKB	SK	
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ABBREVIATION

AFC	Approved For Construction
BM	Bench Mark
CI	Cast Iron
CPT	Cone Penetration Test
GI	Galvanized Iron
IRC	Indian Road Congress
JB	Junction Box
MS	Mild Steel
MT	Magnetic Particle Testing
NDT	Non Destructive Testing
PCC	Plain Cement Concrete
PQR	Procedure Qualification Record
PT	Penetration Testing
PVC	Poly Vinyl Chloride
PWHT	Post Weld Heat Treatment
RCC	Reinforced Cement Concrete
RF	Reinforcement
SPT	Standard Penetration Test
U/G	Under Ground
WBM	Water Bound Macadam
WPS	Welding Procedure Specification
ITP	Inspection and Test Plan
VCS	VCS Project Consultants Pvt. Ltd.

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GENERAL NOTE

The enclosed ITPs are indicative and shall be followed for developing the job specific ITP's for the works to be performed by the contractor. The provisions indicated for stage wise inspection by VCS/Owner (For specific activities) are the minimum and the Engineer-In-Charge may decide to increase Hold Points/ Witness Points while approving the job specific ITP's. Activities for which ITP's are not provided in this specification contractor to develop and get the same approved by VCS/Owner before start of the work. In general role of VCS has been specified in the document. The role of owner to be specified during preparation of site specific ITPs

Contractor to submit job specific reporting formats with the aid of enclosed sample reporting formats and job procedures for the jobs for which ITP's are attached and submit to VCS/Owner for approval, before commencement of the activity. If the contractor has to deviate from the given ITP for a valid reason, he shall obtain prior written approval of VCS/Owner. Contractor to carry out 100% examination of all activities.

LEGEND

HP: Hold Point;

A point which requires witnessing/inspection/verification and acceptance by Owner/VCS before any further processing is permitted.

The Contractor shall not process the activity/item beyond a Hold Point without written approval by Owner/VCS except where prior written permission for further processing is available.

W: Witness Point;

An activity which requires witnessing/inspection/verification by Owner/VCS when the activity is performed.

After proper notification has been provided (notification modalities and period shall be finalized before hand), the Contractor is not obliged to hold further processing if Owner/VCS is not available to witness the activity or does not provide comments before the date notified. In such cases, basis of acceptance shall be review of Contractor generated report/document as per relevant technical specification.

Rw: Review of Contractor's documentation.

S: Surveillance Inspection by Owner/ VCS.

Monitoring or making observations to verify whether or not material/items or services conform to specified requirements. Surveillance activities may include audit, inspections, witness of testing, Review of quality documentation & records, personnel qualifications, etc.

WC: 100% Supervision and Examination by Contractor.

Responsibility for execution of the inspection/testing is with the Contractor; Owner/VCS only verifies examination or testing done by the Contractor at important stages

ITP NO: 101

LAND & TOPOGRAPHICAL SURVEY

SL. NO.	ACTIVITY	CONTRACTOR	VCS
1.	Boundary markings and submission of drgs./sketches	WC	S
2.	a) Availability of valid calibration certificates of instruments/ testing equipment's	WC	HP
	b) Field calibration, if any	WC	W
3.	Block levels, contour plans, establishing Permanent bench marks with ref. to Survey of India B.Ms. by check levels and submission of relevant drgs. & records	WC	S
4.	Protection of control points, permanent bench marks and regular rechecking	WC	S
5.	Submission of Master plan showing monuments, structures exposed rocks, weirs, water works, ponds, underground services if crossing that area, etc.	WC	S
	INSPECTION & TEST DOCUMENTS		
1.	Review Test and Inspection Documents	WC	Rw

ITP NO: 102

SOIL INVESTIGATION

SL. NO.	ACTIVITY	CONTRACTOR	VCS
1.	Positioning of test location	WC	S
2.	a) Availability of valid calibration certificates of instruments/ testing equipment's	WC	HP
	b) Field calibration, if any	WC	W
3.	Boring & sampling	WC	S
4.	In-situ testing (SPT, CPT, Plate load test, Soil Resistivity, Block vibration test, etc.)	WC	S
5.	Lab testing (as applicable)	WC	W/ Rw
6.	Monitoring of water level	WC	S
	INSPECTION & TEST DOCUMENTS		
1.	Review Test and Inspection Documents	WC	Rw

ITP NO: 103

SITE GRADING

SL. NO.	ACTIVITY	CONTRACTOR	VCS	
			CAT A	CAT B
1.	Clearing and stripping of soil including disposal of unsuitable material	WC	S	-
2.	a) Availability of valid calibration certificates of instruments/ testing equipment's	WC	HP	HP
	b) Field calibration, if any	WC	S	-
3.	Taking and plotting of initial levels at specified intervals for cutting as well as filling areas	WC	S*	S*
4.	Classification (Levels of strata) and testing of filling soil for suitability including preparation of Lead Charts to filling/disposal areas.	WC	S	-
5.	Proper warning of explosions, misfires and storage of explosive materials (As applicable).	WC	-	S
6.	Breaking up of clods, lumps, etc. at the time of filling and compaction.	WC	S	-
7.	Identification and suitability of borrow areas for filling soil/murum including verification of payments for royalty, etc.	WC	Rw	-
8.	Compaction test for earth filling in specified layers including finished areas.	WC	Rw	-
9.	Verification of final finished grade levels.	WC	S*	S*
10.	Computation of Earth works.	WC	Rw*	Rw*
11.	Record of tree cuttings, stacking of blasted rocks and other quarry materials including handing over to Owner	WC	S	S
12.	Preparation of "As built drawings	WC	Rw	Rw
13.	Removal of Surplus earth/excavated material and levelling in disposal areas.	WC	S	-
	INSPECTION & TEST DOCUMENTS			
1.	Review Test and Inspection Documents	WC	Rw	Rw

CAT A: All fillings
CAT B: All cuttings.

* In case quantum of earthwork is required to be certified by VCS then HP.

ITP NO: 104

EXCAVATION

SL. NO.	ACTIVITY	CONTRACTOR	VCS		
			CAT A	CAT B	CAT C
1.	a) Availability of valid calibration certificates of instruments/ testing equipment's	WC	HP	HP	RW
	b) Field calibration, if any	WC	W	S	-
2.	Layout checking	WC	S	-	-
3.	Taking initial levels	WC	S	-	-
4.	Slopes of excavation, benching, overburden, shoring & strutting (in case of deep excavation)	WC	S	S	-
5.	Check for sub-soil water, dewatering requirements as per specifications.	WC	S	S	S
6.	Bottom level of excavation and compaction	WC	S	S	S
7.	Stacking of different type of soils separately	WC	S	-	-
8.	List of obstacles encountered (cables, pipes, conduits, etc)	WC	S	S	-
9.	Barricading of excavated pits for safety & protection from rain	WC	S	S	S
	FOR HARD ROCK				
1	Obtaining license from district authorities for undertaking blasting operations	WC	Rw	Rw	Rw
2	Storing of explosive materials as per explosive rules	WC	S	S	S
3	Prominent display of red flags around the area to be blasted	WC	S	S	S
4	Check the dimensions of bore holes	WC	S	S	S
5	Stacking of hard rock for useable/non useable including handing over to owner	WC	S	S	S

	INSPECTION & TEST DOCUMENTS				
1.	Review Test and Inspection Documents	WC	Rw	Rw	Rw

CAT A : Equipment foundations, Plant buildings, etc.
CAT B : Non Plant buildings, pipe culverts, bridges, etc.
CAT C : Boundary walls, wing walls, manholes, drains, etc.

ITP NO: 105

BACK FILLING

SL. NO.	ACTIVITY	CONTRACTOR	VCS		
			CAT A	CAT B	CAT C
1.	Selection of materials/selected earth	WC	W	S	S
2.	Check for treatment of soil, if any	WC	S	S	-
3.	a) Availability of valid calibration certificates of instruments/ testing equipment's	WC	HP	HP	HP
	b) Field calibration, if any	WC	W	S	-
4.	Filling in specified layers, consolidating, watering.	WC	S	-	-
5.	Compaction tests for layers	WC	W	S	Rw
6.	Filling to required levels	WC	S	-	-
	INSPECTION & TEST DOCUMENTS				
1.	Review Test and Inspection Documents	WC	Rw	Rw	Rw

CAT A: Equipment foundations, Plant buildings, etc.
CAT B: Non Plant buildings, pipe racks, pipe culverts, bridges, etc.
CAT C: Boundary walls, wing walls, manholes, drains, etc.

ITP NO :106

UNDERGROUND PIPING (RCC/ CI)

SL. NO.	ACTIVITY	CONTRACTOR	VCS	
			CAT A	CAT B
1.	Checking of material	WC	NOTE 1	NOTE 1
2.	Adequate slope, benching in excavation for safety purposes (if required)	WC	S	
3.	Layout, line & level	WC	S	-
4.	Laying & jointing, grouting at manholes/chambers	WC	S	-
5.	Check for supports/ firm bed/ sub soil water level	WC	S	-
6.	Testing for leakages by blocking pipe ends	WC	W	W
7.	Hydro-testing and other tests, Removal of blockages, Cleaning & flushing of system	WC	W	W
8.	Backfilling in layers	WC	Rw	Rw
9.	Check for MS rungs in proper position, inlet/outlet pipe levels in manholes	WC	S	S
10.	Preparation of "As-built drawings"	WC	Rw	Rw
	INSPECTION & TEST DOCUMENTS			
1.	Review Test and Inspection Documents	WC	Rw	Rw

NOTE : 1 For incoming material inspection please refer VCS Standard Specification No: SS-EA -001

CAT A: Plant Buildings, etc.

CAT B: Non Plant Buildings, Admn. Buildings, Gate House, Security/Guard

Rooms etc.

ITP NO:107

WBM ROADS

SL. NO.	ACTIVITY	CONTRACTOR	VCS	
			CAT A	CAT B
1.	a) Availability of valid calibration certificates of instruments/ testing equipment's	WC	HP	RW
	b) Field calibration, if any	WC	S	-
2.	Layout checking including Road crossings and taking initial levels	WC	S	S
3.	Approval of source & checking/testing of materials (wherever required)	WC	NOTE 1	NOTE 1
4.	Filling (if any), compaction, providing cambers in sub-base including levels	WC	S	S
5.	Spreading metal to required thickness, line & levels, dry rolling including spreading of screening material	WC	-	-
6.	Check for camber and levels over metalling	WC	S	S
7.	Spreading murrum/ sand, watering and rolling	WC	S	-
8.	Checking thickness after each layer and rectification thereof (if any)	WC	S	S
9.	Checking quantity of aggregate by excavation of trial pits as per IRC Code	WC	W	S
	INSPECTION & TEST DOCUMENTS			
1.	Review Test and Inspection Documents	WC	Rw	Rw

NOTE : 1 For incoming material inspection please refer VCS Standard Specification No: SS-EA -001

CAT A: Roads subjected to heavy loading, connected to main highway, main plant roads

CAT B: Balance Roads

ITP NO:108

BLACK TOPPING (PREMIX CARPETING) & BITUMINOUS MACADAM (BM)

SL. NO.	ACTIVITY	CONTRACTOR	VCS
1.	Approval of source of materials	WC	Note 1
2.	a) Availability of valid calibration certificates of instruments/ testing equipment's	WC	HP
	b) Field calibration, if any	WC	S
3.	Surface preparation & check for camber/level	WC	S
4.	Checking/ testing of material wherever required	WC	W
5.	Tack coat application	WC	-
6.	Laying of Premix carpeting/ BM including rolling	WC	S
7.	Application of Seal coat	WC	-
8.	Check for camber and levels	WC	S
9.	Check for bitumen temperature and consumption	WC	S
10.	Thickness check of Premix carpet/ BM	WC	S
11.	Removal of surplus earth	WC	-
12.	Berm preparation	WC	-
13.	Final Inspection	WC	W

	INSPECTION & TEST DOCUMENTS		
1.	Review Test and Inspection Documents	WC	Rw

NOTE : 1) For incoming material inspection please refer VCS Standard Specification No: SS-EA -001

ITP NO:109

MICRO GRADING

SL. NO.	ACTIVITY	CONTRACTOR	VCS
1.	a) Availability of valid calibration certificates of instruments/ testing equipment's	WC	RW
	b) Field calibration, if any	WC	-
2.	Taking initial levels	WC	S
3.	Clearing/ Removal of extra soil, debris, etc. from site by transportation	WC	-
4.	Taking final levels	WC	S
5.	Verification of gradient of ground	WC	-
6.	Finishing of ground surface by hand compactor/ Roller (As applicable)	WC	S
7.	Final inspection	WC	W
	INSPECTION & TEST DOCUMENTS		
1.	Review Test and Inspection Documents	WC	Rw

ITP NO:110

PLAIN CEMENT CONCRETE

SL. NO.	ACTIVITY	CONTRACTOR	VCS	
			CAT A	CAT B
1.	a) Availability of valid calibration certificates of instruments/ testing equipment's	WC	RW	RW
	b) Field calibration, if any	WC	S	Rw
2.	Checking of layout and materials, compaction of sub –grade	WC	S	-
3.	Mix proportion	WC	S	-
4.	Check for shuttering, dewatering if any.	WC	-	-
5.	Concreting with proper compaction	WC	-	-
6.	Checking of top level of PCC	WC	Rw	-
7.	Curing	WC	-	-
	INSPECTION & TEST DOCUMENTS			
1.	Review Test and Inspection Documents	WC	Rw	Rw

CAT A : for filled-up area

CAT B : for cutting area

ITP NO:111

REINFORCED CEMENT CONCRETE (SUBSTRUCTURE)

SL. NO.	ACTIVITY	CONTRACTOR	VCS	
			CAT A	CAT B
1	Approval of source of materials	WC	HP	Rw
2.	a) Availability of valid calibration certificates of instruments/ testing equipment's	WC	HP	HP
	b) Field calibration, if any	WC	Rw	Rw
3.	Checking of layout & condition of PCC/ levelling course	WC	S	-
4.	Incoming material checking	WC	NOTE 1	NOTE 1
5.	Design of mix & establishment of strength at site by trial mix	WC	HP	HP
6.	Check for line & level of shuttering including its condition, quality and rigidity.	WC	S	-
7.	Check for sub-soil water & dewatering arrangement, if any	WC	S	-
8.	Reinforcement & covers to reinforcement	WC	S	S
9.	Inserts, Anchor bolts and pipe sleeves, pockets, dowels, etc.	WC	S	S
10.	Pour Card	WC	W	Rw
11.	Check for obstacles encountered (Electrical conduits, pipe lines, etc.)	WC	S	-
12.	Concreting, testing, compaction & finishing	WC	S	Rw
13.	Casting of cubes	WC	S	S
14.	Curing	WC	S	-

15.	Testing of cubes	WC	W	W
16.	Removal of shuttering	WC	-	-
17.	Check for water tightness, rendering, if any	WC	S	S
18.	Preparation of As-built drawings	WC	Rw	Rw
	INSPECTION & TEST DOCUMENTS			
1.	Review Test and Inspection Documents	WC	Rw	Rw

NOTE: 1 For incoming material inspection please refer VCS Standard Specification No: SS-EA -001

CAT A: Pipe racks, plant buildings and equipment foundations etc

CAT B: non-plant buildings, pipe sleepers, manhole, catch pit and balance works.

ITP NO:112

REINFORCED CEMENT CONCRETE (SUPER STRUCTURE)

SL. NO.	ACTIVITY	CONTRACTOR	VCS	
			CATB	CAT C
1	Approval of source of materials	WC	HP	Rw
2.	a) Availability of valid calibration certificates of instruments/ testing equipment	WC	HP	HP
	b) Field calibration, if any	WC	Rw	Rw
3.	Checking of layout	WC	S	-
4.	Incoming material inspection	WC	Note 1	Note 1
5.	Design of mix & establishment of strength at site by trial mix	WC	HP	HP
6.	Check for line & level of shuttering and scaffolding/ vertical bracing including hoisting arrangements.	WC	S	-
7.	Reinforcement & covers to reinforcement	WC	S	S
8.	Inserts, bolts, pipe sleeves, MS rungs, concealed electrical conduits, fan hooks, dowels, etc. including welding if any	WC	S	-
9.	Pockets/ openings	WC	S	-
10.	Expansion joints, if any	WC	S	-
11.	Check for water stops, slopes, stoppers, if any	WC	S	-
12.	Pour Card	WC	W	Rw
13.	Concreting, testing, compaction & finishing	WC	S	S
14.	Casting of cubes	WC	S	S
15.	Curing	WC	S	-

16.	Testing of cubes	WC	W	W
17.	Removal of formwork/ staging	WC	-	-
18.	Verification of dimensions viz AFC drawings and tolerances	WC	S	S
19.	Check for water tightness, rendering, if any	WC	S	-
20.	Preparation of As built drawings.	WC	Rw	Rw
	INSPECTION & TEST DOCUMENTS			
1.	Review Test and Inspection Documents	WC	Rw	Rw

NOTE: 1 For incoming material inspection please refer VCS Standard Specification No: SS-EA -001

CAT A: Pipe racks, plant buildings and super structure of equipment Foundations, etc

CAT B: non-plant buildings, pipe sleepers, manhole, catch pit and balance work.

ITP NO:113

RCC PAVEMENT/FLOORING

SL. NO.	ACTIVITY	CONTRACTOR	VCS
1.	Approval of source of materials	WC	Rw
2.	a) Availability of valid calibration certificates of instruments/ testing equipments	WC	HP
	b) Field calibration, if any	WC	S
3.	Layout checking/ excavation of all new foundations	WC	-
4.	Incoming material inspection	WC	NOTE 1
5.	Design of mix & establishment of strength at site by trial mix	WC	HP
6.	Check for proper back filling/compaction/ completion of sub - Structure works	WC	S
7.	Check for edges of shuttering, alternate panels	WC	-
8.	Check for slopes, thickness of flooring	WC	S
9.	Shuttering, reinforcement (as applicable)	WC	-
10.	Check for expansion joints/ Construction joints	WC	S
11.	Check for concealed pipe embedment, earthing, if any	WC	-
12.	Check for dividing strips, as applicable	WC	S

13.	Concreting, finishing, etc	WC	S
14.	Checking for line, levels, slopes, joints, thickness of flooring viz. AFC drawings	WC	S
15.	Curing	WC	S
16.	Grinding & polishing, as applicable	WC	S
17.	Testing of concrete cubes (as applicable)	WC	W
18.	Preparation of "As Built Drawings"	WC	Rw
	INSPECTION & TEST DOCUMENTS		
1.	Review Test and Inspection Documents	WC	Rw

NOTE: 1 For incoming material inspection please refer VCS Standard Specification No: SS-EA -001

ITP NO:114

BRICK MASONARY

SL. NO.	ACTIVITY	CONTRACTOR	VCS	
			CAT A	CAT B
1.	a) Availability of valid calibration certificates of instruments/ testing equipment's	WC	RW	RW
	b) Field calibration, if any	WC	Rw	Rw
2.	Incoming material inspection	WC	Note 1	Note 1
3.	Cleaning of surface	WC	-	-
4.	Wetting/soaking of bricks	WC	S	S
5.	Cement mortar proportion	WC	S	S
6.	Staging & scaffolding	WC	-	-
7.	Hacking of adjacent concrete surface	WC	S	S
8.	Check for bond/closers, thickness of joints	WC	S	-
9.	Line, level & plumb	WC	S	S
10.	Raking out joints, keys in brick work, if any	WC	S	S
11.	Check for placement of Reinforcement bars in case of partition brick work	WC	S	S

12.	Embedment of fixtures	WC	S	S
13.	Curing	WC	-	-
14.	Preparation of 'As Built' Drawings	WC	Rw	Rw
	INSPECTION & TEST DOCUMENTS			
1.	Review Test and Inspection Documents	WC	Rw	

NOTE: 1 For incoming material inspection please refer VCS Standard Specification No: SS-EA -001

CAT A : Load bearing walls

CAT B : Balance works

ITP NO:115

STRUCTURAL STEEL WORKS

S. NO	ACTIVITY	CONTRACTOR	VCS	
			CAT B	CAT C
A	PRE – FABRICATION ACTIVITIES			
1.	a) Availability of valid calibration certificates of instruments/ testing equipment's	WC	HP	RW
	b) Field calibration, if any	WC	S	Rw
2.	Incoming material inspection	WC	Note 1	Note 1
3.	Welding Filler material approval/ qualification			
	a) Manufacturing test certificates/ documents	WC	Rw	Rw
	b) Testing, if any	WC	W	W
4.	Approval of WPS/ PQR	WC	HP	HP
5.	Welders performance qualification	WC	W	Rw
6.	Layout checking	WC	-	-
7.	Welding equipment and accessories	WC	-	-
8.	Preparation and approval of Fabrication drawings	WC	Rw	-
B	FABRICATION ACTIVITIES			
1.	Materials as per design drawing	WC	Rw	Rw
2.	Check straightness and non-warping of members	WC	S	-
3.	Dimensional and fit-up checks including provision of slopes for deflection wherever required	WC	S	-

4.	Visual check for welding	WC	S	-
5.	Grinding including surface preparation for painting and application of primer	WC	S	Rw
6.	Checking paint as per specs, shelf-life, etc.	WC	S	-
7.	Application of specified paint, painting thickness, etc.	WC	S	-
C	FIELD ERECTION ACTIVITIES			
1.	Lifting arrangements including test certificates of lifting tackles	WC	S	Rw
2.	Correctness of location	WC	-	-
3.	Orientation of bracing, lugs	WC	-	-
4.	Alignment & levels	WC	-	-
5.	Field welding (if any)	WC	S	-
6.	Grouting	WC	S	-
7.	Finishing coat of paint, thickness of paint etc.	WC	S	S
8.	Preparation of As-built drawings	WC	Rw	Rw
	INSPECTION & TEST DOCUMENTS			
1.	Review Test and Inspection Documents	WC	Rw	Rw

NOTE: 1 For incoming material inspection please refer VCS Standard Specification No: SS-EA -001

CAT A: Steel structures pertaining to Pipe racks, and equipment's, etc.

CAT B: Steel structures of plant buildings and non-plant buildings, pipe sleepers, manhole, catch pit, walkways, platforms at grade levels, etc.

ITP NO: 116

PILING WORKS

SL. NO.	ACTIVITY	CONTRACTOR	VCS	
			CAT A	CAT B
1.	Approval of source of materials	WC	Rw	Rw
2.	Layout and ground level	WC	S	-
3.	Incoming material inspection	WC	Note 1	Note 1
4.	Design of mix & establishment of strength at site by trial mix	WC	HP	HP
5.	Driving of piles & check for set point	WC	S	-
6.	Check for depth of bore and lowering of cage measuring	WC	-	-
7.	Pour Card	WC	HP	Rw
8.	Concreting, testing	WC	S	S
9.	Casting of cubes/Testing	WC	S/W	S

10.	Check for cut off level of concreting & quantity of concrete poured	WC	-	-
11.	Lifting of casing pipe	WC	S	-
12.	Pile load tests (lateral/vertical/cyclic/pull out)	WC	Rw	Rw
13.	Submission of pile load test report	WC	Rw	Rw
	INSPECTION & TEST DOCUMENTS			
1.	Review Test and Inspection Documents	WC	Rw	Rw

NOTE: 1 For incoming material inspection please refer VCS Standard Specification No: SS-EA -001

CAT A: Pipe racks, plant buildings and other equipment foundations etc.

CAT B: Non-plant buildings, Pipe sleepers, Manhole, Catch pit, etc.

ITP NO:117

ANTI-TERMITE TREATMENT

SL. NO.	ACTIVITY	CONTRACTOR	VCS
1.	Incoming material inspection & spraying devices including personal protective equipment's like facemask, gloves, shoes, etc.	WC	HP & Note 1
2.	Preparation of surface for taking dosage of emulsion by ramming of each layer of soil by roding the earth at specified intervals	WC	-
3.	Backfilling and compaction in specified layers along with application of emulsifier along the sides of masonry & RCC structures	WC	S
4.	Compaction of top surface for taking dosage of emulsifier by roding the earth at specified intervals for the entire floor area before concreting	WC	-
5.	Check for consumption of emulsifier utilized	WC	S

	INSPECTION & TEST DOCUMENTS		
1.	Review Test and Inspection Documents	WC	Rw

NOTE: 1 For incoming material inspection please refer VCS Standard Specification No: SS-EA -001

ITP NO:118

PLASTERING

SL. NO.	ACTIVITY	CONTRACTOR	VCS	
			CAT A	CAT B
1.	Check for completeness of all hidden jobs like piping, conduiting, etc.	WC	-	-
2..	Check for grading of sand, Mix proportion	WC	S	S
3.	Sample preparation for finish and its approval	WC	W	S
4.	Neeru application on plaster (as applicable)	WC	S	-

5.	Hacking and cleaning the surface, removing loose particles, wetting the surface	WC	-	-
6.	Checking of plaster thickness, plumb & even surface	WC	S	-
7.	Check for grooves, openings, rounding off the corners, hollowness in plaster	WC	-	-
8.	Curing	WC	S	-
	INSPECTION & TEST DOCUMENTS			
1.	Review Test and Inspection Documents	WC	Rw	

CAT A: Area requiring special finish (e.g. pebble dash finish etc.)

CAT B: Balance works.

ITP NO:119

DOORS, WINDOWS AND VENTILATORS

SL. NO.	ACTIVITY	CONTRACTOR	VCS	
			CAT A	CAT B
1.	Incoming material inspection	WC	Note 1	Note 1
2.	Check for sections & dimensions	WC	S	-
3.	Line, level & plumb	WC	-	-
4.	Section joinery details	WC	Rw	-

5	Grouting with lugs/ dash fasteners	WC	-	
6	Check for fixtures & fittings	WC	S	S
7	Check for thickness & type of glazing	WC	-	-
8	Check for rubber gasket, anodizing (as applicable)	WC	-	-
9	Brand/ shade of paints, no. of coats including surface preparation	WC	S	Rw
	INSPECTION & TEST DOCUMENTS			
1.	Review Test and Inspection Documents	WC	Rw	Rw

NOTE: 1 For incoming material inspection please refer VCS Standard Specification No: SS-EA -001

CAT A: plant buildings
CAT B: Balance works

ITP NO:120

PAINTING (BUILDING WORKS)

SL. NO.	ACTIVITY	CONTRACTOR	VCS	
			CAT A	CAT B
1.	Completion of surface preparation	WC	-	-
2.	Incoming material inspection	WC	Note 1	Note 1

3.	Confirmation of colour, shade & brand	HP	-	-
4.	Check for number of coats and thickness	WC	S	-
5.	Curing, if any	WC	S	-
INSPECTION & TEST DOCUMENTS				
1.	Review Test and Inspection Documents	WC	Rw	Rw

NOTE: 1 For incoming material inspection please refer VCS Standard Specification No: SS-EA -001

CAT A: plant buildings

CAT B: Balance works

ITP NO:121

SANITARY FITTINGS

SL. NO.	ACTIVITY	CONTRACTOR	VCS	
			CAT A	CAT B
1.	Incoming material inspection	WC	Note 1	Note 1

2.	Checking of sample (as applicable)	WC	S	-
3.	Check completeness of finishing works w.r.t. line, level & position	WC	S	-
4.	Check proper fixing of the sanitary fittings to give aesthetic appeal	WC	S	-
5.	Check for leakage	WC	S	Rw
	INSPECTION & TEST DOCUMENTS			
1.	Review Test and Inspection Documents	WC	Rw	Rw

NOTE: 1 For incoming material inspection please refer VCS Standard Specification No: SS-EA -001

CAT A: Main plant buildings
CAT B: Balance works

ITP NO:122

WATER PROOFING (ROOF)

SL. NO.	ACTIVITY	CONTRACTOR	VCS

1.	Surface preparation for screeding/ water proof plastering	WC	W
2.	Mix proportion, thickness of screeding/ plastering & slope towards rain water pipes	WC	S
3.	Formation of groove at specified height on parapet wall	WC	-
4.	Incoming material inspection, no. of coats, application procedure and consumption.	WC	S/Note 1
5.	Termination of material in groove on vertical plane	WC	S
6.	Check for hollowness, bubbles in water proofing, if any	WC	S
7.	Conducting a sample of water proofing test by flooding the area for specified interval (as applicable)	WC	S
8.	Cleaning of surface	WC	-
9.	Submission of Guarantee in the requisite Performa	WC	Rw
	INSPECTION & TEST DOCUMENTS		
1.	Review Test and Inspection Documents	WC	Rw

NOTE: 1 For incoming material inspection please refer VCS Standard Specification No: SS-EA -001

ITP NO:123

FALSE FLOORING AND FALSE CEILING

SL. NO.	ACTIVITY	CONTRACTOR	VCS

	FALSE FLOORING		
1.	Manufacturers Test Certificate	WC	Rw
2.	Incoming material inspection	WC	Note 1
3.	Cleaning base floor	WC	-
4.	Painting base floor with Polyurethane based paint (as specified)	WC	S
5.	Proper line, level & layout	WC	S
	FALSE CVCSING		
1.	Manufacturers Test Certificate	WC	Rw
2.	Incoming material inspection	WC	Note 1
3.	Surface preparation of panel boards	WC	-
4.	Proper line, level & cut-outs	WC	S
5.	Painting of panel boards	WC	S
	INSPECTION & TEST DOCUMENTS		
1.	Review Test and Inspection Documents	WC	Rw

NOTE: 1 For incoming material inspection please refer VCS Standard Specification No: SS-EA -001

ITP NO:124

UNDER DECK INSULATION

SL. NO.	ACTIVITY	CONTRACTOR	VCS
1.	Incoming material checking including density	WC	Note 1
2.	Checking of adhesive, fasteners for anchorage	WC	S
3.	Fixing of scaffolding, ladders, platforms	WC	S
4.	Fixing of under-deck insulation with adhesive	WC	-
5.	Fixing of dash fasteners at defined spacing	WC	-
6.	Finishing	WC	S
	INSPECTION & TEST DOCUMENTS		
1.	Review Test and Inspection Documents	WC	Rw

NOTE: 1 For incoming material inspection please refer VCS Standard Specification No: SS-EA -001

ITP NO:125

ROOFING ACCESSORIES

SL. NO.	ACTIVITY	CONTRACTOR	VCS	
			CAT A	CAT B
1.	Incoming material inspection	WC	HP/Note 1	HP/Note 1
2.	Check for mitring, overhang, laps, etc.	WC	S	-
3.	Slopes line, level of sheets, barge boards, ridges & gutters, overhang of sheets	WC	S	-
4.	Bolting by drilling only, length of bolts, nos., anodizing and type of washers	WC	S	-
5.	Check for slopes of rain gutters, down take pipes, north lighting curves/ supports for gutters	WC	S	-
6.	Check for leakage/ passing of light	WC	S	-
	INSPECTION & TEST DOCUMENTS			
1.	Review Test and Inspection Documents	WC	Rw	Rw

NOTE: 1 For incoming material inspection please refer VCS Standard Specification No: SS-EA -001
2) Fixing arrangement need to be reviewed with respect to contract specifications.

CAT A: Important structures (e.g. Compressor House, Warehouse and Pump House etc.)

CAT B: Balance works.

ITP NO:126

LIGHTING WORKS (NON PLANT BUILDINGS)

SL. NO.	ACTIVITY	CONTRACTOR	VCS
1.	Prepare detailed conduit layout diagram as per the approved electrical drawing	WC	W
2.	Provide /PVC/GI sleeves in columns/beams at identified locations to facilitate laying of conduit on later date.	WC	S
3.	Ensure conduit & accessories material is inspected at site before using	WC	W
4.	Ensure that the conduit is laid in line with execution drawings & provide pull-wires as per requirement.	WC	S
5.	Check correctness of drop/JB locations	WC	S
6.	Check threaded joints are proper	WC	S
7.	Ensure all JB/Fan box are properly stuffed with jute	WC	S
8.	Ensure conduits are properly tied to reinforcement bars to prevent floating during concrete	WC	S
9.	Ensure proper supporting of conduit lengths wherever required	WC	S
10.	Ensure adequate chasing depth for conduit portion coming inside brick walls	WC	S
11.	Check workmanship towards joints and presence of any foreign material inside the conduits	WC	S
12.	Ensure wiring material is inspected at site before use	WC	W
13.	Ensure correctness of lighting wire size and no. of wires as per the drawing in each conduit portion	WC	S
14.	Preparation of "As Built" drgs.	WC	Rw
	INSPECTION & TEST DOCUMENTS		
1.	Review Test and Inspection Documents	WC	Rw

VOLUME C
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NORTH EAST GAS DISTRIBUTION LIMITED CITY GAS DISTRIBUTION PROJECT ELECTRICAL DESIGN BASIS For MANGALDOI MOTHER STATION					
C1	18.06.2026	ISSUED FOR TENDER	FJ	VV	AA
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1.0 CODES & STANDARDS

Electrical equipment and system design, manufacture, testing, installation and commissioning will comply with all the latest applicable standards, regulations and codes as mentioned below:

BIS	Bureau of Indian Standards
CIMFR	Central Institute of Mining and Fuel Research
OISD	Oil Industrial Safety Directives
IEEE	Institute of Electrical & Electronics Engineer
IER	The Indian Electricity Rules
ANSI	American National Standards Institute
BEE	Bureau of Energy Efficiency India
IEC	International Electrotechnical Commission

2.0 SITE CONDITIONS

A. Max/Min temperature	50°C/2°C
B. Relative Humidity	95%
C. Soil Resistivity	As per Soil Analysis report
D. Min. temp. for battery sizing	5°C
E. Altitude	Less than 1000M
F. Weather	Dry, dust storms in summer, humid / heavy rain fall during monsoon

3.0 AREA CLASSIFICATION AND EQUIPMENT SELECTION

Area Classification	Zone-I & II as per IS:5572
Gas Group	IIA & IIB
Temperature Classification	T3
Enclosure Protection of Equipment	
Installation Area	IP Rating of Equipment
Outdoor	
All Electrical Equipment	IP-65
Indoor	
UPS	IP-31 (Minimum)
MEDB	IP-42
Hazardous Area	
All electrical equipment	Flameproof (Ex-d)

4.0 POWER SUPPLY DETAILS	
Power Source:	
Mother Station	AC supply from local grid at 11 or 33 kV and stepped down to 415V, 3Phase, 4 Wire
Power Supply Parameters:	
Voltage	415VAC +/- 10%
Frequency	50Hz +/-5%
Phase & Wire	3Ph. & N (4W)
	1Ph. & N & E (3W)
Fault Level	25kA for 1 sec.- 3 Ph circuits
	10kA for 1 sec.- 1Ph Circuits
Neutral Earthing	Solidly Earthed
Back-up Power Source:	
Mother Station	Gas Generator Set
Critical Power Supply Details:	
MS	UPS Only
Loads envisaged on UPS	Instrumentation
	Fire Alarm and Gas Detection System
Load envisaged on Solar	Not Envisaged
Utilization voltage & Operating philosophy:	
SCADA	230V AC UPS and Non UPS feeder will be provided. Voltages as required for various systems will be generated from the 230V AC UPS supply. Necessary converters in dual redundant configuration and appropriate rating will be provided by the equipment vendor.
Instrumentation	
Electrical System	230V/415V AC from Grid Power Supply
Lighting/ventilation	At all locations 230V AC grid power supply
Fire Alarm system	230V AC UPS feeder will be provided. All AC to DC converters to meet the equipment requirements shall be in the scope of the equipment vendor
Note: All AC- DC converter required for various systems but not mentioned here are in scope of respective equipment vendor.	

5.0 EQUIPMENT/ELECTRICAL SYSTEM ENVISAGED AT:	
MS	a) 415V MEDB for receiving normal power at Receipt stations.
	b) Single Online UPS system (2 kVA) with static switch and SCVS bypass with SMF VRLA type battery bank (for 1 Hours back-up).
	c) Gas Engine Generator
	d) LT cables (Power and Control).
	e) Indoor & Outdoor lighting (Classified type)
	f) Earthing and Lightning protection system
	g) Local Control Stations (Classified type)
	h) Structural steel, cable tray, erection accessories etc. as required.
6.0 AIR CONDITIONING AND VENTILATION	
For Instrument /Control room	AC will be provided
For electrical room	Not required
For Battery Room	Adequate Ventilation through flameproof exhaust fans if placed in a separate battery room
7.0 DISTRIBUTION BOARDS	
MEDB	Fixed, Single front, floor mounted, IP-42 with surge protection device at the input terminals
UPSDB	Fixed, Single front, Wall mounted, IP-31 (min), with surge protection device at the input terminals
All panels shall be equipped for mod-bus communication for remote monitoring. All lighting feeders shall be fed through RCCB.	
8.0 UPS	
UPS type	Single Online UPS (1 x 100%) with SCVS bypass
9.0 UPS BATTERY	
Battery type	SMF VRLA
Back up time	1 hours
Battery execution	Single Bank 1x100% capacity

10.0 CABLES FOR ELECTRICAL SYSTEM

10.1 LT Power Cable (1.1 kV Grade)

Conductor Size	As per Design/SOR
Insulation	XLPE
Inner Sheath	Extruded ST2 Type
Armour	Steel Strip/Wire
Outer Sheath	Extruded FRLS ST2 Type
Voltage Grade	1100 V

10.2 Control Cable (1.1 kV Grade)

Conductor Size	As per Design/SOR
Insulation	XLPE
Inner Sheath	Extruded ST2 Type
Armour	Steel Strip/Wire
Outer Sheath	Extruded FRLS ST2 Type
Voltage Grade	1100 V

10.3 Lighting Cable

- 3 core 2.5 mm² stranded copper cable (YKY) will be used for flameproof fixtures.
- 3 core 2.5 mm² stranded copper cable (YKY) will be used from outdoor lighting DB to JB on the lighting poles and JB to lighting fixture. Flameproof Cable gland suitable for un-armoured cables shall be used for wiring/cabling from pole JB to FLP light fixture.

11.0 CABLING SYSTEM

Cable laying philosophy	
Paved area	Cable tray / RCC trench/ HDPE Conduit
Unpaved area	RCC trench / Directly buried
Inside Buildings	Cable trays / PVC Conduits
Type of cable trays	Galvanized prefabricated / Site fabricated and painted
Road Crossings	MS Conduits

12.0 EARTHING SYSTEM

A. Type of Earthing System	Conventional GI Pipe/Copper plate
B. Max Earthing Resistance	2
Note: Additional earth pits shall be provided if required as per IS: 3043.	
C. Size of Earthing Conductor	As per IS:3043

13.0 LIGHTING SYSTEM DESIGN

Lux Level shall be as follows:

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Area	Lux Level	Lighting Technology
Control room building	500	9W,12W,18W,36W LED Lights (Recessed/Surface fixtures)
Office	100	9W,12W,18W,36W LED Lights (Recessed/Surface fixtures)
Battery Room	100	1x40W FTL/LED Flame-proof lighting fixture (Recessed/Surface fixtures)
Electrical Equipment room	100	9W,12W,18W,36W LED Lights (Recessed/Surface fixtures)
Process Area, Pipe Racks etc.	60	LED With flame-proof fittings
Approach Area	50	LED Street Lights /Flood Lights

NOTES:

- All electrical equipment installed in hazardous area will be selected as per IS: 55
- All electrical equipment for hazardous area will have CMIFR and PESO certification
- All electrical fixtures for Hazardous area shall be classified type (Flame proof) as per the Area Classification given in this document and have approval of respective statutory agency as per the Petroleum Act, 2002.
- Applicable standard for HT Cables shall be IS-7098 Part I&II.
- Applicable standard for LT Cables shall be IS-7098 Part I&II.
- Applicable Standard for Control Cables shall be IS-7098 Part I.
- M.B. Lal Committee recommendation to be followed in all electrical design & installations.
- The equipment shall also confirm to the provisions of Indian Electricity rules and statutory regulations currently in force in the country.
- In case of any contradiction between various referred standards/specifications/data sheet and statutory regulations, the following order of priority shall govern.
 - Contract Agreement.
 - Detailed Letter of Acceptance along with Statement of Agreed Variation.
 - FAX/Letter of Intent.
 - Schedule of Rates as per enclosed LOA.
 - Job/Particular Specifications
 - Drawings
 - Technical/Material Specifications
 - Special Conditions of Contract
 - Instruction to bidders
 - General conditions of Contract
 - Indian Standards
 - Other applicable standards

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Energising Quality

PROJECT NUMBER: C241131



ELECTRICAL SCOPE OF WORKS

TOTAL
SHEETS

10

DOCUMENT NO.

C241131

MGS

EL

SOW

4002

NORTH EAST GAS DISTRIBUTION LIMITED

CITY GAS DISTRIBUTION PROJECT

ELECTRICAL SCOPE OF WORK

For

MANGALDOI MOTHER STATION

C1	18.06.2026	ISSUED FOR TENDER	FJ	AA	AA
REV	DATE	DESCRIPTION	PREP	CHKD	APPR

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1. INTRODUCTION

M/s North East Gas Distribution Company Limited (NEGDCL) is a consortium of Assam Gas Company Limited (AGCL) and Oil India Limited (OIL) having its registered office in 6th Floor, Central Mall, G.S. Road, and Guwahati.

VCS Quality Services Pvt. Ltd. has been appointed as Engineering Project Management Consultant by M/s NEGDCL to provide engineering consultancy services for setting up City Gas Distribution facilities in Assam and Tripura GA.

2. SCOPE OF WORKS (DESIGN, SUPPLY, INSTALLATION, TESTING & COMMISSIONING)

The CNG Mother station construction works are to be executed at Mangaldoi of Darrang district in Assam, India, awarded to NEGDCL by PNGRB.

The scope shall include construction of new CNG mother stations.

2.1. Scope for Mother Station (1 Nos 1200 SCMH GAS ENGINE DRIVEN COMPRESSOR)

Design, supply, installation, testing and commissioning of Electrical system comprising of the following: -

- 2.1.1 Supply & Installation of 11/0.433 kV, 63 KVA copper wound Distribution Transformer complete with all accessories and systems as mentioned below.
- 2.1.2 Distribution Transformer with Double Pole, Gang switch, overhead Conductor of suitable rating and all necessary accessories for completion of work including tapping from existing HT line etc. complete as per specification, SOR and requirement of approval from respective electricity/ statutory authority. All electrical work i.e., charging of transformer, pole mounted substation, tapping from battery limit of electricity board shall be carried out in supervision of respective authority including necessary approval, if required
- 2.1.3 Double pole structure with AB Switch, Lightning arrestors, horn gap fuse, copper wire jumpers up to transformer HT terminals.
- 2.1.4 ACSR conductor, 9m MS joint/ pole, Pin insulator and G I hardware etc. as required from respective state electricity board battery limit up to double pole structure inside customer premises.
- 2.1.5 Cables between transformer LT terminals of transformer & load break fuse switch unit, cable supports, double compression cable glands, lugs etc. as required.
- 2.2. 415V, 25 kA Single Front Indoor, fixed type, LT Panel to receive and distribute power to all electrical equipment etc. as per SLD No. C241131-MGS-EL-SLD-4001. Cable gland plate of suitable size & of minimum 3mm thickness shall be

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provided for cable termination, wherever required, for all the electrical panels (MEDB, UPSDB etc.). The MFM of MEDB shall have provision for energy metering also and valid calibration report shall be submitted of the same. Type1+Type2 Surge protection device to be provided for both incoming feeders. The MEDB should have provision to send signal to AMF panel during mains failure and on restoration of grid power to ensure auto ON/OFF of GG.

- 2.2.1. Single online UPS (1 nos. X 100% ratings+ SCVS bypass) 2 kVA, 230V, AC UPS with bypass The UPS shall be industrial type i.e., having three-phase input with automatic healthy phase selector and single-phase output. The UPSDB shall have a digital meter with provision to display current and voltage ratings. The UPS shall also have a RS-485 port for communication with SCADA.

1 No s. 1 X 100 % Sealed maintenance free (SMF) VRLA battery bank as per SOR for UPS suitable for charging with 1 hour battery back-up time, with isolator, battery rack, earthing of battery rack, complete.

Note: Contractor scope also includes the following:

Apart from battery racks, racks fabricated from structural steel to be provided for proper placing of UPS cabinets and SCVS bypass.

- 2.2.2. Power cable (XLPE insulated armoured Al/Cu conductor 1/ 2/ 3/ 3.5/ 4 core cables) as per SOR. FRLS cables shall be used for wiring of FLP fittings. Scope includes preparation of RCC/ Buried trench, conduiting in roof/walls as required, laying of GI/HDPE pipes and laying of cables in RCC/buried trenches, pipes and cable trays etc. along with termination of cables using cable glands of proper sizes. FLP (CMIFR tested, PESO approved) type double-compression nickel-plated brass cable glands, tinned- copper lugs, clamping material etc. shall be used for cable termination in FLP street lights.
- 2.2.3. HDPE pipes, GI Cable-trays and accessories like, cable markers, identifier tags, GI saddles and all other associated accessories for cable laying.
- 2.2.4. Supply, installation, testing and commissioning of 4 stage, 20kVAR APFC panel for power factor improvement.
- 2.2.5. Flameproof Lights suitable for outdoor and indoor lighting and flameproof exhaust fan for battery room as per SOR. GI poles of 7-meter height to be installed for street lights complete with swan neck/ bracket for lighting fixture mounting. FLP JB to be used for street light poles installed in hazardous area.

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- 2.2.6. Internal electrification works, including conduit work (PVC conduit to be laid in the concrete slab / other civil construction etc.), wiring, lighting fixtures, lighting and distribution boards, GI boxes, modular switches and sockets, complete with all accessories.
- 2.2.7. Complete conventional GI pipe/Copper plate earthing system as per SOR. Maximum resistance of earthing pit shall be 2 . Proper arrangement for disconnection of each pit shall be made in order to enable measurement of resistance of each pit.
- 2.2.8. Supply, installation, testing and commissioning of 58.5 kVA natural gas fueled generator with AMF panel. There shall be provision of transfer of power to GG set in case of mains failure and re- transfer to mains on restoration of mains supply.
- 2.2.9. Safety materials and Insulated Rubber Mats to withstand High Voltages as per IS 15652 to be placed in front of all Electrical panels. Safety materials as per SOR complete with all accessories required.
- 2.2.10. Emergency shutdown button to be provided in sales/office room. The button shall trip the incomer to MEDB.

Note: SLD attached with tender documents having SLD No. C241131-MGS-EL-SLD-4001 are for tender purpose only. The Bidder shall furnish detailed SLD as per the requirements of the system. Any change, Modifications, Addition/Deletion occurs later due to system requirements shall deem to be inclusive in the price quoted by the bidder, no extra cost shall be paid for the same.

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2.3. SCOPE OF DESIGN, ENGINEERING & RESIDUAL ENGINEERING

- 2.3.1. Submission of electrical equipment design calculations (Lighting, Earthing & Lightning, PDB, LDB etc.), Complete SLD with control scheme, detail engineering, various drawings/layouts for review and approval, preparation of cable schedules, BOM, preparation of site engineering drawings and details for installation works wherever applicable or required by the Engineer-in-charge, and submits to the Engineer-in-charge for review.
- 2.3.2. Updating and submission of all AS-BUILT drawings for all works done is in the contractor's scope.
- 2.3.3. Obtaining clearance for energizing the complete electrical facilities covered under this tender and approval of installation and drawings from the Chief Electrical Inspector of the State Government/Central Electricity Authority and other statutory authority as required. This includes equipment installed or commissioned by others within the battery limit. This is for obtaining a comprehensive approval in one go.

3. OTHER MISCELLANEOUS WORKS

- 3.1.1. Preparation of buried cable trenches, including, back filling, compacting providing of brick protection by second-class bricks, spreading of fine river sand, including all supplies.
- 3.1.2. The job includes repairing of all civil works damaged during installation of electrical facilities.
- 3.1.3. The scope of work under this contract shall be inclusive of breaking of walls, floors and chipping of concrete foundations necessary for the installation of equipment, materials, and making good of the same.
- 3.1.4. Minor modifications wherever required to be done in the owner free supplied equipment / devices to enable cable entry, termination, etc.
- 3.1.5. Sealing of opening made in the walls / floors for cables trays, cables, bus ducts, etc. using acceptable practice and standards.
- 3.1.6. Supply and installation of all other accessories not specifically mentioned herein, but never the less necessary for completion of the job.

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- 3.1.7. Proper Electrical Signages 415V / DANGER etc. to be displayed on the body of Electrical panel units, rooms and Equipments.

4. AREA CLASSIFICATION

Hydrocarbon handling areas have been generally classified as zone 1 & 2, gas group IIA/IIB as per IS: 5572 and OISD - 113 and IP Rules. All equipment to be installed in these areas shall be suitable for the area classification with temperature class T3, and be approved by CCOE/PESO.

5. JOB SPECIFICATIONS

Various electrical works covered under this contract like equipment erection, cabling, lighting and grounding works, etc. shall be performed in accordance with specifications attached with this tender.

Erection and commissioning of equipment shall be performed in accordance with supplier's instructions and directions of the Engineer-in-charges.

The equipment/materials to be supplied by the Bidder shall conform to the requirements of the applicable specifications enclosed in the tender document.

6. STATUTORY APPROVAL OF WORKS

All works relating to statutory approvals of the complete installation, from competent authority like CEA, DGMS, State electricity Authority/Board etc., shall be in the scope of Bidder.

The application on behalf of the owner for submission to Electrical Inspector etc. along with copies of required certificates and drawings, complete in all respects, shall be prepared by the Bidder and submitted to the Engineer-in-charge for onward transmission well ahead of time so that the actual commissioning of equipment is not delayed for want of inspection by the Electrical Inspector. The actual liaison work shall be arranged by the bidder and necessary coordination and liaisons work in this respect shall be responsibility of the Bidder. However, the Owner on submission of bills along with documentary evidence shall reimburse any fee paid to the statutory Authority in this regard.

7. MAKES OF EQUIPMENT AND MATERIALS

All equipment / materials supplied by the Bidder shall be as per the approved vendor list enclosed with this document subject to submission of Certification and approvals.

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8. INSPECTION, TESTING & COMMISSIONING

- 8.1 All the equipment supplied and installed by the Bidder shall be tested and commissioned, as required and no separate payments shall be made for the same. Any damage or defect noticed shall be brought to the notice of the engineer-in-charge and shall be rectified without any delay and no payments shall be made for rectification.
- 8.2 Any work not conforming to the execution drawings, specifications or codes shall be rejected forthwith and the Bidder shall carry out the rectification at his own cost.
- 8.3 The Bidder shall carry out all the tests as enumerated in the technical specifications and as per applicable codes and standards.
- 8.4 Before the electrical system is made live, the electrical Bidder shall carry out suitable tests to establish to the satisfaction of engineer-in-charge that the installation of equipment, wiring and connections have been correctly done and are in good working condition and that it will operate as intended.
- 8.5 All the tests shall be conducted in the presence of Owner/ Engineer-in-charge or his authorized representative unless he waives this requirement in writing. The Bidder shall arrange all testing equipment necessary to carry out the test. The tests shall be recorded on approved Performa and certified records of the tests shall be submitted to Owner/ Engineer-in-charge.
- 8.6 After the completion of all tests and rectification of all defects pointed out during final inspection, plant start-up trials would be commenced. During the start-up trials Bidder shall provide skilled / unskilled personnel and supervision round the clock at his cost. The number and category of workmen and duration up to which required, will be decided by the Engineer-in-charge. Any defects noticed during the start-up trial relating to the equipment supplied and work carried out by the Bidder, will be rectified by the Bidder at his own cost.
- 8.7 Engineer-in- charge shall have the right to get these defects rectified at the risk and cost of the Bidder if he fails to attend to these defects immediately as desired.
- 8.8 No materials shall be supplied without TPI inspection release and O er s dispatch clearance.

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9. DRAWINGS, STANDARD SPECIFICATIONS AND INSTALLATION STANDARDS

- 9.1 The equipment / materials to be supplied by the Bidder shall conform to the requirements of the applicable specifications. Also, the installation of various material / equipment shall conform to the installation standards / norms.
- 9.2 The drawings accompanying the tender documents when read with specification shall depict the electrical system of the station. These are indicative of the nature of work and issued for tendering purposes only. Purpose of these drawings is to enable the tendered to make an offer in line with the requirements of the Owner. Construction shall be as per drawings / specifications issued / approved by the Engineer-in-charge during the course of execution of work.
- 9.3 Conduit layout drawing in ceiling, wherever required, to be prepared by the Bidder and shall be submitted for approval.
- 9.4 After the job completion, Bidder shall prepare AS-BUILT drawings and documents, submit catalogues/manuals (O&M) of major brought out items like Inverter, HT Substation, Lighting fixture etc. Final certified as built drawings, documents and manuals etc. shall be submitted by the Bidder to owner in bound volume with one set in soft copy (CD) plus five sets of prints.

10. MEASUREMENT AND TEST EQUIPMENT

Wherever testing and measurement is required, Contractor shall propose a list of measurement and test equipment in his procedure and shall demonstrate that sufficient equipments will be allocated for all concurrent tasks. All measurement equipments shall be fit-for-purpose and, for each piece of equipment, the Contractor shall provide documentation of current third-party calibration by a recognized independent certified testing house.

11. SITE ACCEPTANCE TESTING

The Contractor shall implement procedures and Inspection and Test Plans (ITPs) and, in accordance with the vendor documentation, shall complete Site Acceptance Testing (SAT). All equipment shall pass SAT and the Contractor shall submit SAT documentation in order to obtain approval of the Engineer-In-Charge (EIC) to proceed for further installations commissioning.

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12. CO-ORDINATION WITH OTHER CONTRACTORS

Owner shall be engaging with other contractors/agencies for performance of other works associated with other composite works. It shall be the responsibility of contractor to communicate, co-operate, co-ordinate and provide assistance to such agencies and sort out all interface issues in consultation with Engineer-in-Charge, for carrying out scope of work of system. The Contractor shall appoint a representative to meet weekly with other contractor's representatives in the presence of the Owner/consultant. The contractor in meeting shall provide the locations to determine programming for construction and commissioning activities such that the Owner's needs for co-ordination for other contractor is not disadvantaged by other contractor's activities.

Contractor shall be entirely responsible for Co-ordination with other contractors to ensure timely execution of station works.

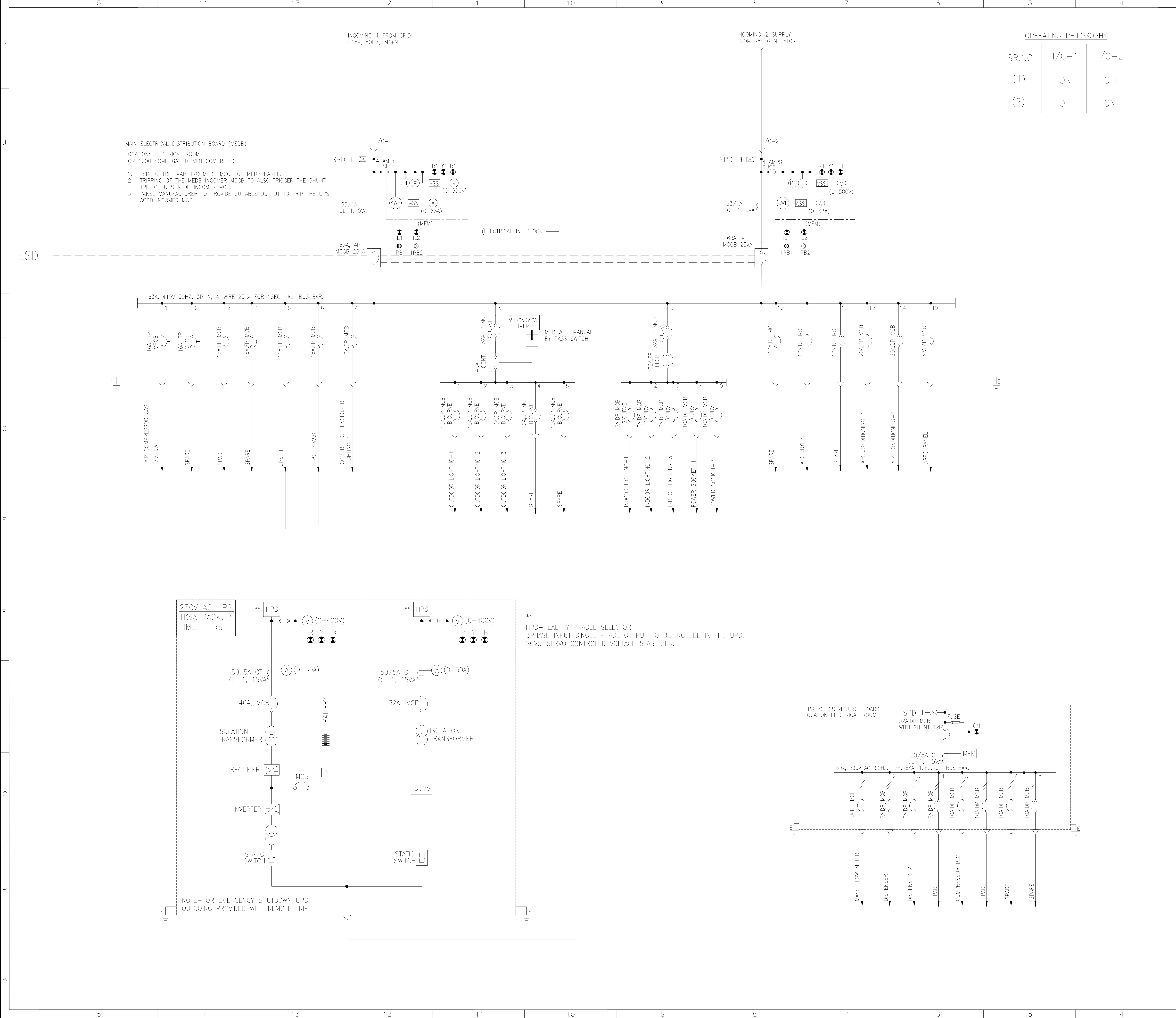
The contractor shall plan his activities requiring interfacing with other contractors / agencies well in advance and provide details to the other contractors / agencies at least one month in advance so that all interface issues can be resolved prior to actual execution of the work. All delays on account of such interface problems arising out of non-co-operation / lack of coordination by the Contractor shall be to Contractor's account.

If the contractor fails to timely execution of the station work, necessary penalty clause shall be applied as per the direction of the Engineer-in-Charge.

13. SAFETY

The Contractor shall be responsible for implementation of a project specific Safety and Health Management Plan immediately after award of work, in line with statutory requirements. The Contractor shall be responsible for the safety at all sites including all travel to the sites and any remote offices. The safety plan shall be in compliance to local and government safety requirements, approvals and standards and Owner's safety manual. Contractor shall depute experienced and sufficiently trained safety personnel at site throughout the project phase.

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OPERATING PHILOSOPHY		
SR.NO.	I/C-1	I/C-2
(1)	ON	OFF
(2)	OFF	ON

ELECTRICAL LOAD LIST		C241131-MGS-EL-LST-4001
ELECTRICAL DESIGN BASIS		C241131-MGS-EL-DB-4001
1. ALL ELECTRICAL EQUIPMENT BE TROPICALISED IN COMPLIANCE WITH LOCAL SITE CONDITION 2. R.Y.B. INDICATIONS ARE FEED TO SCADA SYSTEM FROM MEDB FOR PANEL 3. THE CAPACITOR BANK FEEDER SHALL BE USED FOR FUTURE POWER FACTOR IMPROVEMENT. 4. THE SIZE OF ALL INSTRUMENTS SHALL BE 95mm x 95mm FOR FULL & HALF SIZE MODULES AND 72mm x 72mm FOR LOWER SIZE MODULES. 5. ALL AMMETER & VOLTMETERS SHALL BE DIGITAL TYPE AND OF CLASS 1 ACCURACY 6. POWER & CONTROL CABLES SHALL BE 1.1kV GRADE. STRANDED COPPER / ALUMINUM CONDUCTOR. PVC INNER SHEATH & PVC OUTER SHEATH WITH FRLS CHARACTERISTICS CABLES SHALL CONFIRM TO IS:7098. 7. OUTDOOR ELECTRICAL MATERIALS SHALL BE PROVIDED IN COMPLIANCE WITH THE RELEVANT HAZARDOUS AREA CLASSIFICATION. 8. ALL INDOOR DB'S SHALL BE PROVIDED WITH IP42 PROTECTION AND FOR OUTDOOR IP65. 9. MCCB'S SHALL BE 4P, 25KA AND MCB'S SHALL BE DP, 6KA. 10. PANEL TO HAVE PROVISION FOR AUTO START/STOP OF DG/IG SET ON FAILURE OF GRID SUPPLY. 11. THE MFM METER IN THE MEDB SHOULD HAVE RS-485 PORT FOR COMMUNICATION WITH SCADA SYSTEM. 12. BOTH INCOMER MCCB MUST HAVE AUXILIARY CONTACTS TO INDICATE (OFF) OPEN/(ON) CLOSED STATUS IN SCADA. 13. THE UPS MUST HAVE RS-485 PORT ENABLED TO COMMUNICATE WITH SCADA.		
S.NO.	LEGENDS	DESCRIPTION
1.	CP/TR	CATHODIC PROTECTION TRANSFORMER RECTIFIER UNIT
2.		RECTIFIER
3.		SWITCH
4.		BATTERY
5.		INVERTER
6.		INDICATION LAMP
7.		PUSH BUTTON
8.		FREQUENCY METER
9.		POWER FACTOR METER
10.		VOLTMETER
11.		AMMETER
12.		ENERGY METER
13.		AMPERE SELECTOR SWITCH
14.		VOLTAGE SELECTOR SWITCH
15.		ELECTRICAL INTERLOCK
16.		SOLID STATE VOLTAGE STABILIZER
17.		MCCB
18.		MCB
19.		CONTACTOR
20.		CURRENT TRANSFORMER
21.		ISOLATION TRANSFORMER
22.		MULTIFUNCTION METER
23.		EARTH
24.		OVER LOAD
25.		SHORT CIRCUIT
26.		NO. OF CORE IN CABLE
27.		STATING POINT
28.		ISOLATOR
29.		BEST PHASE SELECTOR
30.		SPD

FOR TENDER

C1	18.06.2026	ISSUED FOR TENDER	SH	FJ	AA
REV.	DATE	DESCRIPTION	PREP.	CHKD.	APPD.
CLIENT:		NORTH EAST GAS DISTRIBUTION COMPANY LIMITED (NEGDC)			
PMC:		VCS QUALITY SERVICES PVT. LTD. UNIT NO. 1116 - 1121, TOWER 4, ASSOTECH BUSINESS CRESTERRA, PLOT NO. 22, SECTOR-135, EXPRESSWAY NOIDA-201301, UTTAR PRADESH			
PROJECT:		CITY GAS DISTRIBUTION PROJECT IN ASSAM			
TITLE:		SINGLE LINE DIAGRAM FOR MANGALDOI MOTHER STATION			
SCALE:	NTS	TOTAL NO. OF SHTS:	SHT.NO		
SIZE	JOB NO.	DRAWING NUMBER			REV.
A1	C241131	C241131-MGS-EL-SLD-4001			C1



Energising Quality

VCS Quality Services Pvt Ltd

**STANDARD SPECIFICATION
FOR
DISTRIBUTION TRANSFORMER**

VCS – SS – EL – 4002S

02	05.03.2022	SP	RD	AA	HK
01	16.10.2019	MG	VV	AD	SK
00	05.07.2017	MG	RD	AD	SK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY : **If printed**

CONTROLLED COPY : **If in soft and signed**

1. INTENT

- a) The intent of this standard specification is to define the general requirements for design, manufacture, assembly and testing at manufacturer's works, packing, transportation and receipt at site with all materials and accessories of distribution transformer.
- b) Tenderer to refer separate Technical Specification (TS) / SOR item details for following minimum details / requirements as part of the project needs:
 - A. Voltage grade, kVA rating and quantity of transformer
 - B. Rated voltage and frequency along with %age variations as per plant specification
 - C. Location of transformer
 - D. List of spare items

Any other item / component / equipment / accessories / services as necessary for satisfactory completion of the project shall also be covered in separate Technical specification (TS) / SOR item.

2. CODES & STANDARDS

The transformers shall comply with the latest edition of the following and other relevant Indian standards. In case transformer is supplied by foreign manufacturers relevant international standards shall be applicable.

IS: 2026 (Part I to IV)	Power transformers
IS: 355	Insulating oil
IS: 1271	Classification of insulating materials
IS: 2099 & IS: 3347	Bushing
IS: 2705	Current transformers
IS: 6600	Guide for loading of oil immersed transformer
IS 9147	Cable sealing boxes for oil immersed transformers
IS: 10028	Code of practice for selection, installation and maintenance of transformers
IEC 76	Transformers
IEEE	Recommended practice for electrical power distribution (Std. 141) for industrial plants.

Transformers shall also confirm to the provisions of the latest revisions of the Indian Electricity rules and any other statutory regulations currently in use.

- 2.1** Wherever the requirements in this specification are in conflict with any of the above Standards, the requirements under this specification shall be binding.
- 2.2** In case any contradiction between various referred standards/specification/data sheets and statutory regulation etc. the following order of priority shall be govern -
- 2.2.1 Schedule of rates
 - 2.2.2 Design Basis
 - 2.2.3 Scope of work/Job specification
 - 2.2.4 Data Sheet
 - 2.2.5 Standard specification
 - 2.2.6 Codes & standard

3. ENVIRONMENTAL CONDITIONS

The transformers shall be designed and constructed for continuous operation at full load under the climatic and environmental conditions as described in the specification "Design Basis-Electrical".

4. TECHNICAL DATA

The technical data of the transformers are defined in the data sheets. The Contractor has to guarantee the fulfillment of these requirements.

4.1. GENERAL REQUIRMENTS

4.2. Components and Equipment

The Contractor has to take care that all components and equipment are selected considering easy maintenance, simple and quick diagnosis and long maintenance intervals.

All components and equipment shall be designed for continuous duty at rated load and under the given climatic conditions. Standard industrial high-performance systems and components of supplier's standard lists shall be used as far as possible. Components and equipment of same kind and type shall be selected for equivalent functions. The interchangeability must be guaranteed.

4.3. Tagging

All components, equipment and installations shall receive the

respective tagging plates, labels etc. which have to be of extremely durable material resistant against the environmental conditions. For further requirements, reference is made to specification “Design Basis-Electrical”.

4.4. TECHNICAL REQUIREMENTS - EQUIPMENT

4.4.1. OIL TYPE DISTRIBUTION TRANSFORMER

4.4.1.1. Electrical Design

- Generally as per IS 2026 - 1977.
- 3 phase, core type, oil filled
- Rated output, voltage ratio, vector group shall be as specified in technical particulars for design.
- Rated frequency 50 Hz, + 4%, -6%.
- Insulation level shall be designed according to the voltages specified below.

Sl. No.	Description	415V System	3.3 kV System	6.6 kV System	11 kV System	33 kV System
1.	Nominal system voltage (kV)	0.415	3.3	6.6	11	33
2.	Max. system voltage (kV)	0.433	3.6	7.2	12	36
3.	One minute power frequency withstand voltage (kV)	3	10	28	35	75
4.	Peak impulse test withstand voltage (kV)	-	40	60	75	170
5.	Clearance in Air (mm)					
	Phase to Earth	25	60	100	120	Specify
	Phase to Phase	32	75	120	150	
6.	External Clearance for			Specify		
	LV bushings in Air (mm)	40				
	HV bushings in Air (mm)	75				
	Phase to Earth				240	320
	Phase to Phase				255	350
7.	Clearance in Air (mm) for transformers with air filled cable-end box/connection chamber, the phase to-phase					
	Phase to Earth	20			80	220
	Phase to Phase	25			130	350

- Transformer shall be capable of delivering rated current at an applied voltage up to 105% rated voltage without exceeding the temperature limits.
- Overload capacity of the transformer shall be as per IS 6600 - 1972 unless

otherwise specified.

- Shall be operable at its rated capacity at any voltage within + 10% of rated voltage of the particular tap.
- Permissible maximum temperature at rated output and principal tap at the ambient temperature of 50 deg. C

a)	Top oil (by thermometer)	85 deg C
b)	Windings (by resistance method)	95 deg. C
c)	Maximum hot spot temperature	105 deg. C

Transformers shall be designed to withstand the thermal and dynamic stresses due to short circuits at its terminals. The duration of short circuit shall be 5 seconds.

- The maximum temperature at the end of the specified duration shall not be more than 250 deg. C with the temperature prior to short circuit corresponding to maximum permissible overload.
- Designed for suppression of harmonics especially 3rd and 5th.
- All transformers shall be located outside the bay in Transformer pen with road access and transformer removal through a truck entry. Necessary provision for Transformers Transportation, Heat dissipation & oil drainage shall be taken care of by Tenderer. All transformers located outside the bay shall be connected with the ECR through necessary cable tunnel / cable trench/ cable basement.
- Transformer shall be designed for a maximum flux density of 1.6 Tesla at 110% primary voltage. Magnetizing current shall be limited to 1%.
- Transformer shall have necessary signal interface to Plant automation system. Operation status of transformer shall be input to fault diagnosis system of automation. So sufficient signal contacts shall be provided on transformer side.
- Grilled door with wicket entry door for ONAN transformer shall be provided along with necessary ventilation (preferably exhaust fans).

4.4.1.2. Magnetic Circuit

- Low loss CRGO silicon steel shall be used.
- Laminations shall be annealed in a non-oxidizing atmosphere to relieve stresses and restore the original magnetic properties of CRGO sheets after the

cutting and punching operations.

- CRGO sheets shall be coated with insulation varnish compatible with the sealing liquid.
- Insulation to withstand annealing temperature as high as 850 Deg. C and shall reduce eddy current to minimum.
- Ducts to be provided to ensure adequate cooling.
- Core, framework and clamps arranged and tightened to securely hold laminations in order to prevent any settling or displacement in case of heavy shocks during transport, handling or short circuits.
- Flux density under specified over voltage or frequency conditions shall be within the maximum permissible for the laminations.
- Transformers shall be designed to withstand 110% over fluxing corresponding to rated voltage.

4.4.1.3. Windings

- Material shall be electrolytic grade work hardened copper of high proof stress with more numbers of radial supports.
- Shall be pre-compressed, press board, pre-stabilization of coil.
- Completed core and winding to be vacuum dried in full vacuum and impregnated immediately.
- Shall be braced to withstand shocks due to rough handling, and forces due to short circuit, switching or other transients.
- Permanent current carrying joints in winding and leads shall be brazed.
- Coils shall be supported using dried and high-pressure compressed wedge type insulation spacers.
- Insulating materials shall be compatible with transformer liquid under all service conditions.
- Leads to the terminal board and bushings shall be rigidly supported.

4.4.1.4. Insulation

Inter turn and inter coil insulation shall be designed such that dielectric stress is uniformly distributed throughout the windings under all operating conditions.

4.4.1.5. Tank

- Welded thick gauge plates stiffened and reinforced to withstand without deformation all stresses applied during transport and operation or short circuit conditions.
- Oil tight welds and joints
- Fully assembled transformer with its radiators, conservator and other fittings shall withstand for one hour a pressure corresponding to twice the normal head of liquid or to the normal pressure plug 35 kN/sq. m, whichever is higher, measured of the base of the tank.
- Plates shall be protected internally against corrosion due to insulating liquid.
- Provided with inspection opening and cover/(with handling equipment) to provide access to bushing connections.
- Form of cover shall be such as to prevent any stagnant water deposit and to drain gas bubbles towards the Buchholz relay
- Tank (with radiators when welded to tank) shall be capable of withstanding of 250 mm of mercury vacuum.

4.4.1.6. Conservator and Breather

- Conservator mounted on frame, integral with tank in such a manner that under all conditions and the lowest oil level the bushings remain under the head of liquid.
- Conservator volume shall be sufficient to maintain oil seal from ambient to oil temperature of 90 deg. C
- Oil filling hole with cap and a drain valve to drain the oil completely shall be provided. One end of the conservator shall be bolted into position so that it can be removed for cleaning purposes.
- Silica gel breather with inspection window and oil seal shall be mounted at 1.4 m from ground level and connected to conservator.
- Prismatic type oil level gauge with maximum and minimum levels marked. One 150 mm diameter dial type magnetic level gauge with alarm and trip contacts shall also be provided.

4.4.1.7. Buchholz Relay

- Double float relay as per IS 3677 - 1985.
- Shut off valves on either side of the Buchholz relay

- Pot cocks at the top and bottom of relay drain plug, inspection window, calibrated scale, terminal box with oil tight double compression type brass gland.
- Potential free, self-reset independent alarm and trip contacts, rated to make, break and carry minimum 2 amps at 220 V DC. No auxiliary relay shall be used to multiply the contacts. Contacts are to be wired to the marshalling box.
- All alarm and trip contacts of transformer fault shall be wired to HTCB directly and individually.

4.4.1.8. Cooling

4.4.1.8.1. General

The cooling system provided may be either of the following or a mixed system of these, as specified.

- ONAN - Oil Natural, Air Natural

4.4.1.8.2. Radiators

Radiators may be detachable type directly mounted or separately mounted flanged, gasketed and bolted connections shall be used for connecting the radiators to the tank.

The following accessories shall be provided for each radiator/radiator bank:

- a) Top and bottom shut off valves and blanking plates.
- b) Bottom drain plug and top filling plug, air release plug
- c) Lifting lugs
- d) Thermometer pockets with thermometers in the inlet and outlet pipes (for separately mounted radiator banks).
- e) Top and bottom filter valves for each separately mounted radiator bank.

4.4.1.8.3. Forced Air System

- The fans shall be mounted in a suitable enclosure to ensure protection against rain.
- Galvanized wire mesh guard shall be provided.

4.4.1.9. Valves and connections

- Valves of sluice type with hand wheels
- Made of gun metal

- Clear indication of open and closed position
- Provided with blanking plates or screwed plugs
- Padlocking facility to lock in closed/open position.

4.4.1.10. Terminations

It shall be possible to withdraw the transformer easily after disconnecting the connections without disturbing the cable terminations.

For cable termination

- Air insulated cable box suitable for the type and number of cables specified.
- Air insulated disconnection chamber with inspection opening
- Compression type brass cable glands with tinned copper lugs
- Bolted type gland plates.
- Sealing kits with associated accessories like stress relieving cones, insulating tape, trifurcating boot, HT insulating tape, etc.

For bus duct termination

- When bus duct termination is specified, flanged throat shall be provided to suit the bus duct. Flange ends and inspection openings shall have weatherproof gaskets.

4.4.1.11. Bushings

- Conforming to IS 3347 Part 5 - 1979, Part 3 - 1988 and 2099 - 1986.
- Minimum rated current of line and bushings shall be 1.5 times rated current of the corresponding windings
- Clamps and fittings made of steel or malleable iron shall be hot dip galvanized.
- Bushings rated 400 Amps and above shall have non-magnetic clamps and fittings only.
- Neutral bushings shall be provided as required for earthing of neutral point.

4.4.1.12. Bushing current Transformers (Where applicable)

- CTs for earth fault shall be provided on the neutral end.
- Removable at site without opening transformer tank cover/active parts.
- Secondary leads shall be brought to a weatherproof terminal box and from there to the marshalling box.

4.4.1.13. Oil temperature Indicator

- 150 mm dial type thermometer with manual reset maximum reading pointer. There shall also be two potential free contacts for alarm and trip signals. The alarm and trip settings shall be independently adjustable. The temperature sensing element mounted in a pocket of oil shall be connected to the indicator through capillary tubing. Contact rating at 110V DC shall be minimum 2 amps. All alarm and trip contacts of transformer fault shall be wired to HTCB directly and individually.

4.4.1.14. Winding Temperature Indicator

- a) Local winding temperature indicator (WTI) shall have a 150-mm diameter dialtype indicator with a manual reset maximum reading pointer. There shall be two potential free contacts for alarm and trip signals. For transformers with forced cooling, another set of contacts shall be provided to start/stop the forced cooling system automatically. The settings for closing/opening of each contact shall be independently adjustable. Contact rating at DC11, 220 V DC shall be minimum 2 amps. The device shall be complete with lamp, sensing element, image coil, calibration device, auxiliary CTs etc. as required.
- b) Remote winding temperature indicator with resistance type temperature detector shall be provided additionally.
- c) All alarm and trip contacts of transformer fault shall be wired to HTCB directly andindividually.

4.4.1.15. Marshalling box

- a) All outgoing connections from the transformer i.e., Buchholz relay, temperature indicators, level indicators, CT secondary, fault contacts for annunciation, shall bewired to a marshalling box.
- b) Degree of protection of enclosure shall be minimum IP 52 for indoor and IP 55 foroutdoor type transformers.

4.4.1.16. Earthing

- All metal parts of the transformer with the exception of individual core laminations, core bolts, and clamping plates shall be maintained at fixed potential by earthing.
- Two tinned copper earthing terminals to be provided
- One end of bushing CTs shall be earthed.

4.4.1.17. List of fittings and Accessories

- Identification plate
- Rating and diagram plates (kVA rating, No load HV/LV voltage, Amperes – HV/LV, Insulation level HV/LV, Type of cooling, frequency, Impedance HV/LV, Vector group & diagram, Weight of core & winding, weight of oil & total weight, Oil in liters, year of manufacture, Tapping positions & CT details etc.)
- HV Box & LV Boxes with bottom support channel.
- First fill of oil as per IS-335, 1993 with 10% excess in drums
- Cooling system complete with accessories as specified
- Off-circuit tap switch as specified
- Conservator with oil level gauge
- Silica gel Dehydrating breather
- Buchholz relay with alarm and trip contact
- Oil filter valves at top and bottom of tank
- Drain off valve at lowest location to allow complete draining
- Oil sampling device at top and bottom
- Pressure release device
- Pockets with thermometers for oil temperature and winding temperature indicators
- Bar type level gauge with alarm contacts
- HV, LV and neutral bushings.
- Bushing CTs as specified
- Dial type winding temperature indicator with maximum reading pointer and alarm and trip contacts
- Tank Lifting lugs with complete transformer
- Jacking pads with hauling eyes
- Earthing terminals/earthing pad/earthing bar with pin type epoxy insulator
- Inspection window with cover
- By-directional rollers/flanged wheels as specified
- Marshalling box.
- Assignment for foundation details

4.4.1.18. Off-Circuit Tap Switch

- i) Externally hand operated with easily accessible links.
- ii) Designed for sustained over current of at least 150% of the rated current of the winding.

- iii) Shall not occupy any intermediate position between clearly marked tap position.
- iv) Capable of repeated operation and withstanding short circuit forces.
- v) Tap position indication diagram
- vi) Inspection and/or repair shall not require removal of transformer core from tank.

4.4.1.19. List of Spares as part of supply:

- i) Bi-directional flat rollers
- ii) Porcelain Bushings
- iii) Buchholz relay
- iv) Magnetic oil gauge
- v) Silica gel breather
- vi) Pressure relief valve
- vii) Radiator valve
- viii) Tap changer contacts
- ix) Temperature sensors
- x) Oil level/flow indicator
- xi) Terminal lugs
- xii) Gaskets etc.

Itemized unit prices for the following spares shall be indicated in the offer. Recommended quantities for two years of operation shall also be indicated in the offer.

4.5. Technical Particulars

Particulars	KVA Rating
Specification	IS 2026, Part I - 1977 Part II - 1977 Part III - 1981 Part IV - 1977
Type	Three phase, core type, oil filled
Duty	Indoor
Voltage HV/LV	33 or 11 or 6.6 / 0.433 kV
Frequency	50 Hz
No. of phase	3
Continuous rating	KVA rating
Insulation class	Class A
Cooling	ONAN
Winding connection	Delta / Star

Vector group	Dyn 11
LV Neutral grounding	Solidly earthed
System earthing	33Kv – unearthed/ resistance earthed as per plant guidelines
	11 kV – unearthed/ resistance earthed as per plant guidelines
	6.6 kV – unearthed/resistance earthed as per plant guidelines
	415 V - Solidly earthed
Percentage impedance	As per IS:2026 – Part – I – Latest revision
Termination	33Kv or 11kV or 6.6 kV – Cable
	415 V –Busduct/ LT cable as per TS

Particulars	KVA Rating
Temperature rise over 50 deg C ambient temp	
Particulars	KVA Rating
a) Top oil (measured by Thermometer)	35 deg C
b) In winding (measured by Resistance method)	45 deg C
Tap changer	Off Circuit on primary side
Range	±5%
Total tap positions	5
Taps above nominal voltage	2
Taps below nominal voltage	2
Voltage per step variation	2.5 %
Tap change controls	Local Manual
Impulse test withstand voltage	As per IS 2026, Part III- Latest revision
One minute dry and wet power frequency withstand voltage	- do -
Induced over voltage withstand voltage	- do -
Withstand time without injury for 3 phase short circuit at terminals	5 Secs.
Parallel operation	Suitable for parallel operation with transformers of similar ratings
Short circuit level designed for H.V terminal	As per short circuit calculation
LV neutral bushing CT for E/F protection	1 no.
Auxiliary supply voltage overload capacity Radiators	240V AC As per IS 6600-1972 Detachable type

4.5.1 Details to be furnished in datasheet of transformer:

- I. Name of manufacturer
- II. Service
- III. Standard
- IV. kVA rating
- V. Rated voltage (HV/LV)
- VI. Rated Current (HV/LV)
- VII. Rated Frequency
- VIII. Number of phases
- IX. Connection (HV/LV)
- X. Vector group

- XI. Tappings (Range & number of taps)
- XII. Ambient temperature, Temperature rise of oil, winding & hot spot temperature
- XIII. Type of cooling
- XIV. Total loss at rated voltage at principal tapping, rated current and frequency (in kw).
- XV. Component losses (No-load losses & load losses)
- XVI. Impedance voltage at rated current for principal tapping
- XVII. Reactance at rated current & at rated frequency
- XVIII. Insulation level:
- XIX. Power frequency withstand voltage (HV/LV)
- XX. Induced over voltage withstand voltage
- XXI. No load current at rated voltage & rated frequency
- XXII. Flux density @100% & @110% of rated voltage
- XXIII. Current density
- XXIV. Efficiency at 75 deg C at UPF at full load/ 75% load / 50% load
- XXV. Regulation at full load at 75 deg C at UPF, 0.8PF
- XXVI. Class of insulation of winding
- XXVII. Type and details of insulation material
- XXVIII. Material of conductor
- XXIX. Core Lamination
- XXX. HV Bushing – Rated voltage & current
- XXXI. LV Bushing – Rated voltage & current
- XXXII. Neutral Bushing - Rated voltage & current
- XXXIII. Weights – Core & winding. Tank fittings & accessories, Transformer oil & Total weight
- XXXIV. Overall dimensions (Length, breadth & height)
- XXXV. Un-tanking height
- XXXVI. Painting
- XXXVII. Minimum air clearance – Phase to phase & Phase to earth
- XXXVIII. Maximum efficiency
- XXXIX. Load at which maximum efficiency occurs (%age of full load)
- XL. Short time rating of HV & LV winding
- XLI. Permissible over loading of HV & LV windingxl) Noise level
- XLII. External short circuit withstand capacity (MVA) and duration (Seconds)

6.0 DRAWINGS & DOCUMENTS

Vendor shall furnish all data/drawings/documents specified in the vendor data requirement. Approval of the drawing shall not relieve the

manufacturer of his responsibility to equipment conforming to the relevant specification and standards or for any mistakes, errors or omissions in the drawing.

6.1 Following minimum information shall be furnished with bid:

- a) Clause wise deviations, if any, to the specifications.
- b) Guaranteed technical particulars as per data sheet.
- c) Transformer type test reports
- d) Efficiency & voltage regulation of offered transformer (At Unity, 0.8, 0.6 PF)
- e) Recommended list of spares for 2 years operation and maintenance.

6.2 Following Drawings & Documents shall be submitted after award of contract for approval:

- i) List of drawings
 - a) Overall General arrangement drawing
 - b) Rating and diagram plate
 - c) GA of Marshalling box
 - d) Wiring drawing of Marshalling box
 - e) H.V. cable box assembly
 - f) L.V. busduct assembly
 - g) Technical Datasheet
 - h) Bill of material
 - i) QAP, Internal Test Certificates and Inspection Certificates
- ii) Instruction manuals for erection, testing and commissioning.
 - a) Instruction manual shall give step by step procedure for:
 - Erection, testing and commissioning
 - Operation
 - Maintenance and
 - Repair
 - b) Operation and Maintenance Manual
 - Recommended procedure for routine maintenance
 - Tests for checking of proper functioning
 - Diagnostic trouble shooting/ fault location charts

- c) Storage, conservation and re-commissioning Manual
- d) Safety Manual

Note: - Instruction manuals shall contain:

- a) Manufacturer's catalogues with ordering specification for all items
- b) List of consumables with specifications, brand names and annual consumption figures
- c) Procedure for ordering spares.
- d) Drawings relevant for erection, operation, maintenance and repair of the equipment.
- e) List of special tools and tackles

7.0 PACKING

Some parts of the transformer may be detached for protection during transportation. The equipment shall be properly packed. Special notations such as fragile, this side up, center of gravity, etc. shall be clearly marked on the package.

8.0 COMPLETENESS OF EQUIPMENT

All fittings, accessories or apparatus which may not have been specially mentioned in this specification but which are otherwise necessary for satisfactory working of Transformer shall be deemed to have been included in the scope of supply.

9.0 INSPECTION & TESTING:

The owner or his authorized representatives may visit the works during manufacture of equipment to assess the progress of work as well as to ascertain that only quality raw materials are used for the same. He shall be given all assistance to carry out the inspection.

The contractor shall submit Quality Assurance Plan (QAP) for respective equipment within three weeks of award of contract. Owner's representative shall be given minimum two weeks advance notice for witnessing the final testing.

Inspection and testing of equipment shall be carried out by the owner/consultant at the works of the contractor on final product to ensure conformity of the same with the acceptable criteria of technical specification, approved drawings and reference national/ international standards.

QAP shall be prepared and furnished by the contractor in VCS Form. Test certificates including test records and performance data etc. shall be furnished

by the vendor.

Inspection will be carried out on the basis of the purchaser's drawings/
manufacturer's approved drawings and instructions contained in the QAP.

QAP shall generally cover the following tests:

- Visual
- Dimensional
- Fitment & alignment
- Measurement of IR Value – Before HV test & after HV test
- High voltage test/ dielectric test
- Routine test as per relevant IS/other standard
- Type test as per relevant IS/other standard
- Impulse test HT
- Test certificates of bought out items
- Paint shade verification
- Operational & functional check
- Verification of BOM

Type tests:

- Measurement of winding resistance
- Measurement of voltage ratio & check voltage vector relationship
- Measurement of impedance voltage/short circuit impedance and load loss
- Measurement of no-load loss and current
- Measurement of insulation resistance
- Dielectric test
- Temperature rise
- Tests on on-load tap changer if appropriate

Routine tests:

- Measurement of winding resistance
- Measurement of voltage ratio & check voltage vector relationship
- Measurement of impedance voltage/short circuit impedance and load loss
- Measurement of insulation resistance
- Dielectric test
- Tests on on-load tap changer if appropriate

Special tests:

- Dielectric test
- Measurement of zero sequence impedance of three phase transformers
- Short circuit test
- Measurement of acoustic noise level
- Measurement of harmonics of the no-load current
- Measurement of power

All the transformers shall be subjected to the routine tests as per IS 2026 at manufacturer's works. Type test certificates for similar design have to be submitted for approval. Test procedures as specified in IS-2026 shall be adopted.



Energising Quality

**STANDARD SPECIFICATION
FOR GAS ENGINE GENERATOR**

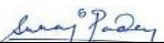
**DOC NO: VCS-SS-EL-4004S
Rev. No : 02**



Energising Quality

VCS Quality Services Pvt Ltd

**STANDARD SPECIFICATION
FOR
Gas Engine Generator
VCS – SS – EL – 4004S**

					
02	05.03.2022	SP	RD	AA	HK
01	16.10.2019	MG	VV	AD	SK
00	05.07.2017	MG	RD	AD	SK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

1.0 SCOPE:

Following are the Technical Requirements for the proposed Gas Engine Generator set and AMF Panel.

These technical requirements outline the criteria for Design, Manufacture, Testing, supply and installation of Natural Gas Generator Set complete with Suitable Excitation System, Automatic Voltage Regulator, Control Panel, Generator Breaker Panel, and other accessories as specified in Purchase Requisition.

Unless stated specifically, the Generator Set Supplied along with the components shall comply with the latest version/edition of Indian Standards.

All the Equipment, Components Used in GEG set, and AMF Panel shall be brand new and usage of old Items / serviced items is not acceptable.

The Generators supplied should be suitable for operation in humid atmosphere. The Generator should operate satisfactorily when subjected to sudden Load Application / Rejection Conditions. Generator Rating shall be the net output of the set after accounting for all auxiliaries for engine and generator.

2.0 REFERENCE DOCUMENTS

The equipment shall comply with the requirements of latest revision of following standards:

IS – 5	Colours for ready mix paints and enamels
IS – 2253	Designation for type of construction and mounting arrangement of rotating electrical machines.
IS – 4691:	Degree of protection provided by enclosures of Rotating Electrical Machinery.
IS – 4722:	Rotating electrical machines.
IS – 4728:	Terminal marking and direction of rotation for rotating electrical machinery.
IS – 4889:	Methods of determination of efficiency of rotating electrical machines.
IS – 6362:	Designation of Methods of Cooling of Rotating Electrical Machines
IS – 7132:	Guide for testing synchronous machines.
IS – 7306:	Methods of determining synchronous machines quantities from tests.
IS – 7372:	Lead acid storage battery for motor vehicle.
IS – 7816:	Guide for testing of insulation resistance of rotating machines.
IS – 12065:	Permissible limits of noise level for rotating electrical machines.
IS – 12075:	Mechanical vibration of rotating electrical machines with shaft heights 56 mm and higher - measurements, evaluation and limits of vibration severity.



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- IS – 12802: Temperature rise measurement of rotating electrical machines.
- IS – 13364: AC Generators up to 20 KVA driven by reciprocating internal Part-I combustion engine
- IS – 13364: AC Generators above 20 and up to 1250 KVA driven by reciprocating Part-II internal combustion engine.
- ISO 3046-1 Reciprocating internal combustion engine -performance declaration of power, fuel, lube oil consumption and test methods
- IS/ISO 8528-6 Reciprocating internal combustion engine driven gensets
- IS 12065 Permissible limits of noise level
- IS 12075 Mechanical Vibration of electrical rotating machine with shaft heights 56 mm and higher
- IS 4691 Degree of protection provided by enclosures for rotating electrical machinery
- IS: 6362-1995 - Degree of methods cooling of rotating machines
- IS 2253 Designations for types of constructions and mounting arrangements of rotating electrical machine
- IS 13364 Ac Generators driven by reciprocating internal combustion engines
- IS/IEC 60947 Low voltage switchgear and controlgear part 1 General rules
- IS/IEC 60947 Low voltage switchgear and controlgear, part 2- Circuit breakers
- IS/IEC 60947 Low voltage switchgear and controlgear, part 3- Switches, disconnectors & fuse-combination units
- IS/IEC 60947 Low voltage switchgear and controlgear, Part 4-1 Contactors and motor starters, Electromechanical contactors and motor controllers and starters
- IS/IEC 60947 Low voltage switchgear and controlgear, Part 4-2 Contactors and motor starters, AC semiconductor and motor controllers and starters
- IS/IEC 60947 Low voltage switchgear and controlgear, Part 5-1 -Control circuit devices and switching elements, electromechanical control circuit devices
- IS/IEC 60044 Instrument transformers, Part 1 - current transformers
- ISO 3046-1 Reciprocating internal combustion engine -performance Part 1- declaration of power, fuel, lube oil consumption and test methods.
- IS/ISO 8528-6 Reciprocating internal combustion engine driven gensets
- OISD Standards, OMR, DGMS Approval

- In case of imported equipment standards of the country of origin shall be applicable if these standards are equivalent or stringent than the applicable Indian Standards.
- The equipment shall also conform to the provisions of Indian Electricity rules and other Statutory Regulations currently in force in the India.
- In case Indian standards are not available for any equipment, standards issued by IEC/BS/VDE/IEEE/NEMA or equivalent agency shall be applicable.

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

- Statutory Regulations.
- Data Sheets.
- Job Specification.
- Standard specification.
- Codes and Standards.

3.0 SITE CONDITION

The operating environment of the power generating system shall be	
Altitude	Less than 1000 M above MSL
Ambient temperature, min	5°C
Ambient Temperature max	45°C
Fuel type	Natural Gas
Fuel pressure (gas)	Vendor to specify maximum pressure at the skid inlet.

4.0 GAS ENGINE SET AND MECHANICAL SYSTEMS

- 4.1 The gas engine should be a Continuous Operating Power Rated, Four Stroke, Inline, and rated for continuous power and capable of developing a Gross Minimum Power of 83 HP BS: 5514/ISO 3046 at 1500 rpm. The Engine should be fully capable to operate the directly coupled Alternator of rating 58.5 kVA, 3 Phase, 415V, 50 Hz, 0.8 p.f. (lagging) with all engine-mounted parasitic and external loads such as radiator fans and power generators.
- 4.2 The Gas Engine shall have Integral Dry Type Air Intake Filters, Exhaust System, Electronic Carburation system Lube Oil System, Cooling Water System, residential silencer, Catalytic Converter, Self-contained piping complete with all instruments etc.
- 4.3 The Engine and Alternator complete shall be mounted on a common base frame with AVN Pads and placed inside a sound attenuated/acoustic weatherproof housing as per applicable BIS Standards, CEA/CPCB guidelines.
- 4.4 The Engine and Alternator Mounting base frame shall be constructed of formed "I" AND/OR "C" section steel members with appropriate thickness to ensure proper strength. Corners shall be squared to provide rodent/bird proof joint when enclosure is added. Suitable provision shall be made for lifting. Support cross members shall add rigidity and allow installation of vibration isolators between base and generator set. The base shall include bottom mounting holes.
- 4.5 The fuel supply system mounted inside the CANOPY shall comprise of Gas pressure regulator/filters/solenoids



valves/isolation valves and any other accessories required as per system design/rating of the gas engine. Fuel inlet line to the engine from the Gas supply point, shall be terminated and connected with flexible connection hoses to take care of vibration/shock if any, in the system. For all fuel Inlet connections, proper quality/material and strength of hoses shall be used so as to ensure reliability/longevity and to prevent any damage/leakage of gas through flanges/connection points etc.

- 4.6 The engine governor shall be Electronic- Integrated ECU Controlled type of Class G2/G3 governing as per ISO 8528 Part 5 (Latest Revisions) with a reliable and proven actuator, suitably tuned to provide speed regulation at varying loads.
- 4.7 The radiator shall be mounted on the engine base frame and the heat rejected shall be discharged to the atmosphere through a close coupled radiator. The engine jacket water cooling system shall be a closed-circuit design with provision for filling, expansion, and de-aeration. The radiator shall be sized to cool the engine continuously while operating at full rated load and at site conditions of approx. up to an Ambient Temperature of 45°C.
- 4.8 The radiator cooling fan shall be a blower type driven from the engine and suitable to cool the engine while delivering the rated power under site ambient conditions. The radiator cooling fan guard shall conform to applicable BIS standards.
- 4.9 Dry Type Air Filter with shall be provided. The engine air cleaner/filter shall be engine mounted with dry element requiring replacement no more frequently than 500 operating hours or maximum of once each year.
- 4.10 The Gas Engine Generator Set shall immediately shut down in the event of over-speed, low oil pressure, high water temperature and over-crank. Cause of shutdown shall be indicated by a light annunciator/indication and hooter sound. System logic shall prevent restart until fault is cleared.
- 4.11 Lube Oil Circulation Pump shall be provided with safety valve and filter with replacement interval of at-least 500 operating hours or maximum once each year.
- 4.12 The Gas Engine shall be able to deliver rated power with the following specification of NATURAL GAS used as fuel and be suitable for operation with the following specification of Natural Gas Confirming to IS: 15958.2012 as below.
- Methane (Range - % by volume) – 85-95%.
 - NCV- 8500-8900 kCcal/standard cubic meter.
 - GCH – 8450-9900kCal/standard cubic meter SCM
 - Sp. Gr.- 0.59-0.62
- 4.13 The Engine shall be capable of start, achieve rated voltage and frequency, and accepting load within 15 seconds.
- 4.14 Block Load Acceptance - Transient response shall conform to ISO 8528 requirements.

5.0 POWER AND CONTROL TERMINAL BOX INSIDE THE GAS GENSET CANOPY/ENCLOSURE

- 5.1 Separate Power and Control Terminal Box having locking feature mounted on a shock-proof base frame, shall be provided inside the Generator Canopy. The Power/Control Terminal Box shall be Weather Proof type with EPDM Gaskets.
- 5.2 The Control terminal box shall have proper size insulated terminals mounted neatly and numbered with details/nomenclature, for termination of various Control Wires/Connections from the Engine and Alternator including any Lighting/Control Circuits/Safety Circuits and Interlocks and having necessary isolation switchgear if required. Lighting Controls for the panel shall be provided with suitable MCB inside the Canopy.
- 5.3 All Control Terminals for the ENGINE EMERGENCY STOP shall be terminated inside the Control Terminal Box. All the Control Connections shall be extended to the STAND-ALONE AUTO-MAINS FAIL (AMF) PANEL or any other PMCC having AMF features mounted outside. All Cable Entry/Exit shall be through cable glands and all control/power cables shall be FRLS type and with copper conductor.



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- 5.4 The Power Terminal Box shall have adequately rated/sized bolted type terminals, for termination of the Alternator Outgoing Power cables.
- 5.5 3 Pole MCCB of minimum 63A Rating (25kA breaking capacity) to be provided with operating handle/switch on outside for isolating the Alternator. Neutral shall be connected directly through links. The MCCB shall have short circuit and over-current protection with shunt trip coil for tripping the MCCB in auto mode in case of any Alternator/Engine Fault.
- 5.6 Outgoing Bolted Type Terminals of appropriate size shall be provided inside the terminal box with suitable glands and lugs, for termination of a 3.5 Core, 50 sq.mm, XLPE Insulated Armoured Aluminium Conductor Cable, going to the AMF Panel.
- 5.7 The Control Panel shall be self-sufficient with all the Measurement, Monitoring, Control and Protection features. GEG Set shall be operable without any External AMF Panel also.
- 5.8 There shall be a provision for EMERGENCY SHUTDOWN of the GEG SET from the outside of the GEG set enclosure/canopy (i.e. without opening the doors of the GEG Set Canopy) along-with hooter for indication of any Engine Trip/Shutdown.
- 5.9 A Class-1 Multi-Function Meter (3 Phase, 4 wire) shall be mounted on the Control Terminal Box Face, for monitoring and measurement of the Generator Electrical Parameters like voltage, current, frequency, kWh, kVAR, PF, and any other parameter as per vendor standard.

6.0 ALTERNATOR

The Alternator coupled to the Gas Engine Set, shall be of synchronous type and should have the capacity to generate a minimum of 58.5 kVA output at the Alternator Terminal at 415 V (+/-) 6%, 50 Hz (+/-)3%, 3 Phase, 4 Wire, 0.8 pf (lag), 1500 RPM suitable for continuous load duty and in accordance with BS:2613 / IS:4722/IEC-34(Part-I) shall be of totally enclosed or screen protected dip proof and self-air-cooled type, IP-23, complete with its excitation system, AVR, complete with all necessary auxiliaries.

- 6.1 The alternator shall be provided with brush less, self-excited and self-regulated excitation system consisting of rotating diodes etc. and capable of supplying the excitation current of the generator under all conditions of output from no load to full load. The exciter shall be capable of delivering the required excitation current during the Over Load Conditions. (50% Overload for 15 Seconds, after attaining thermal equilibrium at rated load.)
- 6.2 Alternator enclosure shall be Screen Protected Drip Proof (SPDP) conforming to IP-23 Degree of Protection. Alternator Terminal Box Protection shall be IP54.
- 6.3 Voltage swing (transient response): When rated load is suddenly switched ON, voltage dip shall be limited to 5-10% and shall be corrected within 0.2 to 0.7 sec.
- 6.4 Permissible Engine Speed variation: When the speed of engine is 1.2 times for two minutes, the alternator should be capable of withstanding it without any damage.
- 6.5 Period for taking load from start impulse: 5 sec
- 6.6 Unbalanced current carrying capacity: 25 %
- 6.7 The generator shall be capable of supporting the starting current of 7.5kW motor.
- 6.8 Short circuit current withstand capacity: Alternator should be capable of sustaining short circuit current 3 to 4

times of full load current for 3 seconds.

- 6.9 Over voltage: The alternator should be capable of operation over a range of 110 % of rated voltage.
- 6.10 The controls, protection and monitoring systems of the generator set and its operation shall be the responsibility of the OEM/ Genset manufacturer. All subsystem components, interfaces, and logic shall be compatible with engine mounted devices.
- 6.11 Name plate/Rating plate shall be fixed on the Alternator frame containing the following minimum information in English language.:
- Manufacturers name, Applicable standards, Serial no., Type, Frame reference, rated output, rated power factor, Duty, rated frequency, rated voltage, No. of phases, Type of connection, rated stator current, rated speed in rpm, Class of insulation, Excitation current and voltage at rated output, Phase Rotation, Temperature rise, Year of manufacture.

7.0 ENGINE STARTING SYSTEM AND BATTERIES

- 7.1 The engine starting system shall have a 12-volt/ 24-volt DC starting motor(s), starter relay, and automatic reset circuit breaker. Maintenance Free Heavy Duty Battery shall be provided for engine starting purpose and shall be of reputed make, capable of delivering the required starting current to the starter motor of reputed make (preferably of LUCAS TVS/DELCO/REMY make). The generator control panel must also have a battery recharging system to keep the battery charged at all times.

8.0 EXHAUST SYSTEM

- 8.1 Exhaust system shall consist of residential type silencers mounted over the engine canopy/frame using stainless steel flexible bellows or as per Manufacturer Standard. Exhaust piping from the GEG Unit shall be extended outside the building/enclosure upto the height above the nearest building as per CPCB/MoEF Guidelines applicable.
- 8.2 The residential Silencer shall be supplied with a flexible, seamless, stainless steel exhaust connection. Rain cap will be supplied to terminate the exhaust pipe. Silencers and Exhaust Piping shall be insulated with Aluminium Sheet Cladding. Silencers and Horizontal runs shall be supported on spring supports fixed to ceiling. Vertical runs shall have expansion bellows where the length exceeds 25 meters.
- 8.3 Catalytic Converter of appropriate design shall be provided.
- 8.4 The engine emission levels shall comply to the CPCB- IV norms for GAS ENGINE GENSETS running on NATURAL GAS as Fuel. **Necessary certificate proving BS IV compliance must be submitted by the bidder.**

9.0 ACOUSTIC ENCLOSURE

- 9.1 The acoustic enclosure shall be made of minimum 14-16 SWG CRCA Sheet in modular construction with provision for easy assembly and dismantling at site. The enclosure shall be coated with uv resistant powder coated/electrostatically applied paint, baked and finished as per applicable BIS Standards on both inside and outside.
- 9.2 The overall design of the CANOPY/ENCLOSURE along with the residential silencer shall be such, that the sound level does not exceed 75db at a distance of 1 meter from the Enclosure.
- 9.3 The enclosure shall be fitted to the engine/generator set base and isolated from engine vibration. Corners shall

be formed and welded to assure strength and rigidity. The Sheet metal shall have no burrs or sharp edges.

- 9.4 The enclosure shall satisfy requirements for drip proof construction and be suitable for outdoor/open installation when doors are closed. The enclosure should be complete with power and control wiring between control panel and alternator and other components, with proper size copper cable.
- 9.5 All nut/bolts/hardware etc. shall be of stainless steel. All doors shall be lift off hinge-less type with lockable stainless steel security latches and provided with high quality EPDM gaskets to prevent leakage of sound.
- 9.6 A viewing window shall be fitted with toughened glass in the door. The enclosure shall have double/single point lifting facility for ease of Handling/shifting.
- 9.7 The enclosure shall be constructed to allow full access to the engine for maintenance without exposing personnel to any moving machinery. Radiator and radiator fan assembly shall be totally enclosed with lockable door over the radiator cap. The radiator shall be sized to accommodate any resulting air flow restrictions. Provision shall be made for a duct flange or perforated metal grill to protect the radiator core.
- 9.8 The Enclosure shall be Compliant with latest CPCB norms/ any other Statutory guidelines / requirements related to Gas Engine Generator Sets. The Engine Manufacturer / Integrator shall submit copy of CPCB Compliance as required.

10.0 AMF PANEL

- 10.1 Following features as minimum shall be provided in the AMF Panel. The Configuration/Setting Software shall be provided in CD/Pen-drive with lifetime license for configuration/settings of the Controller through a Laptop/PC.
- a) The Controller shall have Back-lit LCD Display Unit and be suitable for operation in an Ambient Temperature of upto 55 Deg. C and with Storage and Display of at-least last 200 Events. The Engine ECU/AVR shall be connected to the Controller for Setting/Display and Control of all Engine Parameters, so as to extend all Engine Parameters to the Controller mounted in the AMF Panel.
 - b) LED based Mimic Diagram on Front panel with AUTO/MANUAL/TEST MODE of operation with Start/Stop/Test/Reset/Transfer to Mains Soft Touch Buttons.
 - c) Settable Current Date and Time with run time and engine running hours Display.
 - d) Engine Parameters, Protections and Indications
 - Battery Voltage, Battery over-voltage/under-voltage
 - Engine Coolant temperature (High)
 - Engine Under-Speed/Under-Frequency and Over-Speed/Over Frequency Alarm/Trip
 - Engine Run hours
 - Engine Fault Codes/Alarms
 - e) Alternator Parameters, Protections, Indications
 - Generator Voltage and Frequency Sensing
 - Mains Voltage and Frequency Sensing
 - Generator Current Sensing for Protection and Measurements
 - Generator Overvoltage/Under Voltage
 - Generator Overcurrent/Overload
 - Unbalance Load Protection.
 - Display of kW, KVAR, KWH, PF

- Generator Over frequency/Under frequency
 - Metering, Display and Storage of Power, Energy, Harmonics, Frequency, Voltage, Current
- 10.2 LED Indications on AMF Panel- Following separate status indications shall be provided separately on the AMF Panel Front, through LED based Indication lamps mounted on the AMF Panel.
- GEG Set ON/OFF Status
 - GEG Set in AUTO/MANUAL
 - ENGINE/GENERATOR EMERGENCY STOP
 - LOAD ON MAINS(GRID)/GEG(EMERGENCY)
 - GRID SUPPLY AVAILABLE/NOT AVAILABLE
 - GEG FAIL TO START
 - BATTERY CHARGER ON/OFF
 - Engine FAIL TO START
- 10.3 SELECTOR SWITCHES/PUSH BUTTON ON AMF PANEL- Apart from soft touch buttons provided on the Auto-Mains Failure Generator Controller/Module, following additional selector switches/push- buttons shall be provided on the AMF Panel as a minimum, for easy operation and necessary configuration of the AMF Controller shall be done accordingly.
- AUTO/MANUAL Mode of Operation.
 - OUTPUT CONTACTOR(GRID/GENERATOR) ON/OFF.
 - START/STOP of GEN SET/ENGINE.
 - EMERGENCY STOP(LOCKABLE).
 - ALARM ACKNOWLEDGE, RESET, TEST.
 - BATTERY CHARGER ON/OFF.
 - CONTROL SUPPLY ON/OFF.
- 10.4 Current Transformer - CTs for Protection and Measurement shall be installed in the AMF Panel, for Measurement and Display of Parameters.
- 10.5 **MULTI FUNCTION METER FOR ENERGY/POWER/ VOLTAGE/CURRENT OF GENERATOR.**
A Separate Class-1 Multi-Function Meter (3 Phase, 4 wire) shall be mounted on the AMF Panel Face, for monitoring and measurement of the Generator Electrical Parameters apart from the measurements in the GENERATOR CONTROLLER.
- 10.6 **BATTERY CHARGER** - A suitable battery charger as per vendor standard to be provided for charging the engine starting battery.
- 10.7 **HOOTER** – A COMMON Hooter shall be installed in the AMF Panel for indication of any Fault/Trip Condition upon activation of any Protection Function of the Engine/Generator. Accept/Test and Reset Push-buttons with Indication lamps shall be provided.
- 10.8 **AMF PANEL CONSTRUCTION/SCHEME AND OPERATION PHILOSOPHY**
An AUTO MAINS- FAILURE panel shall be provided for 58.5 kVA GEG Set and the same shall be installed and commissioned at site as per the operational philosophy based on DUAL SOURCE CHANGEOVER (GRID AND GENERATOR SUPPLY). The main grid incomer and the emergency generator incomer shall have an MCCB each of adequate rating of Four pole, single-throw, stationary- mounted with manual operating handle, adjustable overload and short circuit trip settings, shunt trip coils, complete with cable lugs/separators etc. installed in the AMF PANEL. The Grid Incomer, and the Out Going from 58.5 kVA GEG set shall be Terminated at the Incoming Side of these MCCB's inside the AMF Panel.
- a) The downstream of the two nos. of MCCB's will have two nos. of adequately rated 4 POLE CONTACTORS

(Electrical Interlocked) installed and the OUTPUT OF THE CONTACTORS shall be fed to a COMMON BUS, which shall be further connected through an OUTGOING CABLE to the MEDB

- b) The generator set start-stop sequence shall be initiated manually or automatically by closing or opening of a contact upon sensing the GRID POWER SUPPLY FAILURE. The control system shall automatically engage the cranking motor, sense engine starting speed, dis-engage the motor and arm the engine protection circuit. The Control Logic shall be designed such that, upon grid power supply failure, the interlocked power contactor (fail safe electrical interlocking) shall get energized to feed emergency power to the critical load, while the second contactor for supply of grid power shall get switched off. Upon restoration of grid power supply, the auto-start logic shall restore the power supply through grid to the critical load through the power contactor.

Note: The AMF Panel shall be capable to sense power availability from Grid and start the generator in case of failure of Grid Incomer. The panel shall be compatible with the Main Electrical Distribution Board present at the site and SLD of the same has been attached with the tender.

11.0 DOCUMENTATION The following documentation is required to be supplied:

- a) AS Built Dimensional drawings, parts assembly drawings, electrical circuit diagrams,
- b) Factory and TPI Inspection Reports
- c) Operation and Maintenance Manual
- d) **WARRANTY CERTIFICATE**

12.0 SERVICE AND WARRANTY

- 12.1 The Gas engine generator set must carry a warranty of ONE year after the date of commissioning.
- 12.2 The manufacturer of the gas engine generator must have a service dealer or authorized service provider within a distance of 150km from the location of installation of the generator.
- 12.3 The manufacturer's service dealer or authorized service provider should be able to provide factory trained servicemen, the required stock of replacement parts, technical assistance, and warranty support.



13.0 SYSTEM OPERATION**13.1 MODES OF OPERATION**

The emergency generator and associated equipment electrics shall normally be in an unattended area. The control system shall be suitable for unattended operation. The control system shall operate in fail-safe mode and shall include all controls and protection necessary for the safe operation of the DG set. The generator and associated electrics shall function as per the following schemes:

- a. Auto start on mains failure with AMF Panel
- b. Manual start/stop and load transfer
- c. Manual start/stop

13.2 AUTOMATIC START ON MAINS FAILURE

- a) This shall be effective in Auto position of Auto / Manual selector switch located in local control panel. The generator shall normally be at rest. Upon failure of normal supply, a start impulse (in the form of changeover of a dry contact) shall be provided by others. Using this impulse, generator shall start automatically and rated speed and voltage shall be built up.
- b) Once the voltage-monitoring relay senses generator healthy voltage, an impulse shall be given for closing of generator breaker or contactor.
- c) All accessories required for starting and completion of various sequence of operation for the above purpose shall be provided as part of generator.

13.3 MANUAL START**a. In Service Mode**

This shall be effective in manual position of Auto/Manual switch and service position of service / test selector switch located in control panel. The scheme of operation shall be same as of auto mode as above except that starting command shall be extended manually using the push button (instead of command from AMF sequence) from the local control panel. Provision shall also be kept for manual start from Owner's remote control panel.

b. In Test Mode

- i. This shall be effective in test position of service / test selector switch. The scheme of operation shall be same as that of manual start in service mode except that the closing command for generator breaker /contactor shall not be extended automatically.
- ii. If periodic load test-run of generator is envisaged as per Data Sheet, the generator breaker shall be closed manually after synchronization with grid.

13.4 STOP UPON RESTORATION OF GRID MAINS SUPPLY

Unless specified otherwise in the Data Sheet, DG set shall be stopped manually using push button. This shall be possible irrespective of the position of Auto / Manual selector switch which is located in generator control panel.

13.5 SHUT-DOWN

It shall be possible to manually stop the generator in all operational cases including emergency case by means of the push button provided in either generator control panel or Owner's remote panel.

13.6 STARTING TIME



Unless specified otherwise, the total time from the receipt of the starting impulse for the generator till the set reaches rated speed and generator reaches rated voltage shall not be more than 30 seconds. If this time is exceeded, an annunciation in the local control panel shall be provided with a facility for repeat annunciation in Owner's panel.

13.7 BLACK START FACILITY

The generating unit shall be provided with all necessary 'black start' facilities. External power at 415 V TPN shall be made available by purchaser at one point for battery charging or any other auxiliary equipment operation during stand still period of generator. This power shall not be available during start-up of the generator.

13.8 DC CONTROL SUPPLY

- a. Unless it is specified that the DC control supply required for AMF/generator relay and control function is being provided by Purchaser, all DC power supply requirement shall be met by DC system consisting of battery and battery charger of suitable capacity to be supplied by the DG set Vendor.
- b. If, the DC control supply for AMF / generator control panel is provided by Purchaser, the engine starting motor and other such special duty DC load required for DG system package shall still be fed from the DC system battery & charger to be supplied by the DG set Vendor. During stand still period of DG set, charger of DC supplies shall be energized from the 415 V feeder provided by Purchaser as above.

GAS GENERATOR DATASHEET

(Information to be filled in by the Purchaser)

1.	Site Condition	
1.1	Altitude	<1000 M
1.2	Ambient temperature, Min	5°C
1.3	Ambient Temperature, Max	50°C
1.4	Fuel type	Natural Gas
1.5	Fuel pressure (gas)	Vendor to specify maximum pressure at the skid inlet.
2.	Electrical kVA Rating (Prime)	_____ kVA (As per SOR)
3.	Duty	Prime
4.	No of Phase	3
5.	AMF Panel	Local control Panel with display
6.	Output Voltage	415V
7.	Frequency/RPM	50Hz/1500
8.	Filter	Dry Type
9.	Cooling System	Air/Water Cooled
10.	Governor Type	Electronic- Integrated ECU Controlled type
11.	Governor Class	G2/G3
12.	Starting System	Battery powered
13.	Starting Time (full load)	15 second
14.	Block Load Acceptance	As per ISO 8528
15.	Fuel Characteristics	➤ Methane (Range - % by volume) – 85-95%. ➤ NCV- 8500-8900 kCal/standard cubic meter. ➤ GCH – 8450-9900kCal/standard cubic meter SCM ➤ Sp. Gr.- 0.59-0.62
1.Information to be filled in by the Bidder		
1.1.	Make Model	
1.2.	Number Of Cylinder	
1.3.	Aspiration	
1.4.	Compression Ratio	
1.5.	Size (Bore & Stroke) Displacement	
1.6.	Duty (ISO 8528-1)	Continuous Operating Power
1.7.	Gross Hp At 1500 Rpm	
1.8.	Deduction For Fan and Other Parasitic Loads	_____ kW
1.9.	Derating Factor for Ambient Temperature	_____
1.10.	Derating Factor for Altitude	_____



Standard Datasheet For Gas Engine Generator

1.11.	Nett Hp Available	_____ kW/HP
1.12.	Acceptable Fuel Gas Pressure Range	_____ kg/cm ²
1.13.	Specific Fuel Consumption	
1.13.1.	# 100% Load	_____ kg/hour
1.13.2.	# 75% Load	_____ kg/hour
1.13.3.	# 50% Load	_____ kg/hour
1.14.	Lub Oil Grade	_____
1.15.	Engine Sump Capacity	_____
1.16.	Recommended Lube Oil Replacement Hours	_____ hours
1.17.	Engine Radiator Coolant Capacity	_____ litres
1.18.	Make & Type of Governor	
1.19.	Governor Class	_____
1.20.	CANOPY DIMENSIONS (Lxwxh)	_____ x _____ x _____ meters
1.21.	ENGINE MOUNTING (Anti-Vibration Pads)	_____
1.22.	COMPLIANCE TO Latest BS Standards, CPCB Regulations (BS IV*) (Certificate Required)	_____
1.23.	Starting Battery	_____ nos _____ volts _____ Ah
1.24.	Catalytic Converter	Required
1.25.	Catalytic Converter Provided	YES / NO



Energising Quality

Standard Datasheet For Gas Engine Generator

DOC NO: VCS-DS-EL-4004S
Rev. No : 02

2.	DATA SHEET FOR ALTERNATOR	
2.1.	Make	
2.2.	Rated Output	____ kW
2.3.	No Of Phase	_____
2.4.	Frequency	____ Hz
2.5.	No. Of Poles	_____
2.6.	Rated Speed	_____ RPM
2.7.	Rated Power Factor	_____
2.8.	Winding Conductor Material	Copper
2.9.	Insulation Class	Class-H
2.10.	Temperature Rise	Class-H
2.11.	Excitation Type	
2.12.	Duty Cycle (IEC 60034-1)	S1
2.13.	Connection	
2.14.	<i>Site Condition</i>	
2.15.	Alternator Protection (Enclosure Ip Rating)	
2.16.	Alternators Terminal Box Protection (Ip Rating)	
2.17.	Alternator Cooling	
2.18.	Excitation System	
2.19.	Voltage Regulator	
2.20.	Make	
2.21.	Rating/Type	
2.22.	Automatic Voltage Regulation Range	
2.23.	Permissible Voltage Variation at Rated Speed, And Power Factor	
2.24.	Voltage Swing (Transient Response)	
2.24.1.	Permissible Engine Speed Variation	
2.24.2.	Permissible Frequency Variation at Rated Speed and Power Factor	
2.25.	Period For Taking Load From Start Impulse	
2.26.	Overload Capacity	
2.27.	Unbalanced Current Carrying Capacity	
2.28.	Short Circuit Current Withstand Capacity	
2.29.	Over Voltage	
2.30.	Alternator Mounting	
2.31.	Amplitude Of Vibration at No Load	



Energising Quality
VCS Quality Services Pvt Ltd

**STANDARD SPECIFICATION
FOR
UNINTERRUPTED POWER SUPPLY**

VCS – SS – EL – 4011S

03	16.05.2025	SP	VV	AA	HK
02	05.03.2022	SP	RD	AA	HK
01	16.10.2019	MG	VV	AD	SK
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Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By
UNCONTROLLED COPY : If printed					
CONTROLLED COPY : If in soft and signed					

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	05.07.2017	MG	RD	AD	SK	Issued for use as Standard
01	16.10.2019	MG	VV	AD	SK	New revision system updated
02	05.03.2022	SP	RD	AA	HK	New revision system updated
03	16.05.2025	SP	VV	AA	HK	New revision system updated

ABBREVIATIONS

AC	Alternating Current
ACDB	AC Distribution Board
Ah	Amp Ampere
BS	British Standard
CD	Compact Disk
CEA	Central Electricity Authority
CFL	Compact Fluorescent Lamp
CRCA	Cold Rolled Cold Annealed
DC	Direct Current
DCS	Distributed Control System
DG	Diesel Generator
EMC	Electromagnetic compatibility
Hz	Hertz
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IGBT	Insulated Gate Bipolar Transistor
IP	Ingress Protection
IS	Indian Standards
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MCCB	Moulded Case Circuit Breaker
MR	Material Requisition
MSL	Mean Sea Level
NEMA	National Electrical Manufacturers Association
Ni-Cd	Nickel Cadmium
PCB	Printed Circuit Board
PIV	Peak Inverse Voltage
SMPS	Switch Mode Power Supply
PVC	Poly Vinyl Chloride
RFI	Radio Frequency Interference
UPS	Uninterrupted Power Supply
SPN	Single Phase Neutral
VDE	Verband Deutscher Electrotechniker
VRLA	Valve Regulated Lead Acid

CONTENTS

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1.0 SCOPE

The scope of this specification is to define the requirements of design, manufacture, testing, packing and dispatch of static Uninterrupted Power Supply (UPS) system.

2.0 CODES AND STANDARDS

2.1 The equipment shall comply with the requirements of latest revision of following standards:

IS 5	Colors for ready mixed paints and enamels
IS:1248	Direct acting indicating analogue electrical measuring (Part 1,2,4 and 9) instruments and accessories
IS:7204 (Part 1 to 4)	Stabilized power supplies D.C. output
IS: 12021	Control transformers for switchgear and control gear for voltages not exceeding 1000V AC
IS: 13314	Solid state inverters run from storage batteries
IS: 13703 (Part 1,2&4)	Low voltage fuses for voltage not exceeding 1000V AC or 1500V DC
IS: 13947 (Part-5/ Sec-2	Low voltage switchgear and control gear specification
IEC-60146-1-1	General requirement & line commutated inverters (specification of basic requirements)
VDE-0875	German EMC directive for broadband interference generated by appliances
IEEE-519	Recommended practices and requirements for harmonic control in electrical power system

- 2.2 In case of imported equipments, standards of the country of origin shall be applicable if these standards are equivalent or stringent than the applicable Indian standards.
- 2.3 The equipment shall also conform to the provisions of CEA regulations with latest amendments and other statutory regulations currently in force in the country.
- 2.4 In case Indian standards are not available for any equipment, standards issued by IEC/BS/VDE/IEEE/NEMA or equivalent agency shall be applicable.
- 2.5 In case of any contradiction between various referred standards/ specifications/ data sheets and statutory regulations, the most stringent requirement shall prevail and owner's/ EIL's decision in this regard will be final and binding.

3.0 GENERAL REQUIREMENTS

- 3.1 The offered equipment shall be brand new with state of art technology and proven field track record. No prototype equipment shall be offered.
- 3.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment at least for 10 years from the date of supply.
- 3.3 Vendor shall give a notice of at least one year to the end user of equipment and EIL before phasing out the product/spares to enable the end user for placement of order for spares and services.
- 3.4 The UPS system shall be an integrated system comprising static rectifiers, battery, static inverters, static switches, manual by pass switch, AC distribution board, voltage stabilizer in bypass, isolating and protection devices and all other equipment/ accessories required for completeness of the system whether specifically mentioned herein or not, but necessary for completeness and satisfactory performance of the system.
- 3.5 The UPS system shall be suitable to feed all loads connected to the output, which are primarily instruments, DCS, computers, disc drives and other SMPS equipment leading to high crest factor of the load.
- 3.6 The inverter shall be transistorized (IGBT) type or with the latest proven technology. All components shall be of a high quality and reliability that satisfy with the requirements of a secure AC power to vital equipment with respect to performance, controlling, monitoring and safeguarding function in continuously operating petrochemical process units, petroleum refineries, gas processing facilities, utility and other miscellaneous industrial plants. Components shall be capable of withstanding the thermal and dynamic stresses resulting from internal and external short circuits and switching surges etc.
- 3.7 The design of the UPS shall be such as to minimize the risk of short circuits and shall ensure human and operational safety.
- 3.8 The vendor shall be responsible for design, engineering and manufacturing of the complete system to fully meet the intent and requirements of this specification and enclosed data sheets. Selection, sizing and suitability of all equipment and components used for UPS system shall be vendor's responsibility.
- 3.9 The UPS shall be single phase or three phase system as indicated in the data sheets.
- 3.10 The batteries shall meet the requirement of battery Data Sheet/ battery specifications attached with the bid document.

4.0 SITE CONDITIONS

The UPS system shall be suitable for installation and satisfactory operation in a closed building with restricted natural air ventilation in tropical, humid and corrosive atmosphere. The UPS system shall be designed to operate under site conditions as specified in the data

sheet. If not specifically mentioned therein, design ambient temperature of 40°C and altitude not exceeding 1000m above MSL shall be considered for the UPS.

5.0 TECHNICAL REQUIREMENTS

5.1 Input Power Supply

5.1.1 The UPS shall be suitable for input power supply as defined in the data sheet. If not specified therein the UPS shall be suitable for the following input power supply.

Voltage 415V $\pm$ 10% or 230V $\pm$ 10%

Frequency 50 Hz $\pm$ 5%

In addition to above variations, the input voltage may be subject to transient variations comprising voltage dip to 80% of normal voltage during motor start-up and voltage interruption during short circuit as well as frequency variations due to large motor start up. UPS system shall be designed to operate satisfactorily while deriving the input power from an emergency diesel/ gas generator set.

UPS system shall also operate satisfactorily on input power supply having the ratio of negative to the positive sequence components not exceeding 5% and total harmonic distortion of not more than 5%.

Total Harmonic Distortion is the ratio in percentage of r.m.s. value of the Harmonic content to the r.m.s. value of the fundamental component of alternating quantity.

5.1.2 The UPS shall be designed to ensure that harmonic components in the input current are limited as per IEEE 519. Suitable filters as required shall be provided.

5.2 UPS Configuration and Operational requirements

The UPS system shall have one of the following basic configurations as specified in data sheet and drawings.

5.2.1 Single UPS with Bypass

In UPS system having this configuration, a single rectifier and inverter shall be provided. Under normal conditions when AC mains power is available, the rectifier shall simultaneously feed DC power to inverter as well as for float/rapid charging of the battery.

The AC supply to loads shall be fed from inverter output. In case of any fault in the inverter, the load shall be automatically transferred to stabilized bypass supply and retransfer of load from stabilized bypass supply to the inverter shall be possible in auto as well as in manual mode.

In case of AC input power failure or battery charger failure, the battery shall supply power to inverter without any interruption. The charger shall be designed for simultaneously feeding complete inverter load and for float/rapid charging the battery to its rated

capacity. Charger shall be equipped with 'On Line' automatic as well as manual charging facility.

5.2.2 Parallel Redundant UPS with bypass (With 1x100% battery)

In UPS system having this configuration, two sets of rectifiers and inverters shall be provided. Under normal conditions, when AC mains power is available, both the rectifiers shall operate in parallel and supply DC power for float/rapid charging the battery and simultaneously to inverters. In case of failure in one rectifier, the other rectifier shall feed the complete load and the battery without any interruption.

In case of incoming supply failure or failure of both rectifiers, the battery shall feed the inverters without any interruption. Each rectifier shall be designed for simultaneously feeding complete inverter load and float/rapid charging of the battery to its rated capacity. Each rectifier shall be equipped with 'On Line' automatic as well as manual charging facility.

Normally both inverters will be synchronized with each other and with stabilized bypass supply. Both inverters shall operate in parallel and share the load equally.

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.

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.

5.2.3 Parallel Redundant UPS with bypass (With 2x50% batteries)

In UPS system having this configuration, two sets of rectifiers and inverters shall be provided. Under normal conditions, when AC mains power is available, both the rectifiers shall operate in parallel and supply DC power for float/rapid charging the 2 x 50% 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.

In case of incoming supply failure or failure of both rectifiers, the 2 x 50% 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 2 x 50% 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 bypass 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.

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.

5.2.4 Hot Stand-by Redundant UPS with bypass

In UPS system having this configuration, the arrangement of rectifiers/inverters and the operating philosophy is same as described in Cl.5.2.2 and Cl.5.2.3 above, except that only one inverter shall be operating at one time. The other inverter shall not be sharing the load but shall be synchronized with the running inverter and stabilized bypass supply and remain ready to accept the load in case of fault in the running inverter. Retransfer of load from stabilized bypass supply to the inverter shall be possible in auto as well as in manual mode

5.2.5 Dual Redundant UPS

In UPS system having this configuration, the arrangement of rectifiers/inverters and the operating philosophy is same as described in Cl.5.2. 1 above except that there shall be two nos. identical, fully independent, 100% rated, single UPS with bypass and output connected to individual ACDB.

5.2.6 In all UPS configurations, the facility for uninterrupted manual transfer in either direction through static switches shall also be provided.

5.2.7 For ease of maintenance, it shall be possible to isolate inverters and static switches from load through manually operated make before break switches. In case of larger rating UPS, where it is not possible to provide one power switch with make before break feature, combination of breakers with the control scheme having make before break logic may be provided which ensures momentary paralleling before tripping of selected breaker.

5.3 UPS Design and Performance Requirements

5.3.1 Incoming AC supply shall be converted to DC through three phase full wave-controlled rectifiers. The rectifiers shall operate according to the constant voltage current limiting principle and shall incorporate a "Soft Start" feature to gradually accept load on initial energizing.

5.3.2 The rectifier section of the UPS system shall be capable of precise regulation to prevent damage to the battery. The output voltage of rectifier's DC bus without the battery shall be stabilized to within $\pm 1\%$ of set value during load variation between 0 to 100% of the rectifiers and specified mains input supply voltage variation.

5.3.3 Suitable protection shall be provided in the control circuits to guard against instability of phase-controlled rectifiers due to electrical oscillations, which may be present in the input

supply as caused by emergency DG set.

- 5.3.4 The UPS system including the stabilized by-pass shall be galvanically isolated from input power supply system by providing double wound transformers having copper winding. All transformers shall be natural air cooled, dry type suitable for location inside the panel. All rectifiers shall also have a double wound transformer at its input.
- 5.3.5 An RFI filter shall be provided. The production of radio frequency interference voltage shall not exceed the value of suppression grade N' as defined in VDE-0875. The performance of UPS system shall not get affected or in any way be degraded by the use of portable radio transmitter receiver in the vicinity of the UPS system and or UPS room.
- 5.3.6 Transient/surge protection circuit shall be provided in the input circuit to rectifiers to protect the UPS from surges & voltage spikes.
- 5.3.7 The UPS system shall be designed to draw power from mains supply at a minimum power factor of 0.85 while working at rated load in normal operating UPS configuration.
- 5.3.8 The UPS shall be provided with automatic sequence and power walk in circuit(s) with time delay of up to 15 sec. such that the rectifiers and inverters can start operating automatically when incoming AC power is restored allowing the UPS to be loaded automatically.
- 5.3.9 UPS system offered with DC-DC buck boost converter in DC link circuit may be considered acceptable as per manufacturer standard proven practice. DC-DC converter shall be with same IGBTs as provided in inverter circuit.
- 5.3.10 Facility for initial charging of batteries shall also be provided at a voltage level recommended by the battery manufacturer. The inverters may be disconnected during initial charging of the battery.
- 5.3.11 For battery sizing, the following factors shall be considered unless specified otherwise in the data sheet
- Load Power Factor of 0.8
 - Minimum ambient temperature as specified in Data sheet
 - Battery current =
$$\frac{\text{Inverter rated kVA} \times \text{Rated load p.f}}{\text{Inverter efficiency} \times \text{End cell voltage} \times \text{No of cell}}$$

At 50% load on each inverter for parallel redundant UPS.
 - Aging factor of 0.8
 - Back up time of 30 minutes in case of mains power failure unless specified otherwise in SOR/data sheet
 - Minimum end cell voltage for lead acid/VRLA battery 1.75 V per cell and 1.0 V per cell for Ni-Cd battery.
 - Battery state of charge factor of 0.95
- 5.3.12 The rectifiers/chargers shall be designed to completely charge the Lead acid and Nickel

cadmium batteries in a maximum time of 10 hours after complete discharge and at the same time meeting the inverter input requirements, when the inverter is delivering its rated output at 0.8 power factor. Facilities shall be provided to initiate battery rapid charge operation by manual & automatic means. An auto charging sequence should be provided for the rapid and float charging based on current sensing. Battery charger for VRLA battery shall be sized to provide boost charging of the battery up to 90% of rated Ampere-hours within a duration of 24 hours and to 100% within 4 days. In addition to above, the charging shall be transferred from rapid to float mode after a preset time adjustable through 0-24 hours timer as back up protection against over charging.

- 5.3.13 The rectifiers shall be sized based on the maximum inverter input load when inverter is delivering its rated output at 0.8 rated power factor and recharge the battery to nominal rated capacity of the battery. The DC load imposed by the inverters shall be considered under the most severe operating conditions where only one rectifier is operating but the UPS load is equally shared by all the inverters. The rating of each rectifier shall be not less than the value calculated as follows:

For Lead Acid Batteries = Inverter input current* + 0.14Ah (10 hr. Rating of the battery)

For Nickel-Cadmium Batteries = Inverter input current* + 0.2Ah (5 hr. Rating of the battery)

For VRLA Batteries = Inverter input current* + 0.2Ah (10 hr. Rating of the battery)

*where Inverter input current = $\frac{\text{Rated kVA capacity of UPS} \times \text{Rated load power factor}}{\text{Battery charging voltage} \times \text{Inverter efficiency}}$

- 5.3.14 The DC rectifiers shall sense the battery charging current and adjust the DC bus voltage to maintain the charging current to preset level. A separate current limit circuit shall also be provided for adjustment of battery current. The rectifiers shall be protected against reverse battery connection at DC link voltage bus. Subsequent to a discharge cycle when battery is connected to rectifier, the battery current shall be monitored, controlled and limited to set value automatically irrespective of the inverter input current.
- 5.3.15 The battery may be taken out of service for maintenance, during which period it shall be possible for the inverter to continue operation by drawing power from the rectifier. Ripple content at the DC link shall not exceed 2% even with battery disconnected.
- 5.3.16 Battery/ DC link shall be provided with a sensitive earth leakage detection.
- 5.3.17 The inverter shall be of the current limiting type (short circuit proof) and have nominal output voltage and frequency as specified in the data sheet. The inverter output voltage and frequency shall not exceed the operational tolerances, as measured at the output terminals of the unit during the following conditions of UPS loading:
- Load variations between 0- 100% of the rated output of UPS
 - Load power factor over the range of 0.7 lagging to unity

- Load current waveform having a relative harmonic content varying between 0 and 50%, the latter waveform having a crest factor not exceeding 2.5 and individual harmonics not exceeding the following values.

3rd harmonic	44 % of fundamental
5th harmonic	33 % of fundamental
7th harmonic	18 % of fundamental
9th harmonic	7 % of fundamental
11th harmonic	10 % of fundamental

The Relative harmonic content is the ratio of the r.m.s. value of the harmonic content to the r.m.s. value of the total non-sinusoidal periodic waveform i.e. relative harmonic content.

$$\sqrt{1 - \left(\frac{\text{rms value of the fundamental component of current or voltage}}{\text{rms value of total waveform of current or voltage}} \right)^2}$$

- DC input voltages over the range corresponding to battery rapid charge and battery discharge operation during the specified discharge times.

The UPS output voltage waveform shall be sinusoidal with a relative harmonic content not exceeding 5% for both linear and nonlinear loads.

5.3.18 The inverter shall control the output voltage of the UPS such as to maintain synchronism with the mains bypass voltage during variations in mains frequency up to the limits specified.

During variations in mains frequency exceeding these limits, the inverter shall revert to internal frequency control.

5.3.19 It shall be possible to vary the inverter output voltage sleeplessly within $\pm 5\%$ of the specified output voltage. This adjustment shall be possible to be made when the inverter is in operation

5.3.20 The steady state output voltage and frequency (free running) variation of inverters shall not exceed $\pm 1\%$ from the set value for specified input power supply conditions from no load to full load condition and load power factor variation from 0.7 lag to 1.0.

5.3.21 The UPS system shall be able to operate satisfactorily on rated loads (in kVA) with power factors in the range of 0.7 lag to 1.0. The overall efficiency of the UPS system shall not be less than 80% at rated load and 0.8 pf.

5.3.22 The UPS shall have capacity to deliver a minimum overload of 125% for 10 minutes and

150% for 1 minute. UPS shall be provided with current limit circuit to avoid excessive loading beyond its permissible overload withstand capability.

- 5.3.23 The inverters shall be 'phase locked' to the stabilized bypass power supply as long as stabilized bypass supply frequency remain within $\pm 4\%$ of nominal. When bypass supply frequency variation exceeds the above limits, the inverters shall be de-linked from mains. Free running frequency tolerance limit shall not exceed $\pm 1\%$. Facility shall also be provided for adjustment of range of synchronizing frequency.
- 5.3.24 Unless otherwise specified, the UPS system output voltage variation shall not exceed $\pm 10\%$ and complete recovery to normal steady state shall be within 0.1 Sec. The phase angle disturbance shall be less than $120^\circ \pm 3\%$ in case of 3 phase inverter. The above requirement shall be complied for following transient disturbances.
- 100% step load and unload (For single UPS and hot stand by UPS)
 - 50% step load (for parallel redundant UPS)
 - Momentary interruption in power supply
 - Load transfer to stabilized bypass supply
 - Complete load transfer to other healthy inverter when one of the two parallel inverters develop a fault.
- 5.3.25 For 3phase UPS system, the maximum output voltage and angle variation between the phases should not exceed 6% and 3 degrees respectively even under the condition of 100% unbalanced loading of the 3-phase output.
- 5.3.26 UPS system shall be suitable for both floating output or earthing of one leg / star point in case of single phase/ three-phase system respectively.
- 5.3.27 The stabilized bypass supply shall be designed to regulate the output voltage within $\pm 2\%$ of the rated voltage over complete range of load from no load to full load and for specified input supply voltage variation. The type of Voltage stabilizer in stabilized bypass supply shall be as indicated in data sheet
- 5.3.28 The stabilized bypass supply shall have a continuous current rating equivalent to the rated output of the UPS unit and be capable of conducting a current ten times the rated output for the duration more than the fault clearing time of the type of fuse provided. The load transfer devices shall comprise of continuously rated static elements in both inverter and stabilized bypass supply.
- 5.3.29 Adequately rated static switches in required number & configuration shall be provided in the inverter(s) output and stabilized bypass supply to ensure positive isolation of faulty inverter section such that the other inverter and bypass circuits do not feed into the fault leading to under voltage / trip. The short time rating of all the static switches shall be at least 10 times the rated output for the duration more than the fault clearing time of the

type of fuse provided.

5.3.30 Facility shall be provided to manually and automatically initiate transfer of the load from inverters to the stabilized bypass supply and from stabilized bypass supply to the inverters. Under voltage and over voltage, sensing levels to initiate transfer shall be adjustable. The maximum transfer time between inverters and bypass supply shall not exceed 4 msec and 20 msec in synchronous and asynchronous mode respectively.

5.3.31 The criteria for load transfer:

A. Load transfer from inverter to the stabilized bypass supply shall be as follows:

I. The load transfer shall only be possible when:

- The stabilized bypass output voltage is within $\pm 5\%$ of rated UPS output voltage.
- The mains bypass frequency is within $\pm 4\%$

II. Auto-transfer of the load from inverter to stabilized bypass supply shall be initiated when:

- The inverter output voltage drops below 95% of nominal output voltage under steady state condition and/or if the inverter output voltage falls below 90% of the nominal value under transient conditions.

OR

- The inverter output voltage exceeds $\pm 10\%$ of the nominal output voltage under steady state condition and/or if the inverter output voltage reaches $\pm 10\%$ of the nominal value under transient conditions.

OR

- The inverter output current exceeds its tolerable limits.

B. Retransfer offload from stabilized bypass supply to the inverter shall be as follows

I. The load transfer shall be possible when

- The inverter output voltage is within $\pm 5\%$ of nominal output voltage for more than 5 sec. and inverter output and stabilized bypass supply are synchronized.

Retransfer of load from stabilized by pass to the inverter shall be done manually only unless otherwise specified in the data sheet.

If automatic retransfer of load to the inverter is specified in the data sheet, then the retransfer of load to the inverter shall be inhibited following four automatic transfers of load to stabilized by pass within a period of 5 minutes.

5.3.32 All breakers shall be adequately rated for continuous rating as well as breaking capacity as applicable. Paralleling of breaker/ switch/ contactor poles to achieve the required current rating is not acceptable. All output isolating device shall be double pole type.

5.3.33 All electronic power devices including thyristors, transistors (IGBTs), diodes etc. shall be

rated under operating conditions for approximately 200% of the maximum current carried by the device. All other electrical components such as transformers, reactors, breakers, contactors, switches, bus bars etc. shall be rated for at least 125% of the maximum required rating. No electronic device shall be subjected to PIV greater than 50% of its rated value.

- 5.3.34 All the thyristors, power transistors, diodes and other electronic devices of UPS shall be protected with high-speed semiconductor fuses. Co-ordination between fuse and semiconductor power devices shall be ensured.
- 5.3.35 The outgoing circuits of ACDB shall be protected by semiconductor fuses. Each inverter shall be designed to clear a fault in any of the branch circuits up to a minimum rating of 25% of the system capacity without the assistance of the stabilized bypass supply. In case of any fault in branch circuits, the load connected to the healthy circuits shall not get affected. The fault clearing time shall be less than 4 msec.
- 5.3.36 All PCBs shall be provided with a transparent epoxy coating for environmental protection and topolization. They shall be suitably located away from heat sources.
- 5.3.37 All electronic control and monitoring printed circuit cards shall be installed in standardized electronic equipment frames and shall be fitted with suitable means for easy removal. The frames shall incorporate guides for PCBs to facilitate correct insertion of PCB's and shall allow access to the wiring side of the connectors. All PCBs shall be placed in a manner to avoid replacement of a PCB by a wrong spare PCB. Monitoring points shall be provided on each of the PCB's and the PCB shall be firmly clamped in position so that vibration or long usage do not result in loose contacts. Failure of each PCB shall be indicated by visual alarms. Visual fault diagnostics shall preferably identify faults up to various sections in the card
- 5.3.38 Forced ventilation of panel, if provided, shall be supplemented by 100% redundant fan. In normal operation, normal & redundant fans shall run together. The power supply for the fans shall be tapped from the inverter output. However, the rating of the UPS as specified in the data sheet shall be the net output of UPS after deducting power consumption for fans etc. However in case of non-operation of 50% of running fans the UPS output shall not be affected. The fans shall be arranged to facilitate removal of faulty fan for maintenance without requiring system shutdown. All fans shall be equipped with monitoring facilities to provide an alarm in the event of fan failure.
- 5.3.39 Maximum noise level from UPS system at 1-meter distance, under rated load with all normal cooling fans shall not exceed 75 dBA.

5.4 Construction

- 5.4.1 Rectifier/charger and inverter, stabilized bypass supply and static switch sections shall be suitably housed in sheet steel panels complete with all interconnections.

UPS panels, ACDB and cell booster enclosures shall be fabricated from structural/CRCA sheet steel. The frames shall be fabricated by using minimum 2mm thick CRCA sheet steel while the doors and covers shall be made from 1.6 mm thick CRCA sheet steel. Wherever, required suitable stiffeners shall be provided.

The panels shall be free standing, fitted with suitable louvers for ventilation and cooling fans as required. Hinged doors shall be provided at the front and back with dust tight gaskets. Inter-panel sheet steel barriers shall be provided. The enclosure shall provide minimum IP-31 degree of protection, if not specified otherwise in the data sheet. The maximum and minimum operating height of the switches shall be 1800 mm and 300 mm respectively.

- 5.4.2 Power cables shall be with aluminium/ copper conductors and control cables shall be with copper conductors. All the cable connections shall be from bottom and front of the panel, if not specified otherwise in the data sheet. A removable bolted gland plate shall be provided along with single compression type nickel-plated brass cable glands for external cable connections. Clamp type terminals shall be used for connection of all wires up to 10 mm² • Bolted type terminals suitable for cable lugs shall be provided for wire size above this. Tinned copper lugs for all external connections shall be provided with the panels. Terminals shall be provided for all external connections. Interconnection cables for cubicles located side to side shall be supplied. All interconnecting cables, as required between UPS system and ACDB, UPS system and batteries shall be in the scope of vendor.
- 5.4.3 Bus bars shall be used in all power circuits which are rated above 100 Amp. Copper conductors PVC/XLPE insulated cables or wires of 660V grade shall be used for power circuits rated less than 100 Amp. Bus bars shall be color-coded and live parts shall be shrouded to ensure complete safety to personnel intending routine inspection by opening the panel doors. All the equipment inside the panel and on the doors shall have suitable name plate and device tag numbers as per the schematic diagram. All wires shall be ferruled and terminals shall be numbered.
- 5.4.4 MCCBs and load break power switches shall be mounted inside the panel. The control switches shall be rotary type mounted on the door and shall be externally operable. An 11W LED lamp controlled through a door switch shall be provided for illumination in each panel. All instruments shall be analogue/digital, switchboard type, back connected, 72 x 72 mm. square (for Analogue type). Analogue instruments shall be preferred. Analogue instruments' scale shall have red mark indicating maximum permissible operating rating. Separate test terminals shall be provided for measuring and testing of the equipment to check the performance.
- 5.4.5 A suitably sized earth bus shall be provided at the bottom of the panels including ACDB running through the panels line up with provision for earth connection at both ends to purchaser's main earth grid. The minimum size of earth bus shall be 25 x 3 mm² copper (or

equivalent aluminium). All potential free metallic parts of various equipments shall be earthed suitably to ensure safety.

- 5.4.6 All panels shall be of same height so as to form a panel line up which shall have good aesthetic appearance. ACDB can be of different height that of UPS panels.
- 5.4.7 Inside the panels, the controls connections shall be done with 660V grade PVC/XLPE insulated wires having stranded copper conductors. 1.5 mm² size wires shall normally be used for circuits with control fuse rating of 10 Amp. or less. For control circuit having fuse of 16 Amps, 2.5 mm² size wires shall be used. Control wiring for electronic circuits shall be through flat ribbon cable or through copper wire minimum of 0.5 mm dia.
- 5.4.8 All control wiring shall preferably be enclosed in plastic channels or otherwise neatly bunched together. Each wire shall be identified at both ends by PVC ferrules. Ferruling of wires shall be as per relevant IS.
- 5.4.9 All metal surfaces shall be thoroughly cleaned and de-greased to remove mill scale, rust, grease and dirt. Fabricated shall be pickled and then rinsed to remove any trace of acid. The under-surface shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc chromate primer. The under-surface shall be made free from all imperfections before undertaking the finished coat.
- 5.4.10 After preparation of the under-surface, the panels shall be spray painted with two coats of epoxy- based final paint or shall be powder-coated. Spray painted finished panels shall be dried in stoving ovens in a dust-free atmosphere. Panel finish shall be free from imperfections like pinholes.

5.5 Cell Booster

- 5.5.1 Cell booster shall be suitable for charging not only the new cells before being introduced to the battery bank but also any treatment to be given to the individual weak cells. Quantity of such boosters shall be as defined in the MR. Cell booster shall be suitable for 240 V $\pm$ 10%, 50 Hz $\pm$ 3% SPN input power supply. Cell booster output voltage shall be in the range of 0-18V and 0-12V for Lead Acid and Nickel Cadmium batteries respectively. Cell booster current rating shall be as under:

For Lead Acid battery = $0.14 \times \text{Ah of cell (10 hr. Rating of the cell)}$

For VRLA battery = $0.2 \times \text{Ah of cell (10 hr. Rating of the cell)}$

For Ni-Cd battery = $0.2 \times \text{Ah of cell (5 hr. Rating of the cell)}$

Cell booster shall have heavy duty switch fuse or MCCB on AC incomer and DC output, AC voltmeter, DC ammeter and voltmeter, indicating lamp for AC/ DC power ON. The output voltage and current of cell booster shall have manual control using a suitably rated variac or a full wave controlled rectifier bridge. Suitable interlock shall be provided, to ensure that the variac/ controlled rectifier is at its minimum position while switching on the cell booster. Cell booster shall be portable type with wheels. Each cell booster shall be supplied

with 5 m long flexible copper conductor, PVC insulated and braided cable for AC incomer power supply and DC output connection to the battery.

5.6 A.C. Distribution Board

Sheet steel enclosed AC distribution board shall be provided. It shall accommodate AC feeders as indicated in the data sheet. The distribution board shall be floor mounted fixed type with compartmentalized construction unless otherwise indicated in the data sheet. The switchboard shall be provided with two incomers (one from UPS & another from Bypass supply) with adequately rated Switch/MCCB/ACB. It shall be possible to operate the switches without opening the doors. Switches shall be provided with door interlock. Vertical cable alley of minimum 200mm width with suitable supports shall be provided for the termination of outgoing cables. Suitable supports shall be provided for supporting incoming and outgoing cables. All outgoing switches shall be air insulated load break type. Fuses on outgoing feeders shall be fast acting semiconductor type and cable entry shall be from bottom. Isolation transformers (if required) shall be mounted inside ACDB. HRC fuses shall be provided for isolation transformer feeders. The gland plate of the distribution board shall be non-magnetic type where single core cables are used as specified in the data sheet. Cable glands shall be of brass and single compression type and cable lugs shall be of tinned copper

5.7 Alarm, Control, Indication and Metering Requirements

If not specified otherwise in the data sheets, following schedule shall be followed for alarm, control, indication and annunciation. Any additional devices/features considered necessary for reliable operation and maintenance shall also be included in various panels and same shall be highlighted separately. An illuminated one line diagram indicating operational status shall be provided on the front of the panel. Metering, indications, audio-visual alarm shall be provided. Parameters/ information indicated shall be available by menu driven LCD display or by other means directly or indirectly.

5.7.1 Metering

5.7.1.1 Rectifier

- a. Incoming line voltages (For all the three phases).
- b. Input line currents.(For all the three phases)
- c. DC voltage at each rectifier output
- d. Battery current

5.7.1.2 Inverters

- a. AC voltage at each inverter output (AC voltages for 3 phase inverter) ·
- b. AC current at each inverter output (AC currents for 3 phase inverter)
- c. Frequency meter at each inverter output

5.7.1.3 Stabilized bypass supply

- a. Frequency meter for incoming supply.
- b. Voltmeter with selector switch for incoming supply.
- c. Ammeter with selector switch for incoming supply

5.7.1.4 ACDB

- a. Voltmeter (voltmeter selector switch shall also be provided for 3 phase inverter).
- b. Ammeter (ammeter selector switch shall also be provided for 3 phase inverter).
- c. Power factor meter

5.7.2 Indications

All indicating lamps shall be LED type. LEDs provided for indication shall be cluster type with adequate brightness and minimum 2Nos LEDs chips per light. LEDs shall be connected in parallel and each LED chip having diameter not less than 3 mm. LEDs shall be provided for following-

- a. AC mains 'ON' - Rectifier.
- b. AC mains 'ON' - Bypass

5.7.2.1 Rectifiers (for each rectifier)

- a. Rectifier output 'ON'
- b. Battery on float charge
- c. Battery on rapid charge

5.7.2.2 Inverters (for each inverter)

- a. DC input 'ON'
- b. Load on inverter.
- c. Inverter synchronized with mains

5.7.2.3 Load on bypass

5.7.3 Audio-Visual Alarm (separately for each circuit)

- a) Mains failure
- b) Battery charger failure
- c) Battery fault
- d) Inverter temperature high
- e) Low voltage from inverter
- f) Load on bypass
- g) Inverter overloaded
- h) All power Fuse failures
- i) DC earth fault

5.7.3.1 Two no's changeover contacts shall be wired to the terminal strip, 1 no for common remote alarm of 'UPS fault' in owner's panel and 1 no for 'load on bypass supply'

annunciation.

5.7.3.2 UPS shall also be provided with provision to hook up all indication and audio visual alarm, as specified in clause no.: 5.7.2 and 5.7.3 above, with owner's PC through RS232/RS485 / fiber optic port through serial interface

5.7.4 Controls

- a. All the switches for starting, shut down and testing sequence
- b. Primary input circuit breakers for feeding chargers, bypass line and DC bus from battery including backup protection.
- c. Inverter ON/OFF switch (to initiate inverter operation)
- d. Static switch transfer test Push Button

5.8 Reliability

All necessary care shall be taken in selection, design, manufacture, testing and commissioning of the equipment for ensuring high system reliability. Following design consideration shall be taken into account to ensure maximum availability of the system.

- 5.8.1 There shall be no common device, between main and redundant units (e.g. master oscillators etc.) in order to ensure that the failure of the same does not cause shutdown of more than one unit.
- 5.8.2 It shall be possible to take out any individual power circuit for maintenance without affecting the total UPS supply.
- 5.8.3 Series-parallel combination of smaller devices to achieve required rating shall not be acceptable.
- 5.8.4 Vendors shall offer their nearest higher standard size that will meet the requirement of the specified UPS rating.

5.9 Fault Diagnostic Unit

If specified in the data sheet, each UPS set shall have provision for adding microprocessor based 'ON line' fault diagnostic unit. This shall supervise the UPS operation continuously. It shall identify and locate faults immediately so that corrective action can be taken. Fault Diagnostic unit shall be compatible to hook up with owner's PC through RS232/RS485 interface. The software shall be provided on a CD ROM.

The. Fault diagnostic unit shall have provision for automatic print out facilities for time, input/output voltages, currents, frequency as a minimum under the following conditions-

- UPS power source changeover from mains to battery
- UPS power source changeover from battery to mains.
- Changeover from inverter to stabilized bypass supply and vice versa.

- Changeover from one inverter to other inverter.
- Changeover time in case of inverter to stabilized bypass supply and from one inverter to other inverter.
- UPS failure.
- Type of failure incident along with diagnostic report.

In addition to the above, any other feature which vendor feels may be useful shall be provided and highlighted separately.

If any Additional equipment (e.g. bin connector, adaptor cards etc.) are required for connecting this unit with UPS system as well as with owner's PC, the same are also to be included in the vendor's scope

6.0 INSPECTION, TESTING AND ACCEPTANCE

- 6.1 During fabrication, the equipment shall be subjected to inspection by EIL / Owner or by an agency authorized by the Owner. Manufacturer shall furnish all necessary information concerning the supply to EIL/ Owner's inspector. Tests shall be carried out at manufacturer's works under his care and expense.
- 6.2 For testing requirement, Inspection and test plan for uninterrupted power supply system (6-81-1017) shall be followed

7.0 SITE ACCEPTANCE TESTS

Vendor shall furnish Site Acceptance Tests procedure to be followed. Final acceptance testing along with the batteries shall be done at site. It shall be Vendor's responsibility to arrange necessary instruments and tools as required by their commissioning engineer for these tests.

8.0 PACKING AND DESPATCH

All the equipment shall be divided in to several shipping sections for protection and ease of handling during transportation .The equipment shall be properly packed for transportation by ship/rail or trailer. The equipment shall be wrapped in polyethylene sheets before being placed in wooden crates /cases to prevent damage to the finish. Crates /cases shall have skid bottoms for handling. Special notations *such as Fragile*, *'This side up'*, center of gravity', 'weight', ' Owner's particulars', 'PO nos.' etc. shall be clearly marked on the package together with other details as per purchase order. The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains and high ambient temperature unless otherwise agreed. In order to prevent movement of equipment/ components within the crates, proper packing supports shall be provided. A set of instruction manuals for erection, testing and commissioning, a set of operation and maintenance manuals and

a set of final drawings shall be supplied along with the shipment duly enclosed in a waterproof cover.



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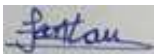
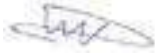
STANDARD DATASHEET
FOR UNINTERRUPTED POWER SUPPLY

DOC NO: VCS-SS-EL-4031
Rev. No : 03



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VCS Quality Services Pvt Ltd

**STANDARD DATASHEET
FOR
UNINTERRUPTED POWER SUPPLY
VCS SS EL-4031**

					
03	18.04.2026	FJ	VV	AA	AA
02	05.03.2022	SP	RD	AA	HK
01	16.10.2019	MG	VV	AD	SK
00	05.07.2017	MG	RD	AD	SK
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PART ONE PURCHASER'S DATA FOR UPS		
1. INPUT POWER SUPPLY		
1.1.	Voltage/freq./ phase:	☒ 415 V (+) 10% & (-) 15%, 3 Φ , 50 Hz $\pm$ 5%. with automatic healthy phase selector. ☐ 230V (+) 10% & (-) 15%, 50 Hz $\pm$ 5% with automatic healthy Phase selector / As per SOR
1.2.	System fault level	10 kA for 1 Sec
2. SITE CONDITION		
2.1	Design Maximum / Minimum temperature	50°C/20°C
2.2	Max. Relative Humidity	95%
2.3	Altitude	Below 1000 M MSL
3. OUTPUT REQUIREMENT		
3.1.	Voltage/ Phase	☒ 230V $\pm$ 1% AC, Single phase 2 wire ☐ 415V, 3 Φ , 4 wire
3.2.	Output waveform & frequency	Pure Sinusoidal Wave 50 Hz $\pm$ 0.1% Voltage distortion (THD): Less than 3% for linear loads & Less than 5% for non-linear loads.
4. SYSTEM REQUIREMENTS		
4.1.	Rating KVA	As per SOR
4.2.	Type of inverter	The inverter circuit should be IGBT based, fully microprocessor controlled with PWM Technology or Latest proven technology
4.3.	Overload capacity	125% of the rated output for 10 minutes & 150% for 1 minute.
4.4.	Mode of operation	- Parallel Redundant with stabilized bypass - Single UPS With stabilized bypass as specified in SOR/Block diagram
4.5.	Stabilizer Type	☒ Servo stabilizer ☐ Static stabilizer
4.6.	Bypass switch	☒ Static switch ☐ Relay
4.7.	Inverter efficiency	>85% at 100% of load and >80% at 25% of load
4.8.	Installation	Floor Mounted
4.9.	Type of enclosure	Minimum IP-31
4.10.	External Cable Connection	From Bottom



4.11.	Internal protection	All live parts shrouded
4.12.	Earthing	Doubly Earthed (Two distinct terminals to be made available)
4.13.	Cooling	Forced ventilation with fans
4.14.	Noise Level	<65 dB at full Load from 1 mtr distance (for UPS of rating 5kVA, 7.5kVA & 10kVA) <75 dB at full Load from 1 mtr distance (for UPS of rating 15kVA & 20kVA)
4.15.	Crest Factor	3:1
4.16.	Input Power Factor	> 0.95
4.17.	Load Power Factor	between 0.6 to 1.0
4.18.	Overall efficiency	> 80%
4.19.	Harmonics	As per IEEE 519 (Total demand distortion not more than 5.0%)
5. Rectifier/Charger		
5.1.	Input voltage	☒ 415 V (+) 10% & (-) 15%, 3 , 50 Hz $\pm$ 5% OR ☐ 230V (+) 10% & (-) 15%, 50 Hz $\pm$ 5% with automatic healthy Phase selector / As per SOR
5.2.	Automatic phase selection device	As per SOR
5.3.	Output DC voltage/Load	As per Manufacturer Design
5.4.	Input Power factor	> 0.95 at rated load
5.5.	Input current THD (Total Harmonic Distortion) at nominal load	$\leq$ 5 %
5.6.	Overload Capability	125% minimum for 10 min. 150% minimum for 1 min
5.7.	Inrush current	Limited by soft-start circuit
5.8.	Output voltage tolerance	+/- 1%
5.9.	DC voltage ripple	<1% With battery connected <2% Without battery connected
5.10.	Rectifier	IGBT based
5.11.	Filter	Input side line filter
5.12.	Harmonics	As per IEEE-519 (Voltage THD <5%, largest single voltage harmonics <3%, Input Current THD <5%)
5.13.	Charging	Automatic Float and Boost charging Manual boost charging option to be provided.
6. Bypass		
6.1.	Manual/Maintenance Bypass	Shall be provided
6.2.	Overload on bypass	125% minimum for 10 min. 150% minimum for 1 min.
7. Battery Bank		
7.1.	Type of Battery	As per SOR
7.2.	Battery Arrangement	1x100% or 2x50% as per SLD
7.3.	Battery end cell voltage	As per specification
7.4.	Battery stand formation	As per vendor standard
7.5.	Battery backup time	As per SOR
7.6.	De-rating factor	(i) Ageing 0.8



		(ii) State of Charge 0.88 (iii) Temp. Correction 0.95 The rectifier/charger output current & voltage shall be limited to the battery supplier's recommendation
8. Alarms, Indications and LCD Display		
8.1.	Single line Power Flow Diagram (Mimic diagram) with LED indications of UPS status (i.e. Mains present, Battery charging & discharging, Low battery Voltage and unit on bypass).	
8.2.	Digital panel Meter with LCD display (touch screen / touch pad) shall be provided for monitoring viz.	As per vendor standard
8.3.	Audible Alarms With LCD play-	As per vendor standard
9. Protective Features		
9.1.	Input	Mains Over voltage, under voltage, phase failure
9.2.	Inverter	Over voltage, short circuit, overload, over temperature
9.3.	Battery	Under voltage at battery terminal, Battery over charge, Battery Over current
9.4.	Rectifier & Battery charger	Maximum current limiting Over temp. Trip Boost charging and float charging current limiting with back up protection against overcharging.
10. Distribution boxes		
10.1.	Distribution Board Details	(As per tender drawings / SOR) (1) ACDB 230V, Single Phase (1 No.): Incomer / Outgoing: As per SOR/ Block Diagram. (The rating of above-mentioned feeders may change during detail engineering; Bidder shall provide all required feeders as per requirement without any financial implications.)
11.	UPS communication	Ethernet / preferably Modbus RS 485



PART 2 TECHNICAL DATA FROM MANUFACTURER (To be filled up by the Tenderer)		
1. INVERTER		
1.1.	Manufacturer's Model No. (Enclose catalogue)	
1.2.	Rating (at specified ambient) / no. of phases	
1.3.	Applicable codes/standards	
1.4.	Steady state output volt/freq (230 V + 1%) (50 Hz + 0.1%)	
1.5.	Input voltage - DC	
1.6.	Synchronization (inv. phase locked with main) in percentage	
1.7.	Synchronization manually adjustable in steps of	
1.8.	Deleted	
1.9.	Harmonics distortion for linear & non-linear loads	
1.10.	Recovery time to reach steady state after above disturbance (not more than 100m Sec)	
1.11.	Overload capacity (125% minimum for 10 min. 150% minimum for 1 min.)	
1.12.	Short circuit capacity and duration (in % and msec.)	
1.13.	Noise Level (dB at 1 m) <65 dB at full Load from 1 mtr distance (for UPS of rating 5kVA, 7.5kVA & 10kVA) <75 dB at full Load from 1 mtr distance (for UPS of rating 15kVA & 20kVA)	
1.14.	Type of control circuit	
1.15.	Output voltage & phase angle (for 3 Phase only) a. For 30% unbalance load b. For 40% unbalance load c. For 50% unbalance load d. For 100% unbalance load	
1.16.	Crest Factors	
2. BATTERY CHARGER		
2.1.	Rating (Amp.) / MAKE (Enclose back up calculation).	
2.2.	Type of charger (Basic configuration)	
2.3.	Output volt under float/boost charging condition	
2.4.	Volt. Accuracy under specified input ($\pm 1\%$)	



2.5.	Max. Ripple content on DC side (% RMS) (not more than 2% without battery & 1% with battery connected)	
2.6.	Efficiency at 100%/75%/50 % of load	
2.7.	Mode of Change over from float to boost and vice- versa	
3. BATTERY		
3.1.	Make	
3.2.	Type (Enclose catalogue)	
3.3.	AH rating (Enclose back up calculation)	
3.4.	End cell voltage at specified discharge rate (V/ cell)	
3.5.	Output (Nominal) volts	
3.6.	Nos. of battery banks	
3.7.	Nos. of cells in each banks	
3.8.	Battery charging requirements (V/ cell) (i) Volts/Cell/Nominal/ (ii) Float (iii) Boost	
3.9.	Voltage variation from fully charged battery to discharged battery (volts)	
3.10.	Charging time (Hrs.)	
3.11.	Max. Permissible ripple content (% RMS)	
3.12.	Overall dimension (L*W*H)	
3.13.	Container type	
3.14.	Accessories for battery as per specification included	Cell testing Voltmeter, Pair of Gloves, Insulated Spanner, ExtraElectrolyte, Hydrometer, Thermometer etc.
3.15.	Type/Formation of battery stand	
4. MANUAL TRANSFER DEVICES		
4.1.	Rating (Amp.).	
4.2.	Make/Type	
5. AC DISTRIBUTION BOARD		
5.1.	Nos. of feeder/rating	
5.2.	Cable entry from (Bottom)	
5.3.	Max. Rating of outgoing feeders possible for fault clearance by UPS with and without supply back up (as percentage of UPS rating) not less than 25% a) With fast acting semi conducting fuses	
6. Indications and Alarm Provided		
7. Metering Provided		



8.	UPS Dimension (L x W x H) except Battery: (Including inverter, charger, rectifier, bypass stabilizer, ACDB etc.)	
9.	OVERALL EFFICIENCY OF UPS SYSTEM	
1.1.	Ratio of output load to input drawn from mains when inverters are on and synchronized with bypass. a) At 100% load a) At 75% load b) At 50% load	
10.	RELIABILITY a) Safety factor used for selecting electronic components/ other electrical components (not less than 200%/ 125% respectively) b) MTBF / MTFR c) Availability factor	
11.	DEGREE OF PROTECTION OF THE PANEL	
12.	Heat loss for total system (W)	
13.	Potential free contracts (for duplicating of fault status in remote panel).	
14.	Fault status shall be compatible to hook-up with Operator's PC through Ethernet/ preferably RS 485 interface (To be decided during detailed engineering).	

CHECK LIST (To be submit along with Datasheets)

Sl. No	Description	REMARKS
1.	Deviation from specification	
2.	Charger sizing calculation enclosed	
3.	Battery sizing calculation enclosed	
4.	Battery catalogue enclosed	
5.	UPS Panel Catalogue enclosed	
6.	Confirm compliance to Block diagram	
7.	Confirm Inspection for UPS and battery as per specification	
8.	Dimension for UPS Panel, rectifier and Battery Bank enclosed.	



Energising Quality

VCS Quality Services Pvt. Ltd

STANDARD SPECIFICATION FOR SEALED MAINTENANCE FREE VRLA BATTERIES

VCS – SS – EL - 4042

02	14.03.2022	SP	RD	AA	HK
01	16.10.2019	MG	VV	AD	SK
00	05.07.2017	MG	RD	AD	SK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

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CONTROLLED COPY	:	If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	05.07.2017	MG	RD	AD	SK	Issued for use as Standard
01	16.10.2019	MG	VV	AD	SK	New revision system updated
02	14.03.2022	SP	RD	AA	HK	New revision system updated

ABBREVIATION

BIS/IS	Bureau of Indian standards
IEC	International Electro-Technical Commission
BS	British Standards
IEEE	Institute of Electrical and Electronics Engineers
NEMA	National Electrical Manufacturers Association
OISD	Oil Industries Safety Directorate
CCE	Chief Controller of Explosive
DGMS	Director General Mines Safety
IE Rules	Indian Electricity Rules
CPRI	Central Power Research Institute
DC	Direct Current
Ah	Ampere hour
PVC	Poly Vinyl Chloride
VRLA	Valve-regulated lead-acid

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1.0 SCOPE

The intent of this Specification is to define the design, manufacture, testing & supply of stationary SEALED MAINTENANCE FREE VRLA batteries for DC power system /AC UPS application.

2.0 REFERENCE DOCUMENTS

- 2.1 The equipment shall comply with the requirements of the latest revision of the following Standards issued by BIS (Bureau of Indian Standards) unless otherwise specified.

IS-15549	Stationary SEALED MAINTENANCE FREE VRLA batteries
ANSI T1 330	SEALED MAINTENANCE FREE VRLA Batteries used in the telecommunication Environment.
ASTM D2863	Test method for measuring the minimum oxygen concentration to support candle like combustion of plastics (Oxygen Index).
IEC 60896-21	Stationary lead-acid batteries - Part 21: VRLA types -Methods of test
IEC 60896-22	Stationary lead-acid batteries - Part 22: VRLA types- Requirements
IEC-60068-2	Environmental testing

- 2.2 The equipment shall also conform to the provisions of CEA regulations with latest amendments and other statutory regulations currently in force in the country.
- 2.3 In case of imported equipment, Standards of the country of origin shall be applicable if these Standards are equivalent or more stringent than the applicable Indian Standards.
- 2.4 The equipment shall also conform to the provisions of Indian Electricity Rules and other statutory regulations currently in force in the country.
- 2.5 In case Indian Standards are not available for any equipment, Standards issued by IEC/ BS/ VDE/ IEEE/ NEMA or equivalent agency shall be applicable.
- 2.6 In case of any contradiction between various referred Standards / Specifications / Data Sheets and statutory regulations, the following order of priority shall govern:
- Statutory regulations.
 - Data Sheets.
 - Job Specification.
 - Standard Specification.
 - Codes and Standards.

3.0 DEFINITIONS

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

OWNER / COMPANY OWNER of the particular Project (Project Specific).

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

4.0 MATERIALS

- 4.1 The terminal posts shall be suitable for acidic condition operation. The terminals shall be suitable for short circuit current and specified discharge current without damage to the cell as a result of terminal heating.
- 4.2 Stationary SEALED MAINTENANCE FREE VRLA cells shall be designed to withstand the mechanical stresses encountered during normal transportation and handling.

5.0 DESIGN

5.1 General Requirements

- 5.1.1 The offered equipment shall be brand new with state-of-the-art technology and proven field track record. No prototype equipment shall to be offered.
- 5.1.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment for at least 3 years from the date of supply.
- 5.1.3 Vendor shall give a notice of at least one year to the end user of equipment before phasing out the product/ spares to enable the end user to place order for spares and services.

5.2 Technical Requirements

- 5.2.1 The standard rated ampere hour capacity of the cell/ battery shall be at a reference temperature of 27°C, constant current discharge at 10 hours rate (C10) and an end cell voltage of 1.85V/cell.
- 5.2.2 The SEALED MAINTENANCE FREE VRLA cell/battery shall be suitable for float duty operation with a constant voltage permanently applied to its terminals which is sufficient to maintain it in a state close to full charge and shall be designed to supply load in the event of normal power supply failure. Type of plate construction for batteries shall be as per the Data Sheet.
- 5.2.3 The components such as containers, lids, covers and seals used in manufacture shall meet the Fire, flame and smoke resistance rating as defined in IS 15549 and have an oxygen Index of at least 28 in accordance with ASTM D-2863.

- 5.2.4 Each cell/battery shall have a separate container of 2.0V (nominal voltage). The cell container shall be made of high strength acid resistant material and designed to withstand mechanical stresses, shocks, vibrations and shall be consistent with the life of the battery.
- 5.2.5 The design of SEALED MAINTENANCE FREE VRLA cell shall be such that regulating valve shall not allow the gas (air) to enter into the cell but shall allow the gas to escape from the cell above certain internal pressure which shall not lead to deformation or cause container to crack or cause failure of seals or shall not cause bulging/ cracking of cell cover.
- 5.2.6 The hydrogen released from SEALED MAINTENANCE FREE VRLA cells shall be sufficiently low to make these cells suitable for use in office, control rooms and equipment environments. The gas leakage rate of the cell shall not exceed 0.05cm³/hr at 27°C and 101.3kpa
- 5.2.7 SEALED MAINTENANCE FREE VRLA stationary cells/battery shall be designed to withstand the mechanical stresses encountered during normal transportation and handling.
- 5.2.8 The terminal posts shall be casted of lead alloy with copper/brass insert for enhancement of conductivity. The terminals shall be suitable for maximum discharge current and short circuit current without damage to the cell as a result of terminal heating. The temperature of the SEALED MAINTENANCE FREE VRLA cells shall be sufficiently low to prevent thermal runaway (critical condition arising due to constant voltage charging).
- 5.2.9 On float, the cell/battery shall be suitable for being recharged to 90% of ampere hours within 24 hours and to 100% within 4 days
- 5.2.10 Ampere hour of the battery shall be selected based on the following:
- a. Minimum site ambient temperature of 10°C or as defined in the Data Sheet.
 - b. Discharge duty cycle.
 - c. End cell voltage.
 - d. Ageing factor of 0.8
 - e. Design margin of 10%, if not defined in the Data Sheet
 - f. Capacity rating factor.
- 5.2.11 Number of cells and end cell voltage shall be decided by the Vendor on the basis of maximum permissible voltage to the load when batteries are float charged while feeding the Load and minimum DC system voltage. However, the number of cells and end cell voltage shall be as per the Data Sheet, unless otherwise specified.
- 5.2.12 The battery shall be suitable for being boost charged to fully charged condition from fully discharged condition within 10 hours, unless otherwise specified.
- 5.2.13 Battery assembly shall be supplied fully charged condition.
- 5.2.14 The following information shall be permanently marked on the cell.
- a. Nominal voltage

- b. Name of manufacturer/model reference
- c. Rated capacity in ampere hours (Ah) with End Cell Voltage
- d. Voltage for float operation at 27°C with tolerance of $\pm 1\%$, Month and year of manufacture
- e. Polarity Marking.

5.2.15 Each set of battery shall be supplied with all the accessories, including, but not limited to the following:

- a. Battery stands in formation as per Data Sheet. Mild steel stand pretreated and epoxy painted /PVC coated.
- b. Inter cell, inter row and interbank connectors and end take offs. These shall be of tin plated copper/flexible-insulated copper cable.
- c. Stand insulator & Portable voltmeter for cell voltage measurements.
- d. Cell number plates, Lugs for cable termination.
- e. Other accessories and their quantity as per Data Sheet.

5.3 Performance

SEALED MAINTENANCE FREE VRLA Stationary batteries shall have been type tested to meet the performance requirements for each design and Ah rating of cells as per the relevant Indian standard referred in clause 2.1 above.

5.4 Site condition

SEALED MAINTENANCE FREE VRLA stationary cell/battery shall be suitable for operating satisfactorily in humid and corrosive atmosphere found in fertilizer plants, refineries, CNG stations, petrochemical and gas processing plants, metallurgical plants and other industrial plants. Service conditions shall be as specified in the data sheets/job specification. If not specifically mentioned therein, a design ambient temperature of 45°C and an altitude not exceeding 1000m above MSL shall be considered, with minimum temperature of 10°C for battery sizing.

6.0 FABRICATION

- 6.1 Flame arrestor shall be mounted on the cell so that all the vented gases diffuse through the arrestor to the outside environment. The construction of the arrestor shall be such that hydrogen burning on the external surface of the arrestor shall not propagate back into the cell to cause explosion.
- 6.2 Each cell shall have a separate container. The cell container shall be of high strength alkali resistant material and designed to withstand mechanical stresses, shocks and vibrations. The cell container shall be translucent /transparent.

7.0 INSPECTION AND TESTING

- 7.1 Batteries shall be subject to inspection by Consultant/Owner or by an agency authorized by the Owner to assess the progress of work. The manufacturer shall furnish all the necessary information concerning the supply to Consultant/Owner's representative.
- 7.2 Consultant/Owner's Representative shall be given free access in the works from time to time for stage wise inspection and progress reporting. Four weeks advance notice shall

be given to witness the final routine tests and other tests as agreed upon.

- 7.3 The routine, acceptance & type testing shall be carried out as per Inspection & test plan for stationary SEALED MAINTENANCE FREE VRLA battery. Routine tests shall be conducted on each cell/battery. Acceptance tests & Type tests shall be conducted on few Cells/batteries as per relevant Indian standard. Battery load test shall also be performed at site after installation as part of commissioning

- 7.4 Following tests shall be carried out as a minimum for each Ah rating of cells/battery:

a. Routine test

- i. Physical examination test.
- ii. Polarity and absence of short circuit.
- iii. Dimension, Mass and layout.
- iv. Marking and packing.

b. Acceptance test

- i. Marking and packing.
- ii. Verification of dimensions.
- iii. Test for Ah capacity
- iv. Test for voltage during discharge
- v. Internal resistance test.

c. Type test

- i. Verification of constructional requirement.
- ii. Test for voltage during discharge.
- iii. Test for Ah capacity.
- iv. Test for charge retention/loss of capacity if specified in the data sheet.
- v. Air pressure test.
- vi. Ampere hour and Watt-hour efficiency test.

- 7.5 Battery duty cycle test to meet the load cycle requirement shall also be performed at site after installation as part of commissioning unless otherwise defined in the Data Sheet.

8.0 MARKING, PACKING AND SHIPMENT

- 8.1 All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for transportation by ship/rail or trailer. The equipment shall be wrapped in polythene sheets before being placed in crates/cases to prevent damage to finish. Crates/cases shall have skid bottom for handling. Special notations such as 'Fragile', 'This side up', 'Centre of gravity', 'Weight', 'Owner's particulars', 'PO nos.' etc., shall be clearly marked on the package together with other details as per purchase order.

The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains/high ambient temperature, unless otherwise agreed.



VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR MV SWITCHBOARD

VCS – SS – EL - 4005

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00	05.07.2017	MG	RD	AD	SK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

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REVISION RECORD						
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01	16.10.2019	MG	VV	AD	SK	New revision system updated
02	25.02.2022	SP	RD	AA	HK	New revision system updated



ABBREVIATION

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



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1.0 SCOPE

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

2.0 REFERENCE DOCUMENTS

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

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

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

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

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



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

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

3.0 DEFINITIONS

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

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

4.0 MATERIALS

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



5.0 DESIGN

5.1 GENERAL REQUIREMENTS

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

5.2 TECHNICAL REQUIREMENTS

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

5.3 SPECIFIC REQUIREMENTS OF AIR CIRCUIT BREAKER PANELS

- 5.3.1 The breaker panels shall have distinct bus bar, breaker and cable compartments.
- 5.3.2 The design of each compartment shall be such as to prevent movement of vermin from a particular compartment to any other compartment of the panel when the breaker is withdrawn and compartment door is closed.



- 5.3.3 Blanking plates shall be provided for each circuit breaker compartments, which would be used after installation, to cover the openings in the event of taking out the breaker outside the compartment.
- 5.3.4 In order to minimize accidental access and avoid accidents due to falling tools, all the outgoing links shall be shrouded.
- 5.3.5 Outgoing Air circuit breaker can be mounted in a maximum of two-tier execution while the incoming/bus coupler Air circuit breaker shall be in single tier execution only.

5.4 CABLE COMPARTMENT

- 5.4.1 Separate compartment totally enclosed from all sides shall be provided for cable termination, on the rear side. Access to cables shall be from the rear side after opening the cabling compartment door.
- 5.4.2 The incoming / outgoing cable termination shall be staggered for each circuit and barriers of sheet steel or insulating material shall be provided between termination of two circuits such that maintenance on one circuit could be carried out while the other circuit is live. Suitable clamping arrangements shall be provided for cables and cable termination. Terminal blocks shall not be used for supporting the cables.
- 5.4.3 The incoming supply for PCC/ PMCC panels shall be through top entry bus ducts or through bottom entry cables unless specified otherwise. The outgoing cables shall have bottom entry unless specified otherwise.
- 5.4.4 The cable terminations shall be suitably sized for receiving specified number of cables per termination and provision shall be made for terminating each outgoing cable with a separate bolted connection. In case the total number of cables entering a particular panel cannot be accommodated in the cabling compartment of the panels an extension panel of full height shall be added to the cabling compartment for accommodating extra cables.

5.5 CIRCUIT BREAKER COMPARTMENT

- 5.5.1 The circuit breaker compartment shall be fully draw out. Suitable guides shall be provided to facilitate easy withdrawal of the circuit breaker.
- 5.5.2 The current transformers for the ammeter/protection circuits shall be mounted on the fixed portion of the compartment. However, current transformers associated with built-in releases may be mounted on the breaker trolley.
- 5.5.3 All terminals except wiping/sliding type control terminals shall be shrouded with plastic covers to prevent accidental contact. For direct termination - clip on shrouded type terminals shall be provided.
- 5.5.4 There shall be three positions for the draw out trolley viz:
 - a. "Service" position - In this position both power and control circuits shall be connected. This shall be the normal operating position of the circuit breaker.



- b. "Test" position - The power contacts shall be disconnected in this position but the control connections shall not be disturbed, it shall be possible to close and trip the breakers in this position.
- c. "Draw out" Position - both power and control circuits shall be disconnected in this position and breaker removed from the cubicle.

5.5.5 The circuit breaker shall be lockable in "service" and "test" positions. Safety shutters shall be provided when the breaker is in withdrawn/draw out position.

5.5.6 The earth connection must remain connected in "Test" position; Earthing of the unit shall be done with a "pin" or with scrapping earth connections.

5.5.7 The earth connection shall make before the main power / control contacts make and break after the power /control contacts are disconnected. Earthing connection through a plug and socket connection shall not be acceptable.

5.6 INTERLOCKS

Following interlocks shall be provided:

5.6.1 Compartment doors shall be interlocked against opening when breaker is in closed condition. However, it shall be possible to defeat this interlock for inspection purposes.

5.6.2 It shall not be possible to push "in" a drawn-out circuit breaker in closed condition or withdraw a circuit breaker in closed condition.

5.6.3 It shall be possible to operate a circuit breaker only in the defined "Full in" or "service" and "test" position inside the panel. It shall not be possible to operate the breaker in intermediate positions while inserting or withdrawing circuit breaker.

5.6.4 Any unused circuit breaker compartment shall be fully equipped and provided with compartment door, vertical busbars and control terminals/wiring etc., such that the same could be used for housing outgoing breakers in future without any modifications to the panel.

5.7 SPECIFIC REQUIREMENTS OF NON-AIR CIRCUIT BREAKER FEEDERS

5.7.1 The design of draw out feeder modules shall not change for single front or double front execution. Separate vertical bus bars shall be provided for each front side modules.

5.7.2 All identical feeder modules shall be interchangeable.

5.7.3 Each vertical panel shall have a separate cable alley. The width of this cable alley shall be sufficient to accommodate all the cables and shall have free access for cable terminations and in any case shall not be less than 200mm minimum. Cable alleys shall be provided with suitable doors.

5.7.4 Sheet steel barriers shall be provided between individual compartments and cable alley. This barrier shall be provided with opening for power and control connections and it shall be possible to safely carryout maintenance work on cable connections to any one circuit in the cable alley with the busbars and the adjacent circuits live.



- 5.7.5 Maintenance and connection of cables to any modules shall be possible without having to take out the modules from its position from the panel.
- 5.7.6 The outgoing feeder trolleys for draw out type switchboard shall be fully draw out and shall have the following features.
- It shall be possible to withdraw the trolley without having to unbolt or unscrew any power and control connections to the equipment mounted on the withdrawable trolley.
 - Both power and control connections shall be draw out type. All line and bus PTs shall be in draw out execution only. However, outgoing modules having size more than half of the useful vertical height of the panel may be in mixed combination of draw out/fixed type.
 - Control supply transformer modules with burden higher than 2.5KVA may be in fixed execution.
 - The trolley withdrawal shall be by means of crank and screw arrangement. Alternatively movement on guided rollers may also be acceptable. Plug in operation shall be independent of manual force.
 - For draw out type feeders of size equal to or greater than half the useful vertical height of panel, positive clamping arrangement shall be provided on the top portion of the trolley in addition to clamping arrangement at the bottom, to ensure all round positive pressure on the power draw out contacts once the trolley is plugged in.
 - Power draws out contacts shall preferably be located towards the bottom portion of each trolley. The trolley shall be lockable in fully plugged in position and devices shall be provided to ensure positive plugging in. In test position, power contacts shall be totally isolated and a device shall be provided for indication of test position.
 - The incomer and bus tie feeders with load break switches rated 800A and above may be in fixed execution.
- 5.7.7 Various compartment sizes in a vertical panel shall be multiples of a basic dimension. However the minimum module size for switch fuse feeder and motor starter/contactors feeder shall not be less than that defined in Data Sheet/Job Specification. Vertical bus bars shall be pre-drilled at regular intervals for complete flexibility for changes in size of modules.
- 5.7.8 All switch drives other than rotary control switches, shall be lockable in both 'ON' and 'OFF' positions.
- 5.7.9 The Switches / Molded case circuit breakers / MCB shall be interlocked with the compartment door to prevent opening of the door when the Switch/ Molded case circuit breaker is in 'ON' position and to prevent switching on when the door is open. A defeat mechanism for this interlock shall also be provided.
- 5.7.10 The maximum height of the operating handle and switches shall not exceed 1900 mm and the minimum height not below 300 mm.



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

5.8 SWITCHGEAR MODULES

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

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

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

FVR Full voltage reversing starter with minimum 24 control terminals.

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

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

MCCB Molded case circuit breaker.

MPCB Motor Protection circuit breaker

MCB Miniature circuit breaker

ELCB Earth leakage circuit breaker

RCCB Residual current circuit breaker

5.8.4 Type of modules for fixed type switchboard shall be similar to above specified draw out modules except that the modules shall be of fixed type.

5.8.5 Minimum 2000 VA control transformer shall be provided for each bus section of the PMCC/MCC switchboard having contactor control feeders and each transformer shall be sized for the entire switchboard. For switchboard having two bus sections and coupled by bus tie shall have manual changeover switch for the control transformers.

5.8.6 To facilitate site modification due to changes in motor KW ratings and to minimize spares inventory, overload relays and power fuse links shall meet the following requirements.

a. All bimetal overload relays shall be separately mounted type with connecting links rated for the maximum rating of the contactor in a starter module.

b. Bimetal overload relays of various current ranges required for motors likely to be connected to a contactor must be identical in dimension for inter-changeability. In case offered relays are with different dimension for any particular starter module, special mounting plate suitable for mounting different relays shall be provided in all the modules of that size.

c. Heavy duty starters shall be provided with saturable type current transformer



operated overload relays only, which shall be suitable for motor starting time of 15-60 seconds.

- d. All contactor-controlled starter feeders shall meet the requirements of type-2 co-ordination as per IS: 13947.

5.9 SWITCHGEAR COMPONENTS

5.9.1 CIRCUIT BREAKER

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

5.9.2 OPERATING MECHANISM

- a. Electric power operating mechanism shall be motor wound spring charged stored energy type. However, manual-operating mechanism may be of the spring charging stored energy type or the spring assisted type. For circuit breakers with electrical power operating mechanism, provision shall also be made for manual spring charging. Closing time of circuit breakers with manual operating mechanism shall be independent of the speed of the operating handle.
- b. All stored energy operating mechanism shall be equipped with following features.
 - i. Failure of springs, vibrations or shocks shall not cause unintended operation of breaker or prevent intended tripping operation.
 - ii. Closing of circuit breakers shall be prevented unless the spring is fully charged.
- c. All electrical power operating mechanisms shall be suitable for remote operation and shall be equipped with following features.
 - i. Provided with universal motor operable on AC or DC control supplies.
 - ii. Provided with emergency manual charging facility. The motor shall be automatically, decoupled (mechanically) once the manual-charging handle is inserted.
 - iii. Closing operation of circuit breaker shall automatically initiate charging of the spring for the next closing operation without waiting for tripping of circuit breaker.
 - iv. Closing operation shall be completed once the closing impulse is given and the



first device in the control scheme has responded even though the control switch / Push Button is released provided no counter trip impulse is present.

- v. Circuit breaker trip and closing coils in case of electrically operated breakers and trip coil in case of mechanically operated breakers and circuit breaker indication shall be suitable for satisfactory operation on a control supply system indicated in data sheets/job specification.
- vi. Circuit breakers shall be provided with anti-pumping and trip free feature.
- vii. Circuit breakers shall be provided with operation counters.
- viii. Releases are not required to be provided with breakers where relays are used. However, breaker having AC control supply voltage shall be provided with under voltage release unless specified otherwise.

5.9.3 SWITCHES

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

5.9.4 FUSES (shall be used as per client requirements only)

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

5.9.5 CONTACTORS

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

5.9.6 THERMAL OVERLOAD RELAY

- a. Bimetal relays shall be provided for protecting the motor from thermal overload.
- b. Bimetal relays shall be manually reset type with the reset push button brought out on the front of the panel. The reset push button shall be capable of being operated without opening the compartment door.
- c. Bimetal relays shall be positive acting ambient temperature compensated type with



adjustable setting range.

- d. Bimetal relays shall have built-in single phasing prevention feature, which operate even with 50% rated current at the time of single phasing.

5.9.7 MOULDED CASE CIRCUIT BREAKERS

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

5.9.8 RELAYS

- a. All the protective relay shall be provided as per OISD/Engineering standard guideline as per utilization of Electrical panels requirements.
- b. All the type of relay shall be numerical only otherwise static or electromagnetic type if specified in the Data Sheet/Job Specification.
- c. All electromagnetic protective relays shall be back connected, of draw out type, suitable for flush mounting, and fitted with dust-tight covers. Alternatively, "plug-in" type relays will also be acceptable. Auxiliary relays are acceptable in fixed execution.
- d. The protective relay cases shall have provision at the front for "testing and calibration" purposes. It shall be possible to test the relays without disconnecting the wiring and without withdrawing the relays. The insertion of the test plug shall automatically short circuit the CTs and permit extension of external power supply to the relay.
- e. Each protective relay shall be provided with minimum 2 nos. potential free contacts of required configuration.
- f. Each tripping relay shall be lockout type with hand reset coil cut-off contact. The tripping relay shall be suitable for satisfactory operation from 50 % to 110 % of the specified control supply voltage.
- g. Protective relays shall be preferably mounted on the front side and upper part of the panel and mounting of relays on the lower portion shall be avoided.

5.9.9 INSTRUMENT TRANSFORMERS (CTS/PTS)



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

5.9.10 MEASURING INSTRUMENTS

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

5.9.11 CONTROL SWITCHES

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



5.9.12 PUSH BUTTONS:

Push button colors shall be as follows:

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

5.9.13 INDICATIONS

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

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

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

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

5.9.14 AUXILIARY RELAYS/CONTACTORS

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

5.9.15 TIMERS

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

5.9.16 MINIATURE CIRCUIT BREAKER

- a. MCB shall provide high mechanical and electrical life, reliable protection of circuits



against overload and short circuit and shall have minimum breaking capacity of 9KA unless otherwise specified. Positive ON/OFF indication shall be provided.

- b. Earth leakage circuit breaker shall have earth sensitivities range 30mA to 300mA unless otherwise specified.
- c. Residual current circuit breaker shall have sensitivities range 30mA to 300mA unless otherwise specified

6.0 FABRICATION

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



single front execution only.

6.9.4 Motor starter and switch fuse modules shall not be accommodated at front and rear of ACB Incomer and bus coupler panel.

6.9.5 All metering and protection equipment associated with a particular circuit as specified in Data Sheet shall be housed in separate and independent compartment earmarked for that particular circuit and in the fixed portion of the vertical panel in case of breaker panels.

6.9.6 All auxiliary devices for control, reset, indication, measurement and protection such as push buttons, control and selector switches, indicating lamps, measuring instruments and protective relays shall be mounted on the front side of the respective compartment. The design shall be such that all power on/off or start / stop and relay reset operations shall be performed without opening the panel door.

6.10 SPACE HEATERS

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

6.11 AUXILIARY BUS BARS

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

6.11.2 Panel space heater supply and motor space heater supply.

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

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

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

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

6.12 BUS BAR

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

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



of the neutral bus bar.

- 6.12.3 Both horizontal and vertical bus bars, bus joints and supports shall be capable of withstanding dynamic and thermal stresses of the specified short circuit currents for 1 second, The short circuit capacity of the neutral bus bars shall be in line with IS:13947.
- 6.12.4 Only zinc passivated or cadmium plated high tensile strength steel bolts, nuts and washers shall be used for all bus bar joints and supports. The hot spot temperature of bus bars including joints at design ambient temperature shall not exceed 95° C for normal operating conditions.
- 6.12.5 The current rating as defined for switchboard and components in Data Sheet/Job Specification are for design ambient temperature at site conditions and for being inside the cubicle at fully loaded condition. The Vendor shall suitably derate the nominal rating to suit the above condition.
- 6.12.6 All bus bars shall be insulated with heat shrunk PVC sleeves of 1100 V grade. Red, yellow and blue color shall be used for phase bus bars and black color shall be used for neutral bus bars; Removable type shrouds shall be provided for joints.
- 6.12.7 Minimum clearance between live parts, between live parts/neutral to earth shall be 19 mm, however clearances between terminals at components shall be as per applicable individual standards for components.
- 6.12.8 Interconnections between the main bus bars and individual units shall be made by using aluminum bus bars of adequate rating. These interconnections of the vertical bus bars shall be in separate compartment and fully shrouded.
- 6.12.9 Vertical bus bars for circuit breaker panels shall be sized depending upon the rating and number of breakers per vertical panel. However Vertical bus bars of all other panels shall be of uniform cross section, Size of vertical bus bars shall not be less than 500 mm² aluminum per phase or equivalent copper for panels rated above 25kA.

6.13 WIRING AND TERMINALS

- 6.13.1 Inside the cubicles, the wiring for control, signaling, protection and instrument circuits shall be done with BIS approved, PVC insulated, flame retardant type, copper conductor wire. The insulation grade shall be 660 V. The wiring shall preferably be enclosed in plastic channels or neatly bunched, together.
- 6.13.2 PVC insulated copper conductor of cross section 1.5 mm² may normally be used provided the control fuse rating is 10 amps or less. For 16 amps control fuse circuit 2.5mm² copper conductor shall be used. Each wire shall be terminated at a separate terminal. C.T. Circuit wiring shall be done with 2.5mm² Copper conductor.
- 6.13.3 Shorting links/suitable-shortening arrangement for shorting CT. secondary shall be provided. Each wire shall be identified at both ends by PVC ferrules.
- 6.13.4 Inter panels wiring within each shipping section shall be switchboard Vendor's responsibility. For wiring between shipping sections, Vendor shall provide terminal blocks on adjoining shipping sections and supply suitable umpiring wires. Interpanel wiring shall be taken thorough PVC sleeves or rubber grommets.



6.13.5 A minimum of 10% spare terminals shall be provided on each terminal block.

6.13.6 Conductors shall be terminated with adequately sized compression-type lugs for connection to equipment terminals and strips. Stranded conductors shall be soldered at the ends before connections are made to the terminals. Sufficient terminals shall be provided on each terminal block to ensure that not more than one outgoing wire is connected per terminal.

6.13.7 Terminal strips shall preferably be separated from power circuits by metal barriers or enclosures. All spare contacts of auxiliary relays, timers, etc. shall be wired up to the terminals.

6.14 EARTHING

6.14.1 All panels shall be connected to a tinned copper / GI earth bus bar running throughout the length of the switchboard.

6.14.2 The minimum earth bus size shall be 30x6 mm² copper for fault level up to 31.5kA and 50x6 mm² copper for fault level above 31.5kA,

6.14.3 All doors and movable parts shall be earthed using flexible copper connections to the fixed frame of the switchboard. Provision shall be made to connect the earthing bus bar to the plant earthing grid at two ends.

6.14.4 All non-current carrying metallic parts of the mounted equipment shall be earthed. Minimum 4 no's, 10 mm diameter bolts with nuts shall be provided on the earth bus for termination of fourth core of cable per vertical panel.

6.15 NAME PLATE

6.15.1 A nameplate with the switchboard designation shall be fixed at the top of the central panel. A separate nameplate giving details for each feeder compartment of all panels shall be provided.

6.15.2 The nameplates for feeder compartments shall be in two parts. One part shall have necessary details pertaining to the compartments number of vertical panel of the switchboards, The other parts shall be removable and shall contain all details regarding the feeder number for drives/equipment controlled by the particular module as per approved single line diagram.

6.15.3 Blank nameplates shall be provided for all spare and vacant modules.

6.15.4 Nameplate or polyester adhesive stickers shall be provided for each equipment mounted inside the switchboard, Special warning plates shall be provided on removable covers or doors giving access to cable terminals and bus bars.

6.15.5 Special warning labels shall be provided inside the switchboards also, wherever considered necessary. Identification tags shall be provided inside the panels matching with those shown on the circuit diagram.

6.15.6 Engraved nameplates shall preferably be of 3 ply (Black-White Black) lamicoid sheets or anodized aluminum. However back engraved Perspex sheet nameplates may also be acceptable. Nameplates shall be fastened by screws and not by adhesives.



6.16 PAINTING

- 6.16.1 All metal surfaces shall be thoroughly cleaned and degreased to remove mill scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid, The under surface shall be prepared by applying a coat of phosphate paint and coat of yellow zinc chromate primer, The under surface shall be made free from all imperfections before undertaking the finishing coat.
- 6.16.2 After preparation of the under surface, the switchboard shall be spray painted with two coats of epoxy based final paint or shall be powder coated.
- 6.16.3 Color shade of final paint shall be 631 as per IS:5 unless otherwise specified.
- 6.16.4 The finished panels shall be dried in stoving ovens in dust free atmosphere. Panel finish shall be free from imperfections like pinholes, orange peels, runoff paint etc. Vendor shall supply final paint (1 liter per switchboard) in non-returnable container for final touch up at site.
- 6.16.5 All unpainted steel parts shall be cadmium plated or suitably treated to prevent rust formation. If these parts are moving elements, then they shall be greased.

7.0 INSPECTION AND TESTING

- 7.1 During fabrication, switchgear shall be subject to inspection by Consultant / Owner or by an agency authorized by the Owner. Manufacturer shall furnish all necessary information concerning the supply to Consultant / Owners inspectors.
- 7.2 All routine and acceptance tests shall be carried out at Manufacturer's work under his care and expense.
- 7.3 Type tests, if specified shall be performed. Short circuit test shall be performed at CPRI or equivalent approved testing agency and heat run test may be performed at manufacturer's works. Heat run test shall be performed at least on one incomer and two outgoing vertical panels of the ordered switchboard.
- 7.4 Type and shop tests shall be witnessed by an inspector of Consultants / Owner or of an agency authorized by the Owner. Prior notice of minimum 4 weeks shall be given to the Inspector for witnessing the tests.

7.5 ACCEPTANCE TESTS

Acceptance tests shall be as follows:

- 7.5.1 A general visual check shall be carried out. This shall cover measurement of overall dimension, location, number and type of devices, location and connection of terminals etc.,
- 7.5.2 Manual and electrical operation of Circuit Breakers. / Relays shall be checked under the worst conditions of auxiliary supply voltage.
- 7.5.3 Dry insulation test with power frequency voltage shall be conducted for the main and auxiliary circuits.



-
- 7.5.4 Insulation resistance of the main and auxiliary circuits shall be checked before and after power frequency voltage withstand test.
 - 7.5.5 Operation check shall be carried out for every control function /interlocks as per the schematic diagrams by manually simulating fault conditions and operation of control switches/relays etc.
 - 7.5.6 For equipment bought from other sub-suppliers, certified test reports of tests carried out at the manufacturers works shall be submitted. Normally all routine tests as specified in the relevant standards shall be conducted by the sub-supplier at his works.
 - 7.5.7 Interchangeability of similar modules shall be checked on a random basis. This may be done on one module of each size.

8.0 MARKING, PACKING AND SHIPMENT

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



VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR MEDIUM AND HIGH VOLTAGE CABLES

VCS – SS – EL - 4007

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ABBREVIATION

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

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1.0 SCOPE

This Specification along with Data Sheets covers requirements for design, manufacture, testing at works and supply of Flame Retardant PVC/XLPE cables and cable jointing / terminating accessories for medium and high voltage systems.

2.0 REFERENCE DOCUMENTS

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

IS: 1554:	PVC insulated (heavy duty) electric cables.
IS: 7098:	cross linked polyethylene insulated PVC sheath
IS: 8130:	Conductors for insulated electric cables and flexible cords
IS: 5831:	PVC insulation and sheath of electric cables
IS: 3975: 10810 (Part 41)	Mild steel wires, strips and tapes for armoring of cables Methods of testing cables: Mass of zinc coating on steel armor.
IS: 209:	Specification of zinc
IS: 3961:	Recommended current ratings for cables: part-2 PVC Insulated and PVC sheathed heavy duty cables.
IS: 10418:	Drums for electric cables
IS: 10462(Pt-1):	Fictitious calculation method for determination of dimension of protective coverings of cables: part – I electrometric and thermoplastic insulated cables.
IS: 10810(Pt-58):	Oxygen index test
IS: 10810(Pt-61):	Flame retardant test
IS: 10810(Pt-62):	fire resistance test bunched cables.
IS: 13573:	Joints and termination for polymeric cables for working voltages from 6.6 KV up to and including 33 KV.
IEC: 60332-3:	Test on electric cables under fire conditions
IEC: 60502:	Extruded solid dielectric insulated power cables for rated Voltages from 1 KV up to 30 KV.
IEC: 60540&60540A:	Test methods for insulation and sheaths of electric Cables.
ASTM: D2863:	Standard method of test for flammability of plastics using oxygen index method.

ICEA S-61-402:	Thermoplastic insulated wire and cable for transmission and Distribution of electrical energy
NEMA-WCS:	Distribution of electrical energy
ICEA. S-66-S24:	Cross-linked thermosetting polyethylene insulated wire
NEMA-WC7:	Cable for transmission of electrical energy.

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

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

- a. Statutory regulations
- b. Data Sheets
- c. Job specifications
- d. Standard specification
- e. Codes and standards

3.0 DEFINITIONS

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

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

4.0 MATERIALS

4.1 PVC CABLES

4.1.1 The core insulation shall be with PVC compound applied over the conductor by Extrusion and shall conform to the requirements of type 'A' compound as per IS: 5831.

4.2 XLPE CABLES

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

5.0 DESIGN

5.1 PVC CABLES

- 5.1.1 All power/control cables for use on medium voltage systems shall be heavy-duty type, 650/1100 V grade with aluminum / copper conductor, PVC insulated, inner-sheathed, armored and overall PVC sheathed unless specified otherwise in Data Sheet.
- 5.1.2 The conductors shall be solid for conductor of nominal area up to and including 6mm² and stranded beyond 6mm². Conductors of nominal area less than 16 mm² shall be circular only. Conductors of nominal area 16 mm² and above may be circular or shaped as per IS 8130. Cables with reduced neutral conductor shall have sizes as per Table 1 of IS 1554 (Part-1).
- 5.1.3 The core insulation shall be with PVC compound applied over the conductor by extrusion and shall conform to the requirements of type 'A' compound as per IS: 5831. The thickness of insulation and the tolerance on thickness of insulation shall be as per Table 2 of IS: 1554 (Part-1). Control cables having 6 cores and above shall be identified with prominent and indelible numerals on the outer surface of the insulation. Color of the numbers shall contrast with the color of insulation with a spacing of maximum 50 mm between two consecutive numbers. Color coding for cables up to 5 cores shall be as per Indian Standards.
- 5.1.4 The inner sheath shall be applied over the laid-up cores by extrusion and shall be of PVC conforming to the requirements of Type ST-1 PVC compound as per IS: 5831. The minimum thickness of inner sheath shall be as per IS: 1554 (Part-1). Single core cables shall have no inner sheath.
- 5.1.5 If armoring is specified for multicore cables in the Data Sheet, the same shall be by single round galvanized steel wires where the calculated diameter below armoring does not exceed 13 mm and by galvanized steel strips. where this dimension is greater than 13 mm. Requirement and methods of tests for armor material and uniformity of galvanization shall be as per IS - 3975 and IS -10810 (Part 41). The dimensions of Armor shall be as per method (b) of IS - 1554 (Part -1). If armoring is specified for single core cables in the Data Sheet, the same shall be with H4 grade hard drawn aluminum round wire of 2.5 mm diameter.
- 5.1.6 For mining cables, the size and type of armor shall be such that the combined conductance of armor shall be equivalent to 75 percent of the conductance of the largest conductor of the cable.
- 5.1.7 The outer sheath for the cables shall be applied by extrusion and shall be of PVC compound conforming to the requirements of type ST-I compound as per IS 5831. The minimum and average thickness of outer sheath for unarmored cables and minimum thickness of outer sheath for armored cables shall be as per IS:1554 (Part-I).
- 5.1.8 If Heat Resisting PVC cables are specified in the Data Sheet, the following shall be the requirements:
- a. It shall be possible to continuously operate the cable at a maximum conductor temperature of 85°C. PVC compounds used for HR PVC cables shall be as follows:

- i. Conductor insulation Type C
- ii. Inner sheath Type ST 2
- iii. Outer sheath Type ST 2

5.2 XLPE CABLES

- 5.2.1 Power cables for 3.3kV up to and including 33kV systems shall be aluminum/copper conductor, XLPE insulated, sheathed, armored and overall PVC sheathed.
- 5.2.2 The conductors shall be stranded and compacted circular for all cables.
- 5.2.3 All cables rated 3.8/6.6kv and above shall be provided with both conductor screening and insulation screening. The conductor shall be provided with non-metallic extruded semi conducting screen.
- 5.2.4 The core insulation shall be with cross linked polyethylene insulating compound dry cured, applied by extrusion it shall be free from voids and shall withstand all mechanical and thermal stresses under steady state and transient operating conditions. It shall conform to the properties given in Table-I of IS 7098-(Part 2).
- 5.2.5 The insulation screen shall consist of non metallic extruded semi conducting compound in combination with a non magnetic metallic copper screen. Unless specified otherwise, the copper screen for all the three cores together shall be capable of carrying the single line to ground fault current value and the duration specified in the Data Sheet.
- 5.2.6 The conductor screen, XLPE insulation and insulation screen shall all be extruded in one operation by 'Triple Extrusion' process to ensure perfect bonding between the layers. The core identification shall be by colored strips or by printed numerals.
- 5.2.7 The inner sheath shall be applied over the laid up cores by extrusion and shall conform to the requirements of type ST 2 compound of IS: 5831. The extruded inner sheath shall be of uniform thickness. In case of single core cables, there shall be extruded inner sheath between insulation metallic screen and armoring.
- 5.2.8 For multicore cables, the armoring shall be by galvanized steel strips as per method (b) of IS7098 (Part-2). If armoring is specified for single core cables in the Data Sheet, the same shall be with H4 grade hard drawn aluminum round wire of 2.5 mm diameter.
- 5.2.9 The outer sheath of the cables shall be applied by extrusion over the armoring and shall be of PVC compound conforming to the requirements of Type ST 2 compound of IS: 5831. The minimum and average thickness of outer sheath for unarmored cables and minimum thickness of outer sheath for armored cables shall be as per IS: 7098 (Part-2)
- 5.2.10 The thickness of the insulation, inner sheath shall be governed by values given in IS: 7098 (Part -2).
- 5.2.11 Where specified, 1100V grade power cables shall also be XLPE insulated and shall meet the requirement specified in IS-7098 (Part-1).

6.0 FABRICATION

- 6.1** The cables shall be suitable for laying in trays, trenches, ducts, and conduits and for underground-buried installation with uncontrolled backfill and possibility of flooding by water and chemicals.
- 6.2** Outer sheath of all PVC and XLPE cables shall be black in color and the minimum value of oxygen index shall be 29 at $27 \pm 2^\circ \text{C}$. In addition suitable chemicals shall be added into the PVC compound of the outer sheath to protect the cable against rodent and termite attack.
- 6.3** All cables covered in this Specification shall be flame retardant (FR) unless specified otherwise in the Data Sheet. The outer sheath of PVC and XLPE cables shall possess flame propagation properties meeting requirements as per IS-10810 (Part-62) category AF.
- 6.4** Sequential marking of the length of the cable in meters shall be provided on the outer sheath at every one meter. The embossing /engraving shall be legible and indelible.
- 6.5** The overall diameter of the cables shall be strictly as per the values declared by the manufacturer in the technical information subject to a maximum tolerance of $\pm 2 \text{ mm}$, up to overall diameter of 60mm and $\pm 3 \text{ mm}$ for beyond 60mm.
- 6.6** PVC / Rubber end caps shall be supplied free of cost for each drum with a minimum of eight per thousand meter length. In addition, ends of the cables shall be properly sealed with caps to avoid ingress of water during transportation and storage.
- 6.7** The cables used in installations under the jurisdiction of Director General of Mines and Safety (DGMS) shall be of copper conductor only, and shall have valid DGMS approvals for the specified locations. The word "Mining Cable" shall be embossed /engraved on the cable outer sheath as per the applicable Indian Standards.

7.0 INSPECTION AND TESTING

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

7.2 CABLES

- 7.2.1** After completion of manufacture of cables and prior to dispatch, the cables shall be subjected to type, routine, acceptance and special tests as detailed below. Consultant/Owner reserves the right to witness all tests with sufficient advance notice from Vendor. The test reports for all cables shall be got approved from the Engineer before dispatch of the cables.

- 7.2.2 All routine tests, acceptance tests, type tests and additional type tests for improved fire performance shall be carried out as listed in IS:1554 (Part 1), and IS:1098 (Part 2) on PVC and XLPE insulated cables respectively.
- 7.2.3 The test requirements for PVC insulation and sheath of cables shall be as per latest revision of IS: 5831.
- 7.2.4 Test for Resistance to Ultra Violet Radiation: This test shall be carried out as per DIN 53387 or ATM-G-53 on outer sheath. The retention value of tensile strength and ultimate elongation after the test shall be minimum 60% of tensile strength and ultimate elongation before the test. Test certificates with respect to this test (not older than one year) from recognised testing laboratory to be furnished for review by Consultant before dispatch clearance of cables. In case test certificates are not available, test is to be conducted by Vendor at his own cost in any recognized test laboratory or in house testing laboratory, before dispatch clearance of cables. Sampling for this test is to be done randomly once for each order, provided outer sheath remains same.
- 7.2.5 Acceptance tests as per IS-1554 (Part-I) and IS-7098 (Part-2) and the following special tests to be performed on the cables as per sampling plan. These tests are required to be witnessed by Consultant/owner before dispatch of cables.
- Accelerated water absorption test for insulation as per NEMA - WC - 5. (For PVC insulated cables) and as per NEMA WC - 7 (for XLPE insulated cables). Test certificates with respect to this test (not older than one year) from recognized testing laboratory to be furnished for review by Consultant before dispatch clearance of cables. In case test certificates are not available, test is to be conducted by Vendor at his own cost in any recognized test laboratory or in house testing laboratory, before dispatch clearance of cables. Sampling for this test is to be done randomly once for each order, provided type of insulation remains same.
 - Dielectric Retention Test: The dielectric strength of the cable insulation tested in accordance with NEMA WC - 5 at $75 \pm 1^\circ \text{C}$ shall not be less than 50 % of the original dielectric strength. (For PVC insulated cables). Test certificates with respect to this test (not older than one year) from recognized testing laboratory to be furnished for review by Consultant before dispatch clearance of cables. In case test certificates are not available, test is to be conducted by Vendor at his own cost in any recognized test laboratory or in house testing laboratory, before dispatch clearance of cables. Sampling for this test is to be done randomly and once for each order.
 - Oxygen Index Test: The test shall be carried out as per ASTM D2863 or applicable Indian Standard specifications. Sampling to be done for every offered lot/size as per sampling plan.
 - Flammability Test: The test shall be carried out on finished cable as per IS - 10810 (part 61 & 62). Sampling for these tests is to be done randomly once for each order, provided outer sheath remains same. The acceptance criteria for tests conducted shall be as under.
 - Part-61-The cable meets the requirement if there is no visible damage on the test specimen within 300 mm from its upper end.

- ii. Part-62-The maximum extent of the charred portion measured on the test sample should not have reached a height exceeding 2.5 m above the bottom edge of the burner at the front of the ladder.
- e. Test for rodent and termite repulsion property: The Vendors shall furnish the test details to analyses the property by chemical method. Sampling to be done for every offered lot / size as per sampling plan.

7.3 CABLE ACCESSORIES

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

8.0 MARKING, PACKING AND SHIPMENT

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

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

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

8.2.1 MV CABLES

a. Multicore power cables up to 6mm ²	: 1000m
b. Multicore power cables from 10mm ² up to 300mm ²	: 500m
c. Single core power cables up to 630 mm ²	: 1000m
d. Control cables up to 61 cores	: 1000m

8.2.2 HV POWER CABLES – UPTO 11KV (E) GRADE

a. Three core cables up to 400 mm ²	: 500m
b. Single core cables up to 400 mm ²	: 1000m
c. Single core cables above 400 mm ² and up to 630 mm ²	: 750m

8.2.3 HV POWER CABLES – ABOVE 11KV(E) GRADE AND UPTO 33KV(E)

a. Three core cables up to 300 mm ² grade	: 350 m
b. Single core cables up to 400 mm ²	: 1000m
c. Single core cables above 400 mm ² and up to 1000 mm ²	: 500m

8.2.4 A tolerance of plus or minus 3 % shall be permissible for each drum. However overall tolerance on each size of cable shall be limited to $\pm 2\%$. Offers with short/non-standard

lengths are liable for rejection. If non-standard drum lengths are-specified.in the Data Sheet, the same shall be supplied.

9.0 SPARES & ACCESSORIES

- 9.1** The termination and straight through jointing kits for use on the systems shall be suitable for the type of cables offered as per this Specification.
- 9.2** The accessories shall be supplied in kit form. Each component of the kit shall carry The manufacturer's mark of origin.
- 9.3** The kit shall include all stress grading, insulating and sealing materials apart from conductor fittings and consumable items. An installation instruction sheet shall also be included in each kit.
- 9.4** The contents of the accessories kit including all consumable shall be suitable for storage without deterioration at a temperature of 45° C, with shelf life extending to more than 5 years.

9.5 TERMINATING KITS

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

9.6 JOINTING KITS

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



VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR LIGHTING FITTINGS FOR HAZARDOUS LOCATION

VCS – SS – EL - 4014

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**STANDARD SPECIFICATION
FOR LIGHTING FITTINGS FOR HAZARDOUS
LOCATION**

**DOC NO: VCS-SS-EL-4014
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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
CIMFR	Central Institute of Mines and Fuel Research
MSL	Mean Sea Level
BIS/IS	Bureau of Indian standards
IEC	International Electro-Technical Commission
BS	British Standards



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1.0 SCOPE

- 1.1** The intent of this specification is to define the requirements of lighting fixtures and accessories suitable for installation in classified hazardous locations.

2.0 REFERENCE DOCUMENTS

- 2.1** In general the equipment covered by this Specification shall, unless otherwise specified, conform to the latest edition of Indian Standards/International Standards but not limited to the following:

a.	IS-2148	Flameproof enclosures for electrical apparatus
b.	IS-5572 (Part-1)	Classification of hazardous area (other than mines) for electrical installation.
c.	IS-5571	Guide for selection of electrical equipment for hazardous areas.
d.	IS-8239	Classification of maximum surface temperature of electrical equipment for use in explosive
e.	IS-6381	Construction and testing of electrical apparatus with type of protection
f.	IS-8289	Electrical equipment with type of protection 'n'.
g.	IS-2206 (Part 1 to 4)	Flameproof electric lighting fittings (well glass and bulk head type, fittings using glass tubes).
h.	IS-8224	Electrical lighting fitting for division 2 areas.
i.	IS-1913 (Part-I)	General and safety requirements for Luminaires.

Wherever the requirements in this specification are in conflict with any of the above Standards, the requirements under this specification shall be binding.

3.0 DEFINITION

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

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



4.0 DESIGN

4.1 GENERAL

4.1.1 The equipment shall be suitable for installation and satisfactory operation in classified hazardous locations in tropical, humid and corrosive atmosphere as prevalent in refineries/petrochemical plants or as specified in Material Requisition/ Data Sheet. If not specifically mentioned therein, design ambient temperature of 40°C and altitude not exceeding 1000 m above MSL shall be considered.

4.1.2 Unless otherwise specified, equipment shall be suitable for 220 - 250 volts, single Phase and neutral, 50Hz. +3% power supply.

4.1.3 All equipment shall be tested and certified by independent authority for use in specified gas group locations. Certification number/data and gas group/temperature classification must be indicated on the manufacturer's name plate on each item. All flameproof equipments shall have BIS marking which must be indicated on the manufacturer's name plate. All equipment for use in hazardous area shall be approved by PESO/CCOE/DGMS as applicable.

4.1.4 POWER SUPPLY

Unless otherwise specified, equipment shall be suitable for 220 – 250 volts, single phase and neutral, 50Hz $\pm$ 3% power supply.

5.0 FABRICATION (TECHNICAL REQUIREMENT)

5.1 All equipment shall be suitable for use in outdoor open locations and shall have IP-55 degree (minimum) of protection.

5.2 The body of the lighting fixtures, control gear box and junction boxes shall be of cast aluminum LM-6 alloy and shall be free from frictional sparking hazard. The temperature rise of external surfaces shall be limited to 200°C, unless otherwise specified.

5.3 LIGHTING FIXTURES

5.3.1 The construction of lighting fixture shall be such that replacement of lamp or any normal maintenance of fixture shall not affect their suitability for use in classified area.

5.3.2 Glass used for lighting fixture shall be clear suitable for use under conditions involving exceptional risk of mechanical damage.

5.3.3 Well glass lighting fixture for zone-2 classified area shall meet requirement of IS6381. Mechanical strength of well glass shall satisfy requirement of IS-2206 (for type A glass) for flame proof lighting fixtures and IS-6381 for Div.2 lighting fixtures. All well glass fixtures shall be provided with a galvanized steel wire protective cage having mesh dimensions not exceeding 50mm.

5.3.4 Glass used for aviation and navigational lighting fixture shall be colored in itself. Painted glass shall not be accepted.



- 5.3.5 Glass shall be of approved make or as specified in Material Requisition.
- 5.3.6 The fixing parts of the enclosure which is to be opened for replacement of bulb shall be so fastened that they can be unfastened only with special tools. All fixtures shall carry a special warning inscription in English "Isolate supply elsewhere before opening".
- 5.3.7 All lighting fixtures which are not certified as flameproof construction but approved for use in Zone-2 area shall have approved enclosed break lamp holder and complete enclosure certified as having restricted breathing type construction. Lamp holder shall be screw type.
- 5.3.8 All lighting fixtures suitable for discharge lamps shall be provided with one 3/4 "ET threaded entry and supplied with approved type double compression nickel plated brass cable gland.
- 5.3.9 All lighting fixtures suitable for incandescent lamps shall be provided with two 3/4 "ET threaded entry. Two entries shall be used for looping of circuit wherever required. The fixtures shall be supplied with approved type two double compression nickel plated brass cable glands and one threaded plug for sealing unused entry.
- 5.3.10 The top of all well glass lighting fixtures shall be identically drilled / threaded to facilitate the installation on pole/column or ceiling.
- 5.3.11 All flood lighting fixtures shall be supplied with adjustable mounting arrangement both in horizontal and vertical plane.
- 5.4 CONTROL GEAR BOX
- 5.4.1 Lighting fixtures suitable for discharge lamps shall be provided with power factor, correction capacitor, choke starter to be housed in separate control gear box. The choke shall be copper wound. The complete control gear shall have power factor not less than 0.9. All components shall be of approved make or as specified in Material Requisition.
- 5.4.2 Control gear box shall be provided with three 3/4 ET threaded entry (Incoming supply to lighting fixture and for looping to other Fixture/Control gear box). The control gear box shall be supplied with approved type three double compression nickel plated brass cable glands and one threaded plug for sealing unused entry.
- 5.4.3 Control gear box for flame proof fixtures shall be flameproof type and for div.2 or increased safety fixtures shall be increased safety type unless specified otherwise in the material requisition.
- 5.5 JUNCTION BOXES
- 5.5.1 The junction boxes shall be 3 way or 4 way type as specified in material requisition. All junction boxes for looping of single phase lighting circuits using cables up to 4mm shall be minimum 100mm diameter in size. Each junction box shall be complete with requisite number of ET threaded cable entries and with approved type double compression nickel plated brass cable glands and one threaded plug for sealing unused cable entry.
- 5.6 TERMINALS & WIRING



- 5.6.1 All equipments shall be provided with sufficient number of terminals. More than 2 wires per terminal shall not be permitted. If required, additional terminal with shorting link may be used. Each terminal for external cable connection shall be suitable for termination of 4mm² copper conductor or as specified in material requisition using crimped type tinned copper lugs. All terminals shall be of non sparking, anti-loosening design such that they do not produce any arc or spark in normal operation.
- 5.6.2 Flexible wires used for internal wiring shall be minimum 1.5mm² copper conductor and connections, shall be done using crimped type tinned copper lugs.
- 5.6.3 Terminals shall be of approved make or as specified in Material Requisition.
- 5.6.4 All equipments on single phase supply shall be provided with an independent earth terminal inside the enclosure for connecting the earth core of the cable and shall have facility for looping.
- 5.6.5 All the hardwares shall be cadmium plated whereas clamps and supporting brackets shall be hot dip galvanized. The galvanizing shall be 610gms/m for clamps and 900gms/m² for supporting brackets. All gaskets shall be of neoprene.
- 5.6.6 External surfaces of all the equipment's shall be treated and prepared for painting with two coats of epoxy paint to shade 632 as per IS-5.

6.0 INSPECTION, TESTING & ACCEPTANCE

- 6.1 During fabrication, the equipment shall be subjected to inspection by Consultant / Owner or by an agency authorized by the Owner. Manufacturer shall furnish all necessary information concerning the supply to Consultant /Owner's inspector. Tests shall be carried out at manufacturer's works under his care and expense. 4 weeks prior notice shall be given before date of commencement of test for witnessing by Consultant /Owner's authorized representative. The test certificate indicating test result shall be furnished.
- 6.2 CMRS test certificates along with CCE/DGFASLI/DGMS approval certificates as applicable shall be furnished for each type of fixture. All equipments shall be routine tested as per applicable Indian standards.
- 6.3 During inspection, facility shall be provided for impact testing of random sample. One well glass of each fixture type from each lot shall be tested for impact strength

7.0 PACKING & SHIPMENT

- 7.1 The equipment shall be shipped to site packed in wooden crates. They shall be wrapped in polyethylene sheets before being placed in crates to prevent damage to the finish. The crates shall have skid bottoms for handling.



Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR ELECTRICAL EQUIPMENT INSTALLATION

VCS – SS – EL - 4023

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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

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1.0 SCOPE

- 1.1 Specification defines the requirements for the installation, field inspection, testing and commissioning of electrical equipment, forming part of electrical power distribution and utilization system, including communication and fire alarm system.

2.0 REFERENCE DOCUMENTS

- 2.1 The work shall be carried out in the best workmanlike manner in conformity with this specification, Consultant Installation Standards, layout drawings and to the following specifications/ codes of practice of Bureau of Indian Standards and OISD standards.

SP-30(BIS) National Electrical Code.

IS-7816 Guide for testing Insulation resistance of rotating machines.

IS 10028(Part-2) Code of practice for selection, Installation and maintenance of transformers; Part 2: Installation.

IS 10118(Part-3) Code of practice for selection, installation and maintenance of switchgear and control gear Part 3 Installation.

OISD 137 Inspection of Electrical Equipment.

OISD 147 Inspection and safe practices during electrical installations

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

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

3.0 INSTALLATION

- 3.1 Prior to start of installation of the electrical equipment contractor shall verify that equipment and complete materials have been received. Handling, shifting to required site location, installation, testing and commissioning of all electrical equipment shall be done by contractor with utmost care. Manufacturer's instructions and the requirements given in their technical manuals shall be strictly adhered. The substation/switchgear room wherein the equipment shall be installed shall be kept clean, dry and-free from all debris. Panel floor cutouts not in immediate use shall be suitably covered to avoid any mishap. When handling the switchboard panels, care shall be taken to observe the correct lifting arrangements and to make sure that slings are attached to the manufacturer's designated lifting points. No parts shall be subjected to undue strains or sudden stresses which could cause damage to the equipment.

- 3.2 The lifting position mark indicated on packing casing shall be adhered to strictly, for keeping it in required vertical position.
- 3.3 Contractor shall check and report to the Engineer-in-charge about any damaged item and / or missing component for getting the same replaced as per Specifications. During installation, all accessories and loose items shall also be inspected by the contractor before their assembly/mounting.
- 3.4 Switchboards and Bus Ducts
- 3.4.1 The term switchboard here includes all HV / MV/ LV switchboard panels, motor control centers, power and lighting distribution boards, UPS panels, ACDB, charger panels, DCDB etc. The switchboard panels shall be handled with care, avoiding any impact to the equipment. Dragging of the panels directly on floor shall be avoided. Roller bars may be used for shifting of panels. Use of a crane and trailer shall be made for handling of equipment. The switchboard panels shall be properly supported on the truck or trailer by means of ropes to avoid any chance of tilting. The switchboards shall be lifted after ensuring that panel supports, nuts and bolts are all intact and tightened. While lifting the panels in packed conditions utmost care shall be taken to avoid any damage to insulators, bushings, metering and protective equipment. The panels shall be preferably kept inside the packing cases till foundations are ready.
- 3.4.2 The switchboard panels shall be installed on prepared foundations or floor cutouts. Steel base channels shall be welded to inserts provided in floor slab. Cross members shall be provided at the junctions of each shipping section and other places as required. Alternatively, when the floor is being laid, base channel frame of panels supplied by the Vendor shall be grouted and leveled in cement concrete. It shall be ensured that the base plate level of HV switchboard shall match with the finished floor level. The foundation pockets and the grouted bolts shall be cured for a minimum period of 48 hours.
- 3.4.3 The switchboard panels shall be taken out from the packed cases and shifted one by one to its proper place. All the panels shall be assembled, aligned and leveled. Alignment of panels shall be checked in both longitudinal and lateral directions. It shall be ensured that panel to panel coupling bolts, bus bar links etc. fit properly without any strain on any part. No new holes for jointing of the panels other than those recommended by the Vendor shall be drilled. No gaps shall be left between the panels. The lifting, racking in and out operation of the breaker and all other motions shall be free from any obstruction.
- 3.4.4 The panels shall be checked for correct vertical position using pendulum weight and spirit levels. The switchboard panels shall be tack welded at suitable intervals at base channel.
- 3.4.5 After erection of switchboard panels, all uncovered portions of floor cutouts shall be covered with 6 mm thick removable chequered plates finished with floor level. The design of the chequered plates shall be such that the maximum allowable deflection is $L/200$ (where L is the span of the chequered plates in meters) for a live load of 500 kg/sq. meters. Suitable lifting arrangements shall be provided for chequered plates. The chequered plates shall be painted with a coat of red oxide zinc chromate primer after proper surface preparation as per specifications. Where specified, panel's cutouts provided for future use shall be filled with lean concrete.

- 3.4.6 After completion of erection of switchboards, all the cubicles, switchboard components such as switches, starters, C.T. and P.T. chambers, busbar chamber shall be cleaned and checked for tightness of all the components. Vacuum circuit breakers shall be checked for integrity of bottle seals. All loosely supplied items shall be fitted up. Bus bar sections or links shall be inserted and where specified, of high voltage equipment shall be insulated. Interconnection wiring between shipping sections shall be made by contractor. All the wiring connections shall also be checked. Phase sequence and polarity of PTs and CTs shall be checked. Contact resistance of all busbar joints and contactors shall be checked. Insulator shall be checked for any damage. All the starters, switches, contacts shall be cleaned with C.T.C. where required. All the moving parts shall be checked for easy and free movement. Hinges of panel doors shall be lubricated to give free and noise free movement. All -openings shall be kept completely closed to avoid ingress of any foreign particles inside the panel.
- 3.4.7 Functional scheme verification of individual feeder shall be carried out and minor wiring modifications in the panel wiring, if required shall be done as per the directions of Engineer-in-charge. Special attention shall be paid to CT circuits polarity, wiring continuity and correctness in the protection as well as measurement circuits. Auto transfer scheme shall be simulated and verified. During the course of scheme verification tests, defective components if any shall be taken out, after bringing to the notice of Engineer-in-charge. The same shall be replaced by component supplied by Owner.
- 3.4.8 Where switchboard is damp or having a low IR value due to damaged insulators/ bushings/any other insulated parts, or any other reason, the entire-switchboard shall be dried up according to the instruction of the Engineer-in-charge for the IR value-to improve to a safe level for commissioning. Care shall be taken to protect the surrounding insulation from direct local heating during the drying up process.
- 3.4.9 All the metering instruments, protective relays and other relays and contactors shall be tested as per manufacturer's recommendations and according to the instructions of the Engineer-in-charge. Protection relays shall be inserted and connected and settings adjusted as required by the Engineer- in- charge.
- 3.4.10 All moving parts, of closing/tripping mechanism racking in and racking out mechanism, spouts and shutter closing mechanism shall be checked for proper operation. All the auxiliary contacts of breaker shall be checked-up cleaned and contact pressure measured.
- 3.4.11 All the control wiring, PTs, bushings, bus bars other live parts of switchgear, incoming and outgoing cables shall be meggered.
- 3.4.12 Electrical simulation tests shall be named out for all the protective alarm and annunciation relays and external interfaces to ascertain proper functioning.
- 3.4.13 Safety insulation mats of approved make and of required voltage grade shall be provided in the sub-station.
- 3.4.14 Pre-Commissioning Checklist

Before commissioning any switchboard, following points shall be checked and ensured for safe energizing of the switchboard:

- a. That the installation of equipment to be commissioned is complete in all respects with its auxiliaries and all other mounting including earthing. Openings in floor within and outside panels have been sealed off. All cover and door gaskets are intact to-make the enclosure vermin proof.
- b. That all the metering instruments have been checked and found in working order. Indicating lamps are healthy and are in correct position. All power and control fuses are of proper rating.
- c. That the polarity test and ratio test of all the PT s and CT s is complete and phase sequence of CTs conforms to the correct vector group connections. Wiring continuity and correctness are ensured in the protection and measurement circuits. Polarity of D.C. supply for all the circuits-is correct.
- d. That the high voltage tests of incoming and outgoing cables have been conducted and results are satisfactory.
- e. That all the protective relays including both conventional and microprocessor based numerical relays and thermal overload relays have been tested for secondary injection tests. (Primary injection tests shall be carried out for differential protection, Restricted Earth fault protection at full / reduced current to ensure correctness of complete wiring). Relay settings, status indications, fault annunciations, data logging, and display of switchboard SLDs shall be verified from MMI in case the same is provided.
- f. That I.R. Value have been recorded for bus bars, circuit breaker, incoming and outgoing cables, control wiring and potential transformers. Where required joint resistance of bus bars have been recorded and found to be satisfactory. All the surroundings and panels have been cleaned and temporary earth leads have been removed.

3.4.15 Bus Ducts:

The bus ducts as per issued drawings will be supplied in parts and all the parts shall be assembled and the bus bar connections shall be made at site. The insulators in bus ducts shall be inspected for any possible damage during transit and the defective ones shall be replaced. The insulators shall be cleaned. Contact surface of bus bars, bus bar bolts and nuts shall be thoroughly cleaned. Petroleum jelly shall then be applied and bolted connection made. The bus duct enclosure shall be checked for earth continuity and then earthed at two places. The bus duct shall be properly supported between switchgear and transformer. The opening in the wall where the bus duct enters the switchgear room. shall be completely sealed to avoid rain water entry. Expansion joints, flexible connections etc. supplied by the manufacturer of the bus duct shall be properly connected. The bus duct leveling shall be checked with spirit level and pendulum weight.

3.5 Transformers

- 3.5.1 Transformers on receipt at site shall be unloaded by means of crane or lifting devices of adequate capacity. All lifting lugs shall be used to avoid unbalanced lifting and undue stresses on lugs. Lifting lugs if any provided for partial lifting (e.g., for. active part, conservator) etc. shall not be used for lifting complete transformer. Parts other than those identified for lifting of the transformer shall not be used for lifting. While slinging,

care shall be taken to avoid slings touching other parts.

- 3.5.2 Before lifting transformer, it shall be ensured that all cover bolts are tightened fully. In case when it is necessary to use jacks for lifting, projections provided for the purposes of jacking shall be used. Lifting jacks shall not be used under the valves or radiator tubes. For transporting transformers from stores to site, the transformers shall be loaded on a suitable capacity truck or trailer. The transformers shall be properly supported by steel ropes and stoppers on the trailer to avoid tilting of the transformers in transit due to jerks and vibrations. At no instance the transformer shall be kept on bare ground. Where it is not possible to unload the transformer directly on a foundation, it shall be unloaded on a properly built wooden sleeper platform. A transformer shall never be left without putting stoppers to the wheels.
- 3.5.3 Transformers shall be examined, for any sign of damage in transit Particular attention shall be given to the following in this regard.
- a. Dents on tank wall or cooling tubes.
 - b. Damage to protruding parts like valves, sight glass etc.
 - c. Loosening of bolts due to vibration in transit.
 - d. Cracked or broken bushings.
 - e. Oil leakage particularly along welds.

Anything adverse is noted the same shall be brought to the notice of Engineer- in- charge.

- 3.5.4 Contractor shall examine the transformer base, oil pit, fire walls and foundations laid by the civil contractor. It shall be surged that oil spills cannot propagate along cable trenches. Any discrepancy noted will be brought to the notice of Engineer- in- charge. Transformers shall be placed on channels or rails over concrete foundation. The transformers shall be leveled, aligned and checked for free movement on the channels or rails. Stoppers shall be provided to the transformer immediately to prevent any movement. Normally transformers up to 1000 kVA rating shall be received duly fitted- with radiator tubes, conservator tanks, valves, wheels and other accessories. While the transformers of above 1000 kVA rating may be supplied with loose accessories. All the accessories like radiators, cooling fans, valves, conservator tanks, explosion vent pipe, bushings and other devices which are supplied indifferent packages shall be checked for any transit damage and cleaned thoroughly before fixing on the transformer. All loosely supplied parts shall be assembled as per manufacturer's instruction manuals/ drawings and documents. All the connections for C.T.s bushings and other wiring shall be checked for tightness and correctness before replacing the lid or tightening all the bolts.

3.5.5 TOPPING OF TRANSFORMER WITH OIL

Before topping up with oil, transformer shall fit with all accessories such as valves, gauges, thermometers etc. Oil samples shall be taken from each drum and tested for determination of dielectric strength. Any sign of leakage of the barrel or of its having been opened shall be recorded and reported. It is necessary to filter the oil before the transformers are filled. It shall be ensured in oil filling operation that no air pockets are left in the tank and that no dust or moisture enters the oil. All air vents shall be opened. Oil shall be filled through a Streamline oil filter using metal hose. To prevent aeration of the oil, the transformer tank shall be filled through the bottom drain valve. In a transformer

with conservator tank, the rate of oil flow shall be reduced when the level is almost up to the bottom of the main cover to prevent internal pressure from rupturing the pressure relief-pipe diaphragm. Sufficient time shall be allowed for the oil to permeate the transformers and also for the locked -up air bubbles to escape. Any air accumulation in the Buchholz relay shall be released.

3.5.6 TRANSFORMER OIL

- a. Sample of oil from the transformer shall be taken from the bottom of the tank.
- b. Testing of oil: -

For dielectric test, the oil shall be tested as described in IS: 335. The oil shall also be tested for acidity in accordance with methods prescribed.

- 3.5.7 Drying out of the transformer's if required shall be carried out and record maintained in accordance with IS: 10028. Normally a streamline filter shall be used for drying-up. I.R. value versus time of both windings shall be recorded during the drying up process.

Precaution when drying:

- a. The maximum sustained temperature to which transformer oil may be subjected shall be limited to 80° C.
- b. The transformer shall be carefully monitored throughout the drying out process and all observations shall be carefully recorded
- c. Drying out shall be continued so that the insulation resistance as prescribed in the standard code of practice is attained and the value remains constant for more than 12 hours. However, a minimum number of cycles shall be done for each transformer as found necessary by the engineer-in-charge. Generally, a megger reading of 2 mega ohms / KV at 60° C temp. with a 5 KV megger may be a rough indication for stopping the dehydration.

- 3.5.8 The following work on transformers shall be performed by the contractor if specifically called for:

Before finally commissioning the transformer, it may sometimes be desired to run it for a few hours on short-circuit, applying a low voltage, approximately equal to the impedance voltage of the transformer. During this process, regular readings of the insulation resistance of the winding to earth and winding to winding and temperature against time shall be recorded.

Testing of radiator tubes for any leakage and rectifying these by welding / brazing.

3.5.9 PRE-COMMISSIONING CHECK LIST:

Before commissioning of any transformer, the following points shall be checked for safe energization of the transformer:

- a. That all the accessories have been fixed properly and transformer body and neutral are properly earthed. The transformer dehydration is over and results are satisfactory and approved by the Engineer-in-charge. In case transformers are idle for more than one month after dehydration, transformer oil has been given at least two circulations.

- b. That the oil level, in the transformer conservator tank and all the bushings is up to the marked point and the oil have been tested for dielectric strength and acidity.
- c. That the silica gel is in reactivated condition. The breather pipe is clear from any blocking and contains oil up to the proper level.
- d. The explosion vent diaphragm does not have any dents. Accumulation of any oil and air had been released.
- e. That the operation of off-load and. on-load tap changers on all the tap positions is satisfactory. The mechanical parts of the on-load tap changer are lubricated. Motor IR value has taken and found satisfactory. Tap position mechanical indicator on the transformer and tap position indication meter on the control panel are reading the same tap positions. Tap changer limit switches are operating satisfactorily on the maximum and minimum tap positions. On-load tap changer contact pressure and resistance is as per manufacturers recommendations. Oil level of tap changer tank is up to the required level and oil has been tested for dielectric strength. The tap setting on which the off-load tap switch is locked shall be recorded. Generally, the off-load tap switch shall be kept on nominal tap.
- f. That the Buchholz relay has been tested and checked up for any friction in the movement, and floats are free. All the other protective relays, alarm and annunciation relays have been tested.
- g. That all the metering equipment's have been tested and polarity test of PT's and transformer winding is satisfactory. Phase sequence and connections have been checked for proper vector group.
- h. That the ratio test and winding resistance on all the tap positions is satisfactory.
- i. That gaps of arcing horns for the bushings where provided are in order and earth connections for the surge diverters have been checked.
- j. That the winding and oil temperature thermometer -pockets contain oil and the winding and oil temperature settings on dial gauges are in order.
- k. That the transformers fitted with fans for forced air cooling have been checked up for automatic starting and stopping of the fans and air-displacement has been verified.
- l. That the simulation tests for all external interface connection alarm, annunciation and trip circuits have been checked and are order.
- m. That the insulation resistance of all the control circuits and IR value of the transformer windings and all the incoming and outgoing cables have been checked.
- n. That all the valves in the codling system and valve between the Buchholz relay and the conservator tank is in open position.
- o. That the setting of all the protective relays is at the desired value and D.C. Trip supply is healthy.

3.5.10 Observations after Commissioning:

After switching on-the transformer the following points shall be observed and recorded.

- a. The inrush magnetizing current and no-load current.
- b. Alarm if any, or if any relay flag has operated.
- c. Voltage and current on all the three phases
- d. Transformer hums or abnormal noise.

- e. Circulation of oil and leakages.
 - f. Record current, voltage, cooling air temperature, winding temperature and oil temperature readings, hourly for 24 hours.
 - g. Cable end boxes for any overheating.
- 3.6 H.V. and M.V. motors
 - 3.6.1 All the motors generally would be erected by the mechanical contractor.
 - 3.6.2 Electrical contractor shall keep the, motor space heater energized, as per the directions of Engineer-in-charge. Electrical contractor shall measure the insulation resistance of motor windings. Insulation resistance of the motors shall be measured between the winding the machine and its frame by means of a 500/1000 V megger in case of 415 V motors. A minimum value of 1 mega ohm for 415 V motors shall be considered a safe value. In case of lower I.R. Value, the insulation value shall be improved by any of the following methods as directed by the Engineer-in-charge.
 - a. Blowing hot air from external source.
 - b. Putting the motor in oven.
 - c. Placing heaters or lamps around and inside after making suitable guarding and covering arrangements so as to conserve the heat.
 - 3.6.3 In case the insulation is low, the following method of drying has to be adopted, after consultation with Engineer-in-charge. During drying the temperature rise of winding shall not exceed the permissible value for the class of insulation used.
 - a. By locking the motor so that it cannot rotate and then applying such a low voltage to the stator terminals so as to pass full load current in the stator keeping the stator winding temperature below 90° C. In this case a close watch shall be kept for any possible overheating and I.R. Values vs. temperature shall be plotted and heating continued till I.R. value becomes steady.
 - b. By blasting hot air from external source, Maximum temperature of winding while drying shall be 70° C to 80° C (thermometer) or 90° C to 95° C by resistance method. Heating shall be done slowly first till steady temperature of winding is reached after 4 to 5 hours, and for large machines after 10 hours. A record has to be kept for drying process, with half an hour reading and, till steady temperature is reached. In case it is essential, the drying process can be supplemented by blower.
 - 3.6.4 It shall be ensured that the motor leads are correctly connected in the terminal box, as indicated in the 'Name Plate'. The covers of all terminal boxes shall be properly fixed, the gaskets intact. The control circuit shall be tested for proper functioning as per circuit diagram.
 - 3.6.5 In case of synchronous machines, slip rings and brush gear shall be polished and brushes shall be fixed in their holders with clearance and pressure as recommended by the manufacturers.
 - 3.6.6 Before commissioning, the ventilation and cooling system of the motor must be inspected. In case of motor with forced ventilation the air inlet shall be examined to ensure that it is free from moisture and any foreign material. It shall also be ensured

that recommended flow and pressure of air is available to produce the required cooling effect.

- 3.6.7 The motor control gear shall also be carefully examined, the over-load settings may be reduced or time lags bypassed from protective gear to ensure rapid tripping of switchgear in event of faults. The direction of rotation of a new motor especially of large capacity, and phase sequence of supply shall be kept in view while joining and connecting to the motor terminals.
- 3.6.8 Finally, the motor shall be started on no-load after decoupling, and shall be allowed to run for a minimum period of 4 hours, or for a time as instructed by Engineer-in-charge. Attention shall be given to the proper running of the bearings, vibration or unusual noises if any. Voltage, starting current, no-load current, stator winding and bearing temperature shall be recorded after every 1 hour during this test. Direction of rotation shall be checked and recorded. Normally the motors run in clockwise direction as viewed with reference to the phase sequence R, Y, B.
- 3.6.9 After switching off the motor, the insulation resistance of the motor shall be recorded under hot and cold conditions.
- 3.6.10 If the no load test run is found satisfactory, the motor shall be allowed to run for 8 hours and all readings shall be recorded.
- 3.6.11 The following work on motors may be performed by the contractor if specifically called for.
- a. The proper level of bearing oil has to be checked. The condition of grease in bearings shall be checked and in case it is necessary, complete replacement of bearing with specified grade of grease after proper cleaning of the bearing shall have to be done. Wherever external greasing facility exists, the condition of grease may be checked by pumping some new grease of specified grade at start. If the grease coming out is deteriorated grease shall be replaced.
 - b. All the motors, -motor exciter set and induction generators directly coupled or coupled through reduction gears shall be checked for abnormal vibration, if any Large rated HV motors with journal type bearings are liable to get damaged from shock, rough handling during transit. Any minor defect in a race or roller may give rise to considerable amount of vibration and noise. Contractor shall check and bring to the attention of Engineer-in-charge any defect noticed in this regard.
 - c. Due care shall be taken to avoid any damage to bearing insulation wherever provided.

3.7 Batteries

- 3.7.1 Battery (Lead acid, Nickel Cadmium or VRLA type as specified) shall be erected on stands and insulators supplied by the manufacturer of the batteries. The installation shall be done as per the layout drawings and manufacturer's instructions. Electrolyte if required / as applicable shall be filled as per manufactures instructions. Interrow connections shall be made with the leads supplied by the manufacturer.

3.8 Neutral Earthing Resistor

- 3.8.1 The neutral earthing resistor shall be inspected for any damage to the resistor grid and

other components. The resistor shall be leveled and installed. All covers etc. shall be checked for lightness to ensure that the enclosure of the resistor is dust, vermin acid weatherproof. Earthing conductors shall be taken from the out-end terminal of the resistor for connection to earth electrodes and to the main grid.

3.9 welding Receptacles

3.9.1 The welding receptacles shall be erected on steel/concrete structures as per the drawings, in isolated places a separate support shall be fabricated and installed.

3.10 Push Button/Control Stations

3.10.1 The push buttons / control stations shall be installed near to the motors to be controlled. Individual channel support shall be installed as per standard installation drawings. If control stations for hazardous areas are to be supplied by contractor. These shall be of Ex(d) type tested by CMRI and approved by CCOE or other applicable certifying authorities. All outdoor push buttons / control stations shall preferably have integral canopies for additional weather protection. The canopy shall be made of 2 mm thick galvanized sheet steel or FRP where these are not integral with the equipment.

3.11 Gang operated Isolators/outdoor Disconnectors

3.11.1 The isolators shall be transported to site in the dismantled condition. All the insulators may be also supplied loose. The contractor shall inspect, clean assemble and install the isolator on the base structure previously fabricated erected and leveled by him. The operating mechanism shall be installed on the structure and connected to the isolator poles. The operating mechanism shall be tested by slowly bringing the isolator to the closed position and carrying out the necessary adjustment as per the manufacturer's instructions. The earthing switches, frames and operating handle etc. shall be earthed.

3.11.2 Contractor shall provide the following items in substation as per Indian Electricity Rules:

- a. Fire buckets filled with clean dry sand and ready for immediate use for extinguishing fires and fire extinguisher (carbon dioxide, dry chemical extinguisher etc.) suitable for dealing with electric fires shall be conspicuously marked and kept.
- b. First aid boxes containing ointments and medicines for immediate treatment of injuries (As prescribed by Indian Red Cross Society or equivalent).
- c. Instructions of restoration of persons suffering from electric shock in English, Hindi and local language of the district shall be affixed in a conspicuous place.
- d. Danger boards (H.V, M.V.) shall be provided on transformer gate, switchboards, entrance to switchgear room and at other places as required by Engineer-in-charge.
- e. The Communication system and Fire alarm system panels and equipment shall be installed complying to manufacturer's instructions. The location of field station (call back station unit, break glass unit, telephone set etc.) shown on, the drawing is indicative. The exact location shall be decided at site by contractor in consultation with Engineer-in-charge. Correct type of equipment with regard to hazardous protection as specified on drawing shall be adhered to by contractor, for installation.

4.0 INSPECTION, TESTING AND COMMISSIONING

- 4.1.1 Field inspection, testing and commissioning of the complete electrical installation shall be carried out as per consultants Specification.
- 4.1.2 After the equipment is installed properly in accordance with drawings and Specifications, Contractor shall carry out all pre-commissioning checks and tests as per company format in the presence of Engineer-in-charge and test readings shall be recorded and furnished to Consultant/Owner in triplicate.
- 4.1.3 All equipment layout drawings shall be marked by the Contractor for "AS BUILT STATUS" and two sets of copies shall be submitted to Consultant/Owner.

5.0 SPARES AND ACCESSORIES

- 5.1.1 The Contractor shall have all necessary construction equipment, tools and tackles and testing instruments to carry out the erection works and to commission the system as specified. These shall include but not be limited to the following, and these shall be brought to site by Contractor before the start of work.

Equipment:

- a. Portable grinder.
- b. Portable welding machine.
- c. Portable gas cutting / welding set.
- d. Pipe threading machine.
- e. Pipe bending machine (hydraulic).
- f. Portable drill machine suitable to take up drilling for different sizes as per requirement.
- g. Dewatering pump sets (diesel driven).
- h. Power Hacksaw.
- i. Conduit dye set.
- j. Hydraulic crimping machine.
- k. Hand crimping tool.
- l. Portable electric blowers, vacuum cleaners.
- m. Miscellaneous items such as slings, pulleys, tarpaulins, wooden sleepers, ladders. etc. as required.
- n. Safety belts, safety goggles, and gloves.
- o. Separate tool kit for each Electrician.
- p. Insulation tester 1000 V hand driven.
- q. Insulation tester 2500 V motor/hand driven.
- r. Insulation tester 5000 V motor/hand driven
- s. Phase sequence indicator.
- t. Earth Resistance tester.
- u. Single phase variac
- v. 3 phase variac of adequate capacity.
- w. Secondary injection testing kit.

- x. Multimeter both analogue and digital
 - y. Portable Ammeters, Wattmeter, P.F. meters.
 - z. Portable Voltmeters.
 - aa. Clip on meters of different ranges.
 - bb. Tacho-meter.
 - cc. Kelvin's double bridge for measurement of very low resistance.
 - dd. D.C. high pot test kit.
 - ee. D.C. high pot test kit.
 - ff. Oil filtration machine of adequate capacity.
- 5.2 Lux meter to measure illumination levels.



Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR CABLE INSTALLATION

VCS – SS – EL - 4024

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REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	05.07.2017	MG	RD	AD	SK	Issued for use as Standard
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02	09.03.2022	SP	RD	AA	HK	New revision system updated

ABBREVIATION

BIS/IS	Bureau of Indian standards
OISD	Oil Industries Safety Directorate
CCE	Chief Controller of Explosive
CEA	Central Electrical Authorities
GI	Galvanized Iron
MS	Mild Steel
FLP	Flam Proof
RCC	Reinforced Concrete Cement
PV	Poly Vinyl Chloride

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1.0 SCOPE

- 1.1** This Specification defines the requirements for supply of materials, wherever applicable, installation, testing and commissioning of cable installation.

2.0 REFERENCE DOCUMENTS

- 2.1** The work shall be carried out in the best workman like manner in conformity with this Specification, Installation standards, layout drawings, the latest edition of relevant Specifications, codes of practice of Bureau of Indian Standards and OISD Standards listed below:

SP: 30 (BIS) Special Publication - National Electrical Code.

IS:1255 Code of practice for installation and maintenance-of power cables up to and including 33 KV rating.

IS:10810 Method of Test for cables; Part 43 Insulation resistance. (Part 43)

IS:10810 Method of Test for cables; Part 45 High voltage test. (Part45)

OISD 147 Inspection and safe practice during electrical installation

OISD I 73 Fire prevention and protection system for electrical installation

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

- a. Indian Electricity Act and Rules.
- b. Regulations laid down by CEA/Electrical Inspectorate.
- c. Regulations laid down by CCE/DGMS/DGFASLI (as applicable).
- d. The Petroleum rules (Ministry of Industry Government of India).
- e. Any other regulations- laid down by central/state/local authorities and insurance agencies

3.0 DEFINITION

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

OWNER / COMPANY	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 MATERIAL SPECIFICATIONS

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

4.2 CABLE TRAYS

These shall be ladder type trays either prefabricated hot dip galvanized sheet steel trays or site fabricated angle iron painted trays as specified in job Specification.

4.3 PRE-FABRICATED HOT DIPPED GALVANISED TRAYS

The cable trays shall comply with the requirements specified in Installation std.

4.4 SITE FABRICATED ANGLE IRON TRAYS

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

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

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

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

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

4.5 CABLE GLANDS

4.5.1 Cable glands shall be of nickel plated brass unless otherwise specified. The single compression type cable glands shall be used for _indoor. -panels/equipment, (e.g., Substation, control room etc.). The cable glands for outdoor terminations shall be weather protected, double compression type and shall have PVC shroud for additional weather protection. Cable glands forming a part of relevant FLP enclosure shall be FLP type, tested by CMRI or any other recognized independent testing laboratory and approved by CCE/DGMS or any other statutory authority as applicable. Indigenous FLP glands shall have valid BIS license as per the requirements of statutory authorities. The size of the cable glands supplied shall be appropriate to the size of cable so that flame proofness of glands is retained.

- 4.5.2 Entry thread of cable gland shall be compatible to the entry thread provided in the equipment (BS, ET, NPT, and PG as applicable). If required, suitable reducers/adopters shall be used.

4.6 CONNECTORS

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

4.7 FERRULES

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

5.0 INSTALLATION

5.1 CABLE LAYING (GENERAL)

- 5.1.1 Cable installation shall include power, control, lighting, fire alarm, telephone and communication cables. These shall be laid in trenches/ cable trays as detailed in the cable layout drawings. Cable routing given on the cable layout drawings shall be checked in the field so as to avoid interference with structures, heat sources, drains, piping, air-conditioning duct etc. Any change in routing shall be -done to suit -the field conditions wherever deemed necessary, 'after obtaining approval of Engineering-charge.
- 5.1.2 High voltage, medium voltage power and control cables shall be separated from each other by adequate spacing or by running through independent pipes, trenches or cables trays, as shown on layout drawings/installation standards, Details of-cable routes and, cable spacing not shown in detail on these drawing shall be determined by the Contractor and approved by the Engineer in charge.
- 5.1.3 When single core cables are laid in flat formation, the individual cable fixing clamps and spacers shall be of non-magnetic material. As a general practice, the sheath of single core cables shall be earthed at one point to keep sheath at earth potential unless otherwise stated. Single core cables, when laid in trefoil formation shall be braced by suitable clamps at a distance, not exceeding 3 meters along the cable routing.
- 5.1.4 If straight through joints are required to be provided on single core cables, armor shall be broken at joints as per manufacturer's recommendations. For single core cables armor shall be earthed at one end for the cable run length as per manufacturer's recommendation.
- 5.1.5 The Telephone, Communication and Fire alarm cables shall run on instrument trays/ducts/ trenches in the units. Wherever these are not available, cables shall be taken in, a separate trench/tray with a min spacing of 600mm from power, and control cables but in any case, such separation shall not be less than 300mm.
- 5.1.6 Telephone, fire alarm and plant communication cables shall be directly buried in road berm area, (unless otherwise specified in cable layout drawings). These cables shall cross power cables preferably at right angles. Streetlighting cables shall be laid on the other side of road berm area.

- 5.1.7 The lengths indicated in the cables schedule are only approximate. The contractor shall ascertain the exact length of cable for a particular feeder by measuring at site. All cable routes shall be carefully measured. Before the start of cable laying, the contractor shall prepare cable drum schedule and get that approved by Engineer-in-charge to minimize/avoid straight through joints and then the cables cut to the required lengths, leaving sufficient lengths for the terminations of the cable at both ends. The various cable lengths cut from the cable reels shall be carefully selected to prevent undue wastage of cables. Extra loop length shall be given for feeder cables where required as per the directions of Engineer-in-charge to meet contingencies.
- 5.1.8 Cables shall be laid in directly buried trench or in RCC trench (underground trench) or in cable tray along pipe sleepers or in overhead trays as shown on cable layout drawings.
- 5.1.9 Overhead trays shall be installed 2700-mm (minimum) above grade level. At road crossings overhead trays shall be installed at 7000mm(minimum) above grade level or cables shall be routed cable tray culvert/ Electrical Road crossings as per layout drawings. Sufficient care shall be taken while laying cables to avoid formation of twist, sharp bend etc. in order to avoid mechanical injuries to cables. Rollers shall be used for pulling of cables.
- 5.1.10 Cable installation shall provide minimum cable bending radii as recommended by cable manufacturer.
- 5.1.11 Cables shall be neatly arranged in the trenches / trays in such a manner that crisscrossing is avoided and final take off to the motor / switchgear is facilitated. Arrangement of cables within the trenches / trays shall be in line with cable layout drawings. Cable routing between cable trench and equipment/motors shall be taken through GI pipe sleeves of adequate size. Pipe sleeves shall be laid at an angle of maximum 45 to the trench wall. Bending radii of pipes shall not be less than 8D. It is to be ensured that both the ends of GI, pipe sleeves shall be sealed with approved weather proof sealing plastic compound after cabling. In places where it is not possible, cables shall be laid in smaller branch trenches.
- 5.1.12 All cables shall be identified close to their termination point by cable tag numbers as per cable schedule. Cable tag numbers shall be punched on aluminum straps (2mm thick, 20 mm wide and of enough length) securely fastened to the cable-and wrapped around it.
- 5.1.13 Each underground cable shall be provided with cable tags of lead securely fastened every 30 m of its underground length with at least one tag at each end before the cable enters/leaves the ground. In unpaved areas, cable trenches shall be identified by means of cable markers as per installation drawing. These cable markers shall be placed at location of changes in the direction of cables and at intervals of not more than 30 m and also at cable straight through, joint locations.
- 5.1.14 All temporary ends of cables must be protected against dirt and moisture to prevent, damage to the insulation. For this purpose, ends of cables shall be taped with an approved PVC end cap or rubber insulating tape.
- 5.1.15 Each row of cables shall be laid in place and before covering with sand. All wall openings/pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water inside building/lined trench. Every cable shall be given an insulation

test in presence of Engineer-in-charge/Owner before filling the cable trench with sand
Any cable which is found defective shall be replaced:

- 5.1.16 Where cables pass through, foundation walls, the necessary openings shall be provided in advance for the same by another agency. However, should it become necessary to cut holes in existing structures for example floor slab etc., the electrical contractor shall determine their location and obtain approval of the Engineer-in-charge before carrying out the same.
- 5.1.17 Cables for road crossings shall be taken through ERC (Electrical Road Crossing) as shown in the cable layout drawings.
- 5.1.18 At road crossing and other places where cables enter pipe sleeves adequate bed of sand shall be given so that the cables do not slack and get damaged by pipe ends.
- 5.1.19 Wherever cable trench crosses storm water, waste water channel/drain, cables shall be taken through PVC/RCC pipes. Where cables are required to cross drains of depth more than 1200 mm, cables shall be taken over the drain on cable trays supported suitably using ISMC 150/200 sections.
- 5.1.20 Ends of cables leaving trench shall be coiled & capped and provided with protective cover till such time the final termination to the equipment is completed.

5.2 CABLES LAID DIRECT IN GROUND

- 5.2.1 Cables shall be laid underground in excavated cable trenches where specified in cable layout drawings. Trenches shall be of sufficient depth and width for accommodation of all cables. Cables shall be properly spaced and arranged with a view of heat dissipation and economy of design. Maximum number of cable layers in trench shall be preferably limited to 5 layers.
- 5.2.2 Minimum depth of cable trench shall be 750 mm for medium voltage and 900 mm for H.V. Cables. The depth and the width of the trench shall vary depending upon the number of layers of cables as per Installation Standard.
- 5.2.3 Cables shall be laid in buried trenches depth as shown in the cable layout drawings. It is to be insured by the contractor that the bottom of buried trenches shall be cleared of all rocks, stones and sharp objects before cables are placed. The trench bottom shall be filled with a layer of sand. This sand shall be leveled and cables laid over it. These cables shall be covered with 150 mm of sand on top of the largest diameter cable and sand shall be lightly compacted. A flat protective covering of 75 mm thick second-class red bricks shall then be laid and the remainder of the trench shall then be back filled with soil, rammed and leveled.

5.3 CABLES LAID IN CONCRETE TRENCH

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

- 5.3.2 All wall openings/pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water.
- 5.4 Above ground cables
- 5.4.1 Cables installed above grade shall run in cable trays, clamped on walls, ceiling or structures and shall be run parallel or at right angles to beams, walls or column. Cable routing shall be planned to be away from heat sources such as hot piping, gas, water, oil drainage piping, air conditioning duct etc. Each cable shall contain only one layer of cables as far as possible for power cables. However control may be laid in double layer in the cable trays.
- 5.4.2 Individual cable or small group of cables (up to 3 to 4 cables) which run along structures / walls etc. shall be clamped by means of 16 SWG GI saddles on 25 x 6 mm saddle bars. Alternatively small group of cables can be taken through 100/150 mm slotted channel tray / ISMC 100. Cables shall be supported so as to prevent sagging. In general, distance between supports shall be approximately 300mm for cables upto 25 mm diameter and maximum 450 mm for cables larger than 25mm dia. To prevent the sagging of cables.
- 5.4.3 Cable laid on supporting angle in cable trenches structures, columns and vertical run of cable trays shall be suitably clamped by means G.I. saddles /clamps, whereas cables in horizontal run of cable trays shall be tied by means of nylon cords. Distance between supporting angles shall not exceed 600 mm.
- 5.4.4 All cable trays (other than galvanized trays) and supporting steel structures. shall be painted before laying of cables. The under surfaces shall be properly degreased, dedusted, descaled and cleaned. The painting shall be done with one coat of red oxide zinc chromate primer. Final painting shall be done with two coats of approved bituminous aluminum paint unless otherwise specified.
- 5.4.5 Where cables rise from trench to motor, lighting panel, control station, junction box etc., they shall be taken in GI pipe for mechanical protection up to a minimum of 300 mm above grade. Cable ends shall be carefully pulled through conduit to prevent damage to cable.
- 5.4.6 All G.I. Pipes shall be laid as per layout drawings and site conditions. Before fabrication of various profiles of pipes by hydraulically operated bending machine (which is to be arranged by the contractor) all the burrs from the pipes shall be removed. GI Pipes having bends shall be buried in soil / concrete in such a way that the bend shall be totally concealed. For G.I. pipes buried in soil, bitumen coating shall be applied on the buried lengths, Installation of G.I. pipes shall be undertaken well before paving is completed and necessary coordination with paving agency shall be the responsibility of Electrical Contractor.
- 5.4.7 Following guide shall be used for sizing of G.I. pipe.
- | | |
|-----------------------|---|
| a) 1 cable in a pipe | -53% of pipe cross-sectional area occupied by cables. |
| b) 2 cables in a pipe | -31% of pipe cross-sectional area occupied by cables. |
| c) 3 cables in a pipe | - 43% of pipe cross-sectional area occupied by cables |

d) And above cables in a pipe - 40% of pipe cross-sectional: area occupied by cables.

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

5.5 TERMINATIONS

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

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

5.5.3 Power cables cores wherever color coding is not available shall be identified with red, yellow and blue PVC tapes. Where copper to aluminum connections is made, necessary bimetallic washers shall be used.

5.5.4 In case of control cables, all cores shall be identified at both ends by their terminal numbers by means of PVC ferrules suitable for core size. Wire numbers shall be as per schematic/ wiring/inter-connection diagram. All unused spare cores of control cables shall be neatly bunched and ferruled with cable tag at both ends, for future use. For trip circuit identification additional red ferrules shall be used only in the particular cores of control cables at the termination points in the Switchgear/ Control panels and Control Switches

5.5.5 Contractor shall drill holes for fixing glands wherever necessary. Gland plate shall be of nonmagnetic material/ aluminum sheet in case of single core cables. All unused cable entries on equipment/panels shall be plugged/sealed.

5.5.6 The cable shall be terminated at electrical equipment /switchboards through glands of proper size. The individual cores shall then be dressed and taken along the cables ways or shall be fixed to the panels with polyethylene straps. The cable glanding shall be done as per manufacturer's instructions. Cable armor shall not be exposed after termination is complete.

5.5.7 In case of termination of cables at the bottom of a panel over a cable trench having no access from the bottom close fit holes shall-be drilled in the gland plate for all the cables in one line, then gland plate shall be split in two parts along the center line of holes. After fixing bottom plate, uncovered cable holes/gaps shall be sealed with cold settings compound.

5.5.8 Crimping of lugs to cable leads shall be done by hand crimping / hydraulically operated tool as per requirement Insulation of the leads shall be removed before crimping. Conductor surface shall be cleaned and shall not be left open. Suitable conducting jelly shall be applied on the conductor lead. Lugs shall enclose all strands of cable core. Cutting of strands shall not be allowed.

- 5.5.9 The contractor shall bring to the notice of Engineer-in-charge any mismatch in cable glands, lugs provided with the equipment vis-a-vis to the cable size indicated in cable schedule for taking corrective action.
- 5.5.10 The cable joints in-power and control cables shall be avoided as far as possible. In case a joint is unavoidable, the following shall be insured:
- a. The number of joints shall be restricted to minimum as far as possible,
 - b. The location of joints shall be identified with permanent markers.
 - c. No joints shall be allowed in hazardous areas without the approval of Engineer-in-charge
- 5.5.11 The jointing and termination of medium voltage power cables shall be carried out by trained personnel only. Jointing and termination of high voltage cables shall be done by skilled and experienced jointer duly approved by Engineer-in-charge. Only type tested termination kits of approved make shall be used.
- 5.5.12 No unauthorized repairs modifications shall be carried-out on the hazardous area equipment terminal boxes and junction boxes. Damaged enclosures of hazardous area equipment shall bring to the notice of Engineer-in-charge by Contractor. After termination is complete all the bolts, nuts, hardware of terminal box shall be properly placed in its position and tightened.
- 5.5.13 Where required, cable sealing boxes intended to be used with the apparatus shall be filled with solid setting type bituminous compound unless otherwise specified.

6.0 TESTING AND COMMISSIONING

- 6.1** Field testing and commissioning of electrical installation shall be carried out as per Standard Specification.
- 6.2** Before energizing the insulation resistance of every-circuit-shall-be measured from phase to phase, phase to neutral and from phase/neutral to earth.
- 6.3** Where splices or terminations are required in circuits rated above 650 volts, insulation resistance of each length of cable shall be measured before splicing and or /terminating. After completion of splices and /or terminations measurements shall be repeated.
- 6.4** The insulation resistance of directly buried cables shall be measured before cable trenches are backfilled. Measurements shall be repeated after back filling.
- 6.5** For cables up to 1.1 kV grade 1000VMegger and for H.V. Cables 2.5 kV / 5 kV Megger shall be used.
- 6.6** D.C. High Voltage test shall be conducted on cables given below after installation. .
- 6.7** All 1100 volts grade cables in which straight through joints have been made.
- 6.8** All cables above 1100 V grade.
- 6.9** The D.C. High Voltage test shall be performed as detailed below in the presence of the Engineer in charge or his authorized representative only,

-
- 6.10** Cables shall be installed in final position with all the straight through joints complete. During the high voltage test, all other electrical equipment related to the cable installation, such as switches, instrument transformers, bus bars, etc., must be earthed and adequate clearance shall be maintained from the other equipment and framework to prevent flash over.
 - 6.11** In each test, the metallic sheath/screen/armor shall be connected to earth.
 - 6.12** All checks and tests shall be made as per Consultant standard test Performa available with site engineer.
 - 6.13** All test readings shall be recorded and submitted to Consultant / Owner in triplicate sets.
 - 6.14** Cable schedule, cable layout drawings, Interconnection drawings shall be marked by contractor for 'AS BUILT STATUS' and two sets of copies shall be submitted to Consultant / Owner.



Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR EARTHING & LIGHTNING INSTALLATION

VCS SS EL - 4025

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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
PESO	Petroleum and Explosives Safety Organization
CCE	Chief Controller of Explosive
DGMS	Director General Mines Safety
IE Rules	Indian Electricity Rules
CPRI	Central Power Research Institute
GI	Galvanized Iron
MS	Mild Steel

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1.0 SCOPE

- 1.1 This specification defines the requirements for the supply of earthing and lightning protection materials and installation of the earthing and lightning protection systems.

2.0 REFERENCE DOCUMENTS

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

SP: 30 (BIS):	Special Publication-National Electrical Code
IEC/IS: 62305:	Code of practice for the protection of buildings and allied structures against lightning
IS: 7689:	Guide for control of undesirable static electricity.
OISD 110:	Recommended practices on static electricity
OISD 147:	Inspection and safe practice during electrical installation.
OISD 180:	Lightning Protection
OISD 149:	Design Aspects for Safety in Electrical System
IEEE Std 80	IEEE Guide for Safety in AC Substation Grounding

- 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 OISD/PESO (as applicable).
- d. The petroleum rules (Ministry of Industry Government of India).
- e. Any other regulations laid down by central/state/local authorities and Insurance agencies.

3.0 DEFINITIONS

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

OWNER / COMPANY	OWNER of the particular Project (Project Specific).
CONSULTANT	The party which is doing engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.

**BIDDER / SUPPLIER /
VENDOR** The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.

4.0 MATERIALS

4.1 MATERIAL SPECIFICATIONS

- 4.1.1 All materials and hardware to be supplied by the contractor shall be of best quality and shall conform to the specifications given here under and to latest Specifications of Bureau of Indian Standards. Contractor shall bring material samples to site and get it approved by engineer-in-charge before installation.
- 4.1.2 The main earth grid conductor shall be hot dip galvanized M.S. flat unless otherwise specified. Sizes for main conductors shall be as indicated on the earthing layout drawing. Amount of galvanizing shall be 610gm per sq. meter. Earth electrodes and Earth plate shall be as per job specification.

5.0 DESIGN

5.1 EARTHING NETWORK

- 5.1.1 This consists of main earth conductor (grid conductor) forming a closed ring network with required number of earth electrodes connected to it to provide a common earth for electrical devices and metallic structures. From each earth electrode two distinct connections shall be made to the main earth conductor. The earth plates shall be used for taking multiple earth connections to two or more equipment.
- 5.1.2 The earth conductor shall be laid along cable trays/cable trench/pipe racks as indicated on the earthing layout drawing. Where lined cable trenches are available, the earth conductor shall be laid in the trenches and shall be firmly cleated to the sidewall of concrete trenches using GI clamps at interval of 400 mm to 500 mm and near to the termination end. The earthing conductor shall run along one of the cable trays along a cable route. The earthing conductor shall be suitably cleated and electrically bonded to all the other cable trays on the same cable route at a regular interval of 25 to 30 meter. The earthing for equipment shall be tapped from the main earth conductor and not from cable tray support structure. Earth conductor when laid underground shall be at a depth of 500mm below finished grade level.
- 5.1.3 Joints and tapping in the main earth loop shall be made in such a way that reliable and good electrical connections are permanently ensured. All joints below grade shall be welded and shall be suitably protected by giving two coats of bitumen and covering with hessian tape. Earth strip laid above ground shall be welded across straight through joints and joints shall be suitably protected by giving two coats of bitumen to avoid oxidation and insulation film formation of the strip surface. When two earth strips are to be joined by means of welding, lap welding with an overlapping of strip equivalent to double the width of the strip and all four sides shall be continuously welded. All joints at tapping above ground shall be by means of connector/lugs. A minimum of two bolts of adequate size shall be used for this purpose. Earthing strip joints at earth plate and equipment shall be through GI bolts, nut etc.

6.0 INSTALLATION

6.1 INSTALLATION OF EARTH ELECTRODE

- 6.1.1 Earth Electrode shall be installed as shown on installation standard and layout drawings. The location shown on the layout drawings are indicative.
- 6.1.2 The exact location of earth electrodes in the field shall be determined by contractor in consultation with the Engineer-in-charge, depending on the soil strata and resistivity. Earth electrodes shall be located avoiding interferences with road, building foundation, column, pipelines etc. The civil area drawings shall be referred for this. The distance between two electrodes shall not be less than twice the depth of electrode.
- 6.1.3 Electrodes shall preferably be located in a moist soil which has a fine texture, grain size and distribution. Wherever practicable the soil shall be dug up, all lumps broken and stones removed from the immediate vicinity of the electrodes and soil packed by watering and ramming as tight as possible.
- 6.1.4 The electrodes shall have a clean surface, not covered by paint, enamel, grease or other materials of poor conductivity.
- 6.1.5 All earth electrodes shall be tested for earth resistance by means of standard earth test meter. The tests shall take place in dry months, preferably after a protracted dry spell.
- 6.1.6 The disconnect facility shall be provided for the individual earth electrode to check its earth resistance periodically.
- 6.1.7 Location of earth electrodes shall be marked by permanent markers for easy identification. All earth Electrodes shall be serial numbered and also marked on 'As Built' drawing for future reference.
- 6.1.8 Individual earth electrodes shall be provided for each lightning arrestor and flood light mast.
- 6.1.9 Earthing system provided for concrete paved area by other agency where applicable; shall be connected to the plant earthing system below ground by minimum two earth connections.

6.2 CONNECTION

- 6.2.1 The earth system connections shall generally cover the following:
 - a. Equipment earthing for personnel safety
 - b. System neutral earthing
 - c. Static and lightning protection
 - d. System neutral
 - e. Current and potential transformer secondary neutral
 - f. Metallic non-current carrying parts of all electrical apparatus such as transformers, switchboards, bus ducts, motors, neutral earthing resistors, capacitors, UPS, battery charger panels, welding receptacles, power sockets, lighting/power panels, control

- stations, lighting fixtures etc.
- g. Steel structures/columns, rail loading platforms etc.
 - h. Cable trays and racks, lighting mast and poles
 - i. Storage tanks, spheres, vessels, columns and all other process equipment.
 - j. Fence and Gate for electrical equipment (e.g., transformer, yard etc.)
 - k. Cable shields and armor.
 - l. Flexible earth provision for Wagon, Truck
 - m. Shield wire
- 6.2.2 Conductor size for branch connection to various equipment shall be as per consultant Installation Standards unless otherwise stated on earthing layout drawings.
- 6.2.3 All process pipelines shall be bonded and earthed at the entry and exist points of battery limit of hazardous area. Earth continuity conductors across pipe line flanges shall not be provided as per OISD 110.
- 6.2.4 Steel pipe racks in the process units and offsite area shall be earthed at every 24 meters.
- 6.2.5 Equipment / street light pole etc. located remote from main earth network may be earthed by means of individual earth electrode and earth conductor unless otherwise stated in Job Specifications.
- 6.2.6 Lightning protection shall be provided for the equipment, structures and buildings as shown on layout drawing. Self-conducting structures shall not require separate aerial rod and down conductors. These shall however be connected to the earthing system at two or more points as shown on layout drawing. An independent earthing network shall be provided for lightning protection and this shall be bonded at least at two points with the main earthing network below ground. Lightning down conductor shall be brought to earth electrode in shortest straight path as feasible to minimize surge impedance.
- 6.2.7 The main earthing network shall be used for earthing of equipment to protect against static electricity.
- 6.2.8 All medium and high voltage equipment (above 250V) shall be earthed by two separate and distinct connections with earth.
- 6.2.9 Plant instrument system clean earthing, UPS system clean/safety earth shall be separate from the electrical earthing system.
- 6.2.10 All paint, scale and enamel shall be removed from the contact surface before the earthing connections are made.
- 6.2.11 All earthing connections for equipment earthing shall be preferably from the earth plate mounted above ground wherever provided.
- 6.2.12 Equipment foundation bolts shall not be used for earthing connection.
- 6.2.13 Earth connections shall be made through compression type cable lugs/by welded lugs.

- 6.2.14 All hardware used for earthing installation shall be hot dip galvanized or zinc passivated. Spring washers shall be used for all earthing connections and all connections adequately locked against loosening.
- 6.2.15 Lighting fixtures and receptacles shall be earthed through the extra core provided in the lighting circuit/cable for this purpose.
- 6.2.16 The reinforcements of sub-station building and the sub-station floor shall be connected to main earth grid.

7.0 INSPECTION AND TESTING OF EARTHING SYSTEM

- 7.1.1 Field inspection, testing and commissioning of electrical installation shall be done as per specification. Earthing systems/connections shall be tested as follows:
- 7.1.2 Resistance of individual earth electrodes shall be measured after disconnecting it from the grid by using standard earth test meggar.
- 7.1.3 Earthing resistance of the grid shall be measured after connecting all the earth electrodes to the grid. The resistance value of an earth grid to the general mass of earth shall be as follows:
- a. For the electrical system and equipment, a value that ensures the operation of the protection device in the electrical circuit but not in excess of 4 ohm. However, for generating stations and large sub-systems the value shall not be more than 1 ohm.
 - b. For lightning protection, the value of 5ohms as earth resistance shall be desirable, but in no case, it shall be more than 10 ohms.
- 7.1.4 The resistance to earth shall be measured typically at the following points.
- a. At each electrical system earth or system neutral earth.
 - b. At each earth provided for structure lightning protections.
 - c. At each point on earthing system used to earth electrical equipment enclosures.
 - d. At one point on earthing system used to earth wiring system, enclosures, such as metal conduits and cable sheaths or armor.
 - e. At one point on fence enclosing electrical equipment.

8.0 LIGHTNING PROTECTION

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

- 8.1 Air terminals shall be mounted on top of buildings or structure as required. All air terminals shall be inter-connected with roof conductors, pipes, hand rails or any other metallic projection above the roofs shall also be bonded to the roof conductors.

- 8.2 Down conductors from air terminals or from roof conductors shall be routed as directly as possible to the test links on earth buses, with minimum bends.

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

- 8.3 In corrosive atmospheres, plumbing metal for corrosion protection shall cover lightning finials or air terminals.

- 8.4 The layout and design of lightning protection systems for building extensions or new buildings and structures provided within existing station areas shall match the existing design.

- 8.5 All connections between the different parts of lightning protection systems and the connections to the earthing system must be performed in a manner such that the arising of chemical elements will be avoided.

9.0 COLLECTORS

Collectors shall be determined in accordance with the lightning ball method. Collectors may comprise a combination of the following components:

Collector lines

Collector rods

9.1 Natural Components of Collectors

Metal cladding, metal roof structures, metal components of roof Structures, gutters and railings may be considered as natural components of collectors.

The requirements of the standards, such as the following, have to be considered:

Parts must be permanently conductively connected,

Minimum thickness of the metal involved,

Cross-sections of the parts.

Installations with metal casings need not to be fitted with collectors taking into consideration the above-mentioned minimum requirements.

Protective coatings or insulation between metal parts shall be electrically bridged.

9.2 Mesh Type Collectors

Buildings shall be provided with mesh-type collector lines. The collectors have to be configured in a way such that no point of the roof is at a distance of more than 5 m from a collector.

The maximum permitted mesh size is as follows:

Buildings with telecommunication or control rooms 10 x 10 m

Other buildings 10 x 20 m

Protruding roof superstructures, such as ladders, chimney stacks, pipes, antenna mounting brackets, etc. and other metallic parts of buildings which are located near the roof (e.g., louvers of ventilation openings) must be directly connected to the collector lines.

9.3 Collector Rods

Collector rods shall be used for roof superstructures featuring mechanically or electrically operated equipment, such as ventilators and non-conductive parts projecting from the mesh plane by 0.3 m. The angle of protection and a certain minimum distance have to be observed.

Outdoor electrical facilities for HVAC or other purposes not located in the protective area of earthed structures, installations or buildings, including exposed electrical equipment shall be protected by collectors.

Buildings with sheet metal roofs where the thickness of the sheet is smaller as the required value, the collector mesh must be equipped with collector rods of sufficient quantity and length to avoid lightning strokes in the sheet metal.

9.4 Down Conductors

Down conductors shall -be selected in a manner such that there are several parallel current paths between the collector and the earthing system. The length of each down conductor is to be kept as short as possible.

Steel structures and steel columns of buildings may be used as down conductor, if the minimum sizes according to the standards are guaranteed. In each case the connections with the earthing system and collectors respectively must be visible and removable.

Starting from the corners of the structure involved, conductors should be distributed around the exterior as evenly as possible. They must be configured in such a way as to constitute the direct continuation of the collector. The minimum distance between conductors and doors, windows and other apertures must be 0.5 m.

If not already connected with the collectors or with the internal potential equalisation, larger metal parts mounted in/on the building outer walls (e.g. frames of doors, ventilation louvers) shall be terminated on the down conductors. The number of down conductors and the minimum distance between the conductors is given as follows:

- a) Buildings containing telecommunication and control systems
- b) Minimum number of conductors: 4
- c) Maximum distance between conductors: 10 m
- d) Other buildings
- e) Minimum number of conductors: 2
- f) Maximum distance between conductors: 20 m

All down conductors which are connected to the earthing system must be provided with an

accessible isolating point for measuring purposes. For termination the grounding bars of grounding loops shall be used, preferably. No conductors are required for outdoor metal structures of adequate size.

9.5 Inadmissibly Short Distances

Inadmissibly short distances between the lightning protection system and metal installations or electrical equipment shall be prevented. In the event of potential hazard due to flash-over or disruptive discharge caused by lightning, appropriate measures shall be taken.

Admissible distances between lightning protection systems and metal installations, electrical wiring and equipment shall be determined in compliance with the standards. This also applies to the use of special roof-mounted collectors.

10.0 TESTS OF LIGHTNING PROTECTION SYSTEM

After erection of the earthing and lightning protection system all installations shall be tested in accordance with applicable regulations

The following tests shall be carried out, at least:

Measures against corrosion protection and arising of chemical elements,

- a) Check of all connections,
- b) Measurements of earthing system resistance,
- c) Measurements of lightning protection system conductivity,
- d) Check of mechanical details,
- e) Compliance with specifications.

The aim of the tests is to ensure the proper function of the complete scope. The measuring results and the locations of the measuring points have to be indicated in respective drawings as a basis for future measurements



Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR LIGHTING INSTALLATION

VCS – SS – EL - 4026

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ABBREVIATION

BIS/IS	Bureau of Indian standards
IEC	International Electro-Technical Commission
BS	British Standards
IEEE	Institute of Electrical and Electronics Engineers
NEMA	National Electrical Manufacturers Association
OISD	Oil Industries Safety Directorate
CCE	Chief Controller of Explosive
DGMS	Director General Mines Safety
IE Rules	Indian Electricity Rules
CPRI	Central Power Research Institute
AC	Alternating Current
DC	Direct Current
CP	Cathodic Protection
SCADA	Supervisory Control And Data Acquisition
FRP	Fiber Reinforced Plastic
TPN	Triple Pole Neutral
MCB	Miniature Circuit Breaker
ELCB	Earth Leakage Circuit Breaker
MDB	Main Distribution Board
HPMV	High Pressure Mercury Vapor
HPSV	High Pressure Sodium Vapor
PVC	Poly Vinyl Chloride
GI	Galvanized Iron
HRC	High Rupturing Capacity
MS	Mild Steel
CFM	Cubic Flow Meter

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1.0 SCOPE

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

2.0 REFERENCE DOCUMENTS

- 2.1 The work shall be carried out in the best workmanlike manner, in conformity with this specification, and the relevant specifications/codes of practice of the bureau of Indian standards.
- 2.2 In addition to the above it shall be ensured that the installation conforms to the requirements of the following as applicable:
- a. Indian Electricity Act and Rules.
 - b. Regulations laid down by CEA/Electrical Inspectorate.
 - c. Regulations laid down by OISD/PESO (as applicable).
 - d. The petroleum rules (Ministry of Industry Government of India).
 - e. Any other regulations laid down by central/state/local authorities and Insurance agencies.

3.0 DEFINITION

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

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

4.0 FABRICATION (EQUIPMENT SPECIFICATION)

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

4.1 Lighting and Power Panels

- 4.1.1 Lighting and power panels (general purpose panels for safe area) shall be made of 1.6mm thick sheet steel and shall be dust and vermin proof. All metal surfaces shall be cleaned free of rust, given a coat of red-oxide primer and finished with two coats of epoxy-based paint of shade 632 of IS 5. Panels shall be indoor/outdoor type as specified. Indoor type panels shall have IP42 degree of protection and shall be suitable for surface or flush mounting on wall surface as specified. Lighting and power panels located outdoor shall be IP55 weather protected and shall also preferably have integral canopy for additional weather protection. The canopy shall be made of 2mm thick galvanized sheet steel or FRP where these are separate from the equipment.
- 4.1.2 Lighting and Power panels shall have TPN incoming feeder and single phase outgoing feeders. Lighting circuit feeders shall be rated for 10 amps and power circuit feeders shall have current rating of 16Amps. In power panels for window Air conditioning units, power circuit feeder shall be rated for 20 amps. Panels shall be equipped with phase and neutral bus bars of required current carrying capacity. The outgoing feeders shall be provided with single pole miniature circuit breakers (MCBs) for safe areas and double pole MCBs for hazardous areas. The incomer shall be with MCB and ELCB unit unless otherwise specified. Miniature circuit breakers shall be mounted in such a way that the operating levers project outside the front Bakelite covers plates for ease of operation. A hinged door to cover the operating knobs shall be provided. In addition, a circuit diagrams indicating incomer details and outgoing details viz. Circuit number, circuit rating, and load connected and details of the load shall be pasted inside the panel. Also a laminated copy of the diagram shall be provided inside the panel in a suitably designed pocket. Two external earthing studs for connection to the plant earthing grid shall be provided on the panel. Further, the panel shall be provided with an earth bus bar with terminal studs for connection to the third core of each outgoing circuit. Each circuit phase and neutral shall be given ferrule numbers. Complete wiring inside the panel, shall be neatly bunched with PVC tape and button. Sufficient terminals shall be provided in the terminal block so as to ensure that not more than one wire (core) is connected to a terminal. The panel shall have knock out holes or removable gland plate for the entry of incoming and outgoing conduits or cables. The panels shall be complete with requisite number of cable glands as specified.
- 4.1.3 The Main distribution board (MDB) where used, shall be made of 2mm thick sheet steel panel, dust and vermin proof similar-in construction to Lighting and Power panels but with TPN MCB incoming and TPN outgoing (MCB with ELCB units and MCB without ELCB unit as applicable) of required numbers as specified.
- 4.1.4 All MCBs shall be of M9 category as per IS 8828 and sensitivity of ELCBs shall be 100 mA unless otherwise specified.
- 4.1.5 Wherever the size of incoming cable to lighting, power panels/MDB is more than 35 sq.mm a suitable cable adapter box shall be provided and attached to the panel. The incoming cable leads shall be connected to terminal block (bolted type terminals) of required size. This terminal block shall be connected to TPN incomer unit through separate PVC insulated copper conductor wires/bus bars. Sufficient space shall be provided (200 to 250mm) between gland plate and the bottom of terminal block for easy termination.

4.2 Lighting fixtures

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

4.3 Switches

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

4.4 Receptacles

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

4.5 Outlet Boxes

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

4.6 Conduit and Accessories

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

4.7 Lighting Poles

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

4.8 Lighting HIGH Mast

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

Unless otherwise specified the flood lighting high masts shall be telescopic type.

4.9 Wires

Wires shall be PVC insulated and shall be of 660 Volts grade as per IS694. Conductor shall be of stranded copper and size shall be minimum 1.5 Sq. mm for lighting, 2.5 Sq. mm for 15A power socket circuits and 4 sq. mm for split A/C power socket circuits. Red/Yellow/blue wires for phases, black wire for neutral and green wire for earth shall be used (size of earth wire shall be same as for phase and neutral size). Wire size for air conditioning circuit feeders shall be as indicated in the panel schedule.

4.10 Ceiling Fan/Exhaust Fan

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

4.11 Decorative switches and sockets

Decorative lighting switches and sockets where specified, shall be modular in design. All these items shall fit into the same frame with overall standard dimensions. Frames shall be suitable for surface and flush mounting in brick / concrete wall. The frames shall be

suitable for conduit entry from all the sides. Switches and sockets shall match colors of the frame and cover plates to obtain a combination which shall match decor of the interiors of Control Room, Administrative buildings, offices rooms etc.

5.0 INSTALLATION

Lighting system installation shall be as per follows.

5.1 General

- 5.1.1 The lighting fixtures in the plant shall be fed from lighting panel. All outdoor lighting shall be group controlled manually or through synchronous timer or photocell. Lighting wiring between panel and lighting fixtures shall be done with PVC insulated 3core (phase, neutral and earth) copper conductor armored cable for hazardous areas. Wiring in the building shall be done by means of 3core copper, conductor. PVC insulated, un-armored cables, or PVC insulated copper conductor wires in conduit/Metsec channel as specified. All joints of conductors in Switch boards/JBs Fittings shall be made only by means of approved mechanical connectors (nylon/PVC connectors). Bare twisted joints shall not be permitted anywhere in the wiring system.
- 5.1.2 The lighting layouts furnished by Owner will indicate approximate locations of lighting fixtures. The electrical contractor shall determine, with approval of Engineer-in-Charge, The exact location of each fixture in order to avoid interference with the piping or other mechanical equipment and also with a view to obtain as much uniform illumination as practicable, and to avoid objectionable shadows. Conduits shall be laid out by the contractor to suit field conditions and as per directions of the Engineer-in-Charge.
- 5.1.3 On walkways, platforms and other outdoor area, lighting fixtures shall be located nearer to landing of stairs or ladders, gauges, flow meters, panel boards and other equipment to provide proper illumination.
- 5.1.4 The minimum height of any lighting fixture shall be preferably not less than 2.5 meters above the floor level.
- 5.1.5 All outdoor cable terminations to outdoor junction boxes, panels, socket outlets etc. shall be through bottom or from side. Top entries for cables shall be avoided to avoid water entry. All cable glands for outdoor terminations shall be double compression type and the gland shall be covered with PVC or rubber boot shroud. All unused cable entries shall be plugged with suitable blanking plugs.
- 5.1.6 Mounting height of equipment shall be as under: -

a. Top of Switch Box	1200 mm from FFL(Finished floor level)
b. Top of Lighting/Power Panel	1800mm from FFL
c. 5/15 Amp. Receptacle	300mm from FFL unless otherwise specified (1200 mm for process areas and industrial sheds)
d. Lighting fixture	As indicated in layout drawing
e. Exhaust fan	in the cutout provided / as indicated in Layout drawings.

- 5.1.7 Fixtures shall be firmly supported from the structures. Support (clamps etc. may be bolted or welded to the existing steel work or metal inserts. In case of concrete, structures, where metal inserts are not available, fixtures shall be suspended from concrete surfaces with the help of anchor fasteners. In such cases special care shall be taken to see that anchoring is firm. In places where ceiling fans are provided, lighting fixtures shall be suspended below the level of fan to avoid shadow effect.
- 5.1.8 Circuit cables in a group shall be cleated to structure by using galvanized strip clamps or cable run in cable trays wherever trays are available. Spacers and cleats shall be of required size to accommodate the cables. All hardware shall be galvanized or zinc passivated. Underground lighting cables (in paved areas), shall be taken in suitable G I sleeves buried at a minimum depth of 300 mm from FFL. GI pipe sleeves shall be extended to 300mm above. FFL Exact termination/layout of pipes (for protection of cables) shall be decided at site as per site convenience in consultation with Engineer-in charge.
- 5.1.9 Wiring for all outlet sockets shall be done with 3 cores of equal sizes for, phase, neutral and earth. The terminals of switch sockets shall be suitable to receive the size of wire specified.
- 5.1.10 All lighting fixtures shall be provided with terminal block with required terminals suitable for connection of wire up to 2.5 sq mm copper conductor.
- 5.1.11 The cable shall be straightened after unwinding it from the drum. All cables be clamped/laid in straight run without any sag and link.
- 5.1.12 For location where fan points are shown, fan hooks with junction box during concreting.
- 5.1.13 Where fan hooks and JB's are provided separately JB shall be located within a distance of 300mm from hook for mounting of ceiling rose.
- 5.1.14 Industrial type plug sockets with 20A MCB or rating as per job specification shall be provided at a height of 500mm from FFL for window AC units.
- 5.1.15 Socket outlets and plugs for installation in Substation building, DG shed, workshop, and maintenance shop etc. shall be of industrial metal clad type.
- 5.1.16 Wiring for exhaust fans shall be terminated in receptacles as specified in layout drawing and the connection from receptacle to the exhaust fan shall be by means of a flexible cord equivalent in size to the main run of wires. Switch for exhaust fan shall be located in a separate switch board along with other switches.
- 5.2 Conduit System
- 5.2.1 Surface or concealed conduit system of wiring shall be adopted, as specified in the drawings. Required number of pull boxes shall be used at intervals to facilitate easy drawing of wires. Separate conduit shall be run for lighting and power circuits. Further, conduits for Normal lighting/Emergency lighting/DC critical lighting shall be separate. Conduit layout shall be decided at site as per site conditions. Drop conduits for switch boards shall be decided by contractor as per wall locations shown in Architectural drawings. All exposed run of conduits on surface, shall be vertical or horizontal.

- 5.2.2 Only threaded type conduit fittings shall be used for metallic conduit system. Pin grip type or clamp type fittings are not acceptable. Conduit ends shall be free from sharp edges or burrs. The ends of all conduits shall be reamed and neatly bushed.
- 5.2.3 Conduit shall be of minimum 25mm dia. Maximum number of wires permissible in a conduit shall be seven/nine for wire size of 2.5 sq mm/1.5 sq mm. respectively.
- 5.2.4 The exposed outer surface of the conduit pipes, including all accessories forming part of the conduit system, shall be adequately protected against rusting. In all cases, bare threaded portion of conduit pipe shall not be exposed unless such bare threaded portion is treated with anti-corrosive preservative or covered with approved plastic compound.
- 5.2.5 Conduit connection to outlet boxes shall be by means of screwed hubs or check nuts on either side. Where concealed wiring is done, junction boxes (65mm deep) shall be used so as to rest on shuttering properly. Conduits shall be laid above reinforcement. All conduit connections shall be properly screwed and Junction box covers shall be properly fitted so as to avoid entry of concrete slurry.
- 5.2.6 Conduit pipes shall be fixed by 1.6mm thick G.I. saddles on 3mm thick G.I. saddle bars of required width in an approved manner at intervals of not more than 50cms for straight run. At places near junction boxes, bends, or similar fittings, saddle and bars shall be provided on either side.
- 5.2.7 Where concealed wiring is to be adopted, conduits shall be laid in time before concreting of the slab. Pull wire (GI or steel) shall be provided inside conduit .for the ease of wire pulling. The contractor shall coordinate his work with other agencies involved in the civil works in, such a way, that the work of the other agencies is not hampered or delayed. Vertical conduit runs shall be made in wall before plate ring is done so as to avoid chasing. Where chases are made for conduit run contractor shall fill these chases or any other openings made by them after completing the work and patch the surface. During installation, care shall be taken to see that proper covers are provided to prevent rusting of conduits. Locations of all point outlets, junction boxes shall be marked with brick powder or sand so that these are easily identified after shuttering removal. As built conduit layout drawing shall be submitted by contractor after completion of the work.
- 5.2.8 All junction boxes, bends and other accessories shall be of the same material as that of conduit and shall have the same protective coatings.
- 5.2.9 After erection, the entire conduit system shall be tested, for mechanical and electrical continuity and shall be permanently connected to earth by means of approved type of earthing clamps.
- 5.3 Hazardous Area Installation
- 5.3.1 Wiring in hazardous area shall be done by using minimum 2.5mm copper conductor armored cable. Circuit wiring feeding hazardous areas shall be controlled by two pole switches/MCBs (for phase as well as neutral isolation).
- 5.3.2 Correct type of lighting equipment (fixtures and JB's) with regard to hazardous protection as specified in the drawing shall be installed for the areas classified as Zone 1, Zone 2 etc.

- 5.3.3 The terminations in the junction boxes and the lighting fittings shall be done avoiding possibility of loose connections due to vibrations. After the terminations are made the cover of the junction boxes and the lighting fittings shall be closed properly with all bolts and hard wares in correct position, retaining its explosion and weather protections. In fixtures having double cable entries, both the entries shall be used for looping in and looping out connection, thus minimizing the use of separate junction box wherever separate control gear boxes (C.G. box) are provided looping in and looping out, connections shall be through CG-box, thus avoiding the use of an additional junction box. All unused cable entries shall be sealed with suitable plugs.
- 5.3.4 Circuit cables shall be firmly cleated in a group along, columns/ beam/ladders/side channels/platform using 1.6 mm thick GI saddles on, 25x3 mm GI saddle bar at intervals of 400mm to 500mm for straight run and on either side close to bending and at both termination ends as per the direction of Engineer-in-charge. Where required 3 or more of cables may be taken in slotted channel tray after getting the approval of Engineer-in-charge. Cables shall not be routed along hand rails.
- 5.3.5 Where fire proofing column/structures are encountered, all cabling shall be taken in GI pipes of required size and both ends shall be sealed, well before fire proofing is done. Similarly, equipment such as lighting fixture, control gear box, lighting/ power panels, field call stations, junction-boxes etc. shall be installed on suitable steel mounting frame/distance bracket, thereby direct contact with the concrete used for fire proofing.
- 5.3.6 Cable glands for terminating cable on flameproof equipment shall be of double compression FLP type. Any material/equipment specified to be supplied by contractor for installation in hazardous areas, shall be tested by CMRI and duly approved by C.C.E. Nagpur or DGMS Dhanbad or any other applicable statutory authority. All indigenous FLP equipment shall also have valid BIS license as required by statutory authorities.
- 5.4 Building Lighting
- 5.4.1 The type of wiring system shall comprise surface/concealed conduit system or cable wiring as specified on layout drawings.
- 5.4.2 Mounting details of fixtures shall be indicated on the drawings. If specified on the drawings, a group of fluorescent lighting fixtures which are to be mounted end to end shall be fixed to mild steel cold Rolled sections of 50mm x 50mm and of 1.2mm thick (Metsec channel). The entire assembly shall be fixed to the ceiling with necessary number of supports which may be by means of steel conduit or chromium plated chain link as required. The 'Metsec' Channel shall run continuous in suitable sections from one end to other end of wall. The complete channel shall be spray painted, with approved color as per the directions of Engineer-in-Charge. All wires inside channel shall be neatly bunched by nylon tape & buttons.
- 5.4.3 Wiring in areas above false ceiling shall be done in Surface Conduit (25mm die GI conduit) suitably clamped to the true ceiling. Vertical drops from true ceiling for panels, switches, receptacles etc. shall be taken in 25mm die PVC conduit concealed in walls up to switchboards/panels. Lighting fixtures shall be supported from true ceiling. Exact location of fixtures shall be finalized in co-ordination with air-conditioning duct-diffuser layout, panels layout and false ceiling grid layout. To facilitate easy maintenance Looping

back system' of wiring shall be followed throughout. Accordingly supply tapping's and other interconnections including for earthing are made only at fixture connector blocks or at switch boards. Required number of junction boxes shall be used at intervals for wire pulling and inspection.

- 5.4.4 All wires in conduit shall be color coded as specified. Each circuit shall have independent phase neutral and earth wire. However when group of circuits are run in a single conduit the earth wire can be common.
- 5.4.5 Building conduit lighting system of wiring where measurement is done on point wiring basis generally consists of two parts. The first part is the circuit wiring which includes the work necessary from lighting panel up to switch box and from switch box to another switch box. The second part is the point wiring which shall include the work necessary from tapping point in the switch box up to various fixtures or fan outlets/ceiling roses.
- 5.4.6 In no case, two different sources or two different phases of supply shall be combined in one switchboard.
- 5.4.7 Switches for light fixtures/exhaust fans in battery room shall be provided outside the Battery room.
- 5.4.8 Lighting layouts for non-plant buildings (such house, cement go down, gate house, workshop, service building, rest room, etc.) shall be prepared by installation contractor.
- 5.4.9 The following basic data/document for layouts will be provided to the contractor.
- f. Architectural drawings
 - g. Illumination level required
 - h. Type of lighting fixture
 - i. Type of wiring (concealed/surface conduit/cable wiring etc.)
- 5.4.10 Based on the above input, contractor shall prepare and submit lighting layout drawings, panel schedules, conduit layout drawings for concealed wiring, design calculations wherever required, for review by purchaser before erection work is started. The lighting layout drawing shall show the location, type and mounting details of lighting fixtures, receptacles, junction boxes, layout of circuit indicating number of wires etc. The number of points in a circuit shall not exceed ten and the load in each circuit shall be less than 1000 Watts.
- 5.4.11 The panel schedule shall include rating of incoming and outgoing feeders, number of outlets, load for each outgoing circuit, etc.
- 5.4.12 All drawings shall be prepared preferably in AO and AI size. Panel schedules shall be in A4 size drawings (Final submission of drawings shall be in soft copies and in bound volumes together with one transparency of each document).
- 5.5 Street Lighting

- 5.5.1 Street lighting poles to be located on road side shall be installed at a minimum distance of 300mm from the edge of the walkway of the road (road berm). Size of wires from marshalling box up to fixture shall be 1.5mm²/2.5mm², copper conductor PVC insulated.
- 5.5.2 Each pole shall be earthed at two points by connecting to the plant earth grid as shown on Installation standards.
- 5.5.3 Street lighting fixture shall be mounted on steel tubular poles as per standard drawings. The foundation for the street lighting poles will be made by electrical contractor Street lighting poles shall be supplied with a base plate.
- 5.5.4 The poles shall be numbered as per the drawings/ directions of Engineer-in-charge.

5.6 HIGH Mast Lighting

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

5.7 Telephone Wiring

- 5.7.1 Conduits for telephone wiring in buildings shall be of 1.6mm thickness. 25mm dia black enameled steel conduit/PVC as per IS 9537, installed on wall surface or concealed or as specified in job specification.
- 5.7.2 Conduit installation system shall comply to the requirements given in conduit system. Required number of pull boxes shall be provided at interval for easy drawing of wires. The telephone wiring shall be done with 0.63mmdiaannealed copper conductor PVC insulated 660V grade, twin flat wire, unless otherwise specified in Job Specification. One telephone socket outlet shall be provided for connection to telephone instrument.

6.0 INSPECTION & TESTING

- 6.1 Lighting installation shall be tested and commissioned by installation contractor as per Specifications. Pre commissioning checks and tests shall include but not be limited to the following:
 - 6.1.1 The insulation resistance of each circuit without the lamps (load) being in place shall be measured and it should not be less than 500,000 ohms. (Between phases, phases to neutral, phase/neutral to earth).

-
- 6.1.2 Current and voltage of all the phases shall be measured at the lighting panel bus bars with all the circuits switched on with lamps. If require load shall be balanced on the three phases.
 - 6.1.3 The earth continuity for all socket outlets shall be checked. A fixed relative position of the phase and neutral connections inside the socket shall be established for all sockets.
 - 6.1.4 After inserting all the lamps and switching on all the circuits, minimum and maximum illumination level shall be measured in the area and recorded.
 - 6.1.5 It shall be ensured that switch provided for ON/OFF control of point (light/fan/socket) is only on LIVE side.
 - 6.1.6 Operation of ELCB's shall be checked
 - 6.2 Contractor shall duly fill in all the above test results and submit the test reports to Engineer-in-Charge in triplicate.
 - 6.3 All lighting layout drawings shall be marked by contractor for 'AS BUILT STATUS' and two sets of copies shall be submitted to the consultant.



Energising Quality

VCS Quality Services Pvt Ltd

STANDARD SPECIFICATION FOR FIELD INSPECTION, TESTING AND COMMISSIONING OF ELECTRICAL INSTALLATION

VCS – SS – EL - 4027

02	09.03.2022	SP	RD	AA	HK
01	16.10.2019	MG	VV	AD	SK
00	05.07.2017	MG	RD	AD	SK
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

UNCONTROLLED COPY	:	If printed
CONTROLLED COPY	:	If in soft and signed

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	05.07.2017	MG	RD	AD	SK	Issued for use as Standard
01	16.10.2019	MG	VV	AD	SK	New revision system updated
02	09.03.2022	SP	RD	AA	HK	New revision system updated

ABBREVIATION

CEA	Central Electricity Authority
CCE	Chief Controller of Explosive
DC	Direct Current
DGMS	Director General Mines & Safe
GI	Galvanised Iron
OISD	Oil Industries Safety Directorate
AFC	Approved For Construction
DCS	Distributed Control System
ECS	Emergency Control System
HV	High Voltage
MV	Medium Voltage

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1.0 SCOPE

- 1.1** This Specification covers the requirements for the field inspection, testing and commissioning of electrical equipment and installation, forming part of electrical power distribution and utilization system.

2.0 REFERENCE DOCUMENTS

- 2.1** The field inspection, testing and commissioning of electrical equipment shall be carried out in line with this Specification and the latest edition of following Indian Standards and OISD standards.

SP-30(BIS)	National Electrical Code
IS-7816	Guide for testing Insulation resistance of rotating machines.
IS 1255	Code of practice for installation and maintenance of power cables up to & including 33 kV rating.
IS 10810(Part 43)	Method of Test for cables; Part 43 Insulation resistance.
IS 10810(Part 45)	Method of Test for cables; Part 45 High voltage test.
OISD 137	Inspection of Electrical Equipment.
OISD 147	Inspection and safe practice during electrical installation.

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

- a. Indian Electricity Act and Rules.
- b. Regulations laid down by CEA / Electrical Inspectorate.
- c. Regulations laid down by Tariff Advisory Committee/Loss prevention council.
- d. Regulations laid down by OISD/PESO (as applicable).
- e. The petroleum rules (Ministry of Industry Government of India).
- f. Any other regulations laid down by central / state / local authorities / insurance agencies.

3.0 DEFINITIONS

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

OWNER / COMPANY	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 electrical equipment as per Inspection Test plans.
- 4.2** Before the completed installation or an addition to the existing installation is put into service, inspection / pre-commissioning checks and tests shall be carried out by contractor. In the event of defects being found out, the same shall be rectified and the installation retested as applicable.
- 4.3** The pre-commissioning inspection among other requirements shall include visual inspection, checking the workmanship of the installation, the rating of equipment, safety clearances, sizes of cables installed, conformance to the AFC document, soundness of switchgear bus connections, wiring properly dressed and labeled, sealing of unused cable entries, checking of all safety interlocks, control/interface functions as per requirement etc.
- 4.4** Visual inspection for soundness of bus bar connections of bus ducts, terminal connections of equipment/motor shall be carried out. It shall be ensured that no foreign materials are present inside bus duct and equipment terminal boxes. After the visual inspection, all the covers of terminal boxes, inspection chambers shall be refitted with gaskets, bolts & nuts as per equipment manufacturer's instructions.
- 4.5** Pre-commissioning tests shall include but not be limited to the following:
- a. Continuity test for each winding and power and control circuits.
 - b. Insulation test for each winding and power and control circuit
 - c. High voltage test for cables
 - d. Dielectric strength test on transformer oil.
 - e. Checking the correctness of wiring schemes, control circuit interlocks for intended functioning.
 - f. Verification of phase sequence.
 - g. Testing of all types of relays/releases for required operation. Testing of measuring instruments for proper functioning Earth continuity test for all circuits.
 - h. Checking of safety features for correctness of operation etc.
 - i. Checking of all wired interface contacts (analog, digital input/output contacts) for, DCS and ECS interface, at panel and equipment terminal chambers as applicable.
 - j. (Electrical contractor shall co-ordinate with other agencies involved for the above and, provide support services for checking interfaces of electrical equipment and the intended functioning)

- k. Earth resistance measurement for each earth electrode, and the earthing system as a whole.
 - l. 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 hardware intact and there is no physical damage mark seen on the enclosure.
- 4.9** Site Acceptance Test procedure for specific equipment shall be furnished by the respective equipment Vendor. The contractor shall provide necessary assistance to the equipment Vendor to perform site acceptance testing to enable the equipment Vendor to perform the same.
- 4.10** All pre-commissioning checks and tests shall be carried-out as per the directions of Engineer in-charge. In addition to the equipment manufacturer's instructions, pre-commissioning check requirements shall also be complied. All tests shall be carried out by contractor in the presence of Consultant /Owner's representatives
- 4.11** The contractor shall bring to site all required tools, tackles, and testing instruments for carrying out field testing. Contractor shall use only calibrated measuring and test instruments and shall maintain calibration records.
- 4.12** The Insulation Resistance test values for various electrical equipment shall be as below.

4.12.1 Cables

The insulation resistance test values for cables shall be as per following table:

Rated voltage of the Cable	DC Voltage Test in Volts	Minimum Insulation resistance in Mega ohms
Lighting and power circuit Wiring	250	1
650/1100 V grade cables	1000	1
1,900/3, 300V grade cables	1000	200
3,800/6,600V grade cables	1000	200
6,350/11,000V grade cables	5000	200
8,700/115,000V grade cables	5000	200
12,700/22 000V grade cables	5000	200
19,000/33000V grade cables	5000	200

4.12.2 HV, MV and miscellaneous switchboards

The insulation resistance test values for the switchboards shall be as per following table:

Rated voltage of the Switchboard	DC Voltage Test in Volts	Minimum Insulation resistance in Mega ohms
33,000V	5,000	200
11,000V	5,000	200
6,600V	1,000	200
3,300	1,000	200
415V	1,000	100
240V	500	10
110V	500	10

4.12.3 Generators and motors

The insulation resistance test values for the Generators and Motors shall be as per following table:

Rated voltage of the Generators and Motors	DC Test Voltage in	Minimum Insulation resistance in Mega 40 °C
11,000V	5,000	120
6,600V	1,000	80
3,300V	1,000	50
415V	1,000	15
240V	500	12

4.12.4 Transformers

The insulation resistance test values for the Transformers shall be as per following table:

Rated Voltage of the Transformer	DC Test Volt in volts	Minimum Insulation resistance in Mega ohms at 40°C
Up to 600V	1,000	100
601 to 5000V	2,500	1,000
5001 to 15,000V	5,000	5,000
15001 to 35,000V	5,000	10,000

It shall be ensured that during insulation tests; electronic devices and components that are liable to get damaged on applied test voltage shall be disconnected from circuit. The instructions of equipment/panel manufacturer shall be followed strictly in this regard.

4.12.5 High-voltage testing

D.C. high voltage test shall be conducted as per following table on all H. V. feeder cables and also on 1100 V grade cables where straight through joints have been made.

Rated Voltage of Cable (kV)	TEST VOLTAGE (kV) BETWEEN		Duration (Minutes)
U₀ / U*	Conductor and Metallic sheath/ Screen/ Armour	Conductor to Conductor (For Unscreened Cables)	
0.65/1.1	3	3	5
1.9/3.3	5	9	5
3.3/3.3	9	9	5
3.8/6.6	10.5	18	5
6.6/6.6	18	18	5
6.35/11	18	30	5
11/11	30	30	5
12.7/22	37.5	-	5
19 / 33	60	-	5

* U_o: Phase Voltage U: Line Voltage

The cable cores must be discharged on completion of DC high voltage test and cable shall be kept earthed until it is put into service.

DC test voltage for old cables shall be 1.5 times rated voltage or less depending on the age of cables, repair work or nature of jointing work carried out, etc. In any case, the test voltage shall not be less than the rated voltage.

All protective relays including thermal overload relays shall be tested by secondary injection current. Primary injection tests shall be carried out for differential protection, restricted earth fault protection at full/reduced current to ensure correctness of complete wiring.

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).

	CONTRACTOR		QUALITY ASSURANCE PLAN FOR ELECTRICAL ITEMS			CLIENT:	NEGDCL
	ORDER NO. & DATE					PROJECT:	City Gas Distribution Project
	SUB-CONTRACTOR					PACKAGE NO.	
	ORDER NO. & DATE					PACKAGE NAME	Electrical Works

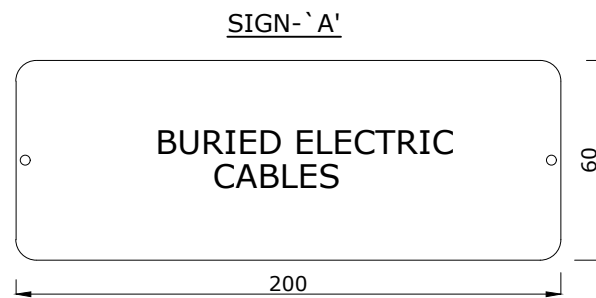
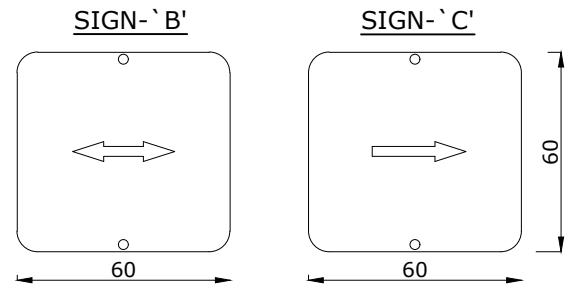
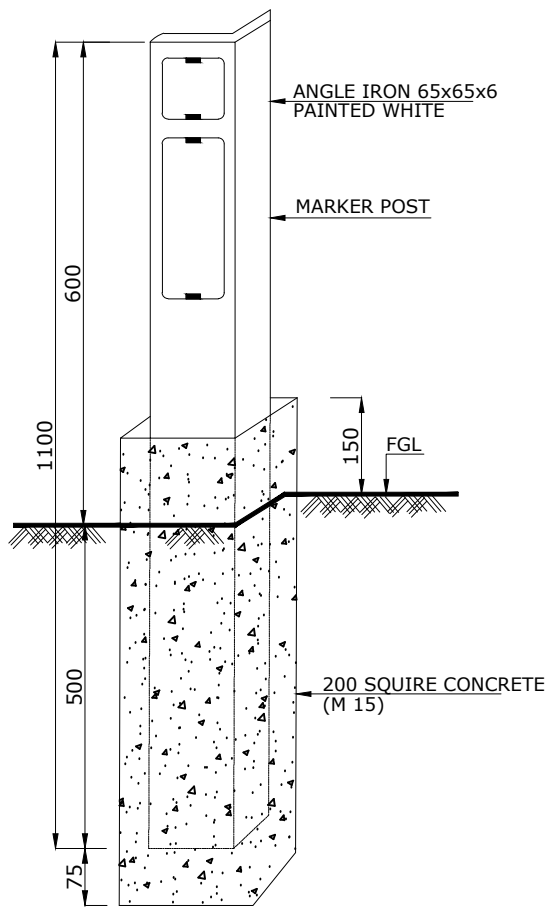
INSTRUCTIONS FOR FILLING UP : 1. A separate QAP should be submitted for each piece of equipment, detailing the assembly, sub-assembly, and part/component breakdown, or for a group of equipment with the same specifications. 2. Use the specified numerical codes to indicate the extent of inspections, tests, and the submission of test certificates and documents. Additional codes and descriptions may be included as required for the plant and equipment. 3. When equipment with the same specifications is grouped together but belongs to different facilities, a unique identification number and quantity should be specified for each piece of equipment. 4. The weight in tonnes (T) must be noted in column 5 for each item. If actual weights are unavailable, estimated weights should be provided.	CODES FOR EXTENT OF INSPECTION, TESTS, TEST CERTIFICATES & DOCUMENTS: <table border="1"> <tr> <th>Description</th> <th>Description</th> <th>Description</th> <th>DOCUMENTS</th> </tr> <tr> <td>1. Dimensional</td> <td>8. Type test as per relevant IS/& other standard</td> <td>17. Tank Pressure Test</td> <td>D1. Approved GA drawings</td> </tr> <tr> <td>2. Visual</td> <td>9. Impulse Test</td> <td>18. Short time rating</td> <td>D2. Approved single line/ schematic diagram</td> </tr> <tr> <td>3. Physical Test (Sample)</td> <td>10. Partial Discharge Test</td> <td>19. Operational & functional check</td> <td>D3. Approved data sheet</td> </tr> <tr> <td>4. Fitment & Alignment</td> <td>11. Heat run risc test/tempr</td> <td>20. Over Speed Test</td> <td>D4. Approved bill of materials</td> </tr> <tr> <td>5. Measurement of IR Value</td> <td>12. Enclosure Protection Test</td> <td>21. Flame Proof Marking/Labeling</td> <td>D5. Unpriced P.O. copy</td> </tr> <tr> <td>A) Before HV Test</td> <td>13. Calibration</td> <td>22. Clearance and creepage Distance</td> <td>D6. Calibration Certificate of all measuring instruments and gauges</td> </tr> <tr> <td>B) After HV Test</td> <td>14. Noise & Vibration</td> <td>23. Acceptance Test</td> <td></td> </tr> <tr> <td>6. High Voltage test/Dielectric test</td> <td>15. Paint shade verification</td> <td>24. Harmonics measurement</td> <td></td> </tr> <tr> <td>7. Routine test as per relevant IS & other standard</td> <td>16. Test certificates for bought out components</td> <td></td> <td></td> </tr> </table>	Description	Description	Description	DOCUMENTS	1. Dimensional	8. Type test as per relevant IS/& other standard	17. Tank Pressure Test	D1. Approved GA drawings	2. Visual	9. Impulse Test	18. Short time rating	D2. Approved single line/ schematic diagram	3. Physical Test (Sample)	10. Partial Discharge Test	19. Operational & functional check	D3. Approved data sheet	4. Fitment & Alignment	11. Heat run risc test/tempr	20. Over Speed Test	D4. Approved bill of materials	5. Measurement of IR Value	12. Enclosure Protection Test	21. Flame Proof Marking/Labeling	D5. Unpriced P.O. copy	A) Before HV Test	13. Calibration	22. Clearance and creepage Distance	D6. Calibration Certificate of all measuring instruments and gauges	B) After HV Test	14. Noise & Vibration	23. Acceptance Test		6. High Voltage test/Dielectric test	15. Paint shade verification	24. Harmonics measurement		7. Routine test as per relevant IS & other standard	16. Test certificates for bought out components		
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EQUIPMENT DETAILS						INSPECTION AND TESTS							Test Certificates & documents to be submitted to V C S	Acceptance Criteria Standards /IS/ BS/ASME/ Norms and Documents	REMARKS / SAMPLING PLAN
Sl. No.	Description (With equipment heading, place of use, and Brief Specifications)	Identification No.	Quantity		Manufacturer's Name and Address	Expected schedule of Final Inspection	Raw Material and in-process stage inspection			Final Inspection/Test by					
			No/M	T			MFR	CONTR	V C S	MFR	CONTR/ TPI	V C S/ CLIENT			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	Main Electric Distribution Board		Set				1,2,3,4,19,22	-	-	1,2,4,7,15, 19,22	1,2,4,7,15, 19,22	1,2,4,7,15, 19,22	D1, D2, D3, D4, D5, D6, 16, 7,8*,11	Tech. Specification, Approved Drawings & Data Sheets, IS, Test certificates	8* for similar rating
2.	LT Power and Control Cable		Mt.				-	-	-	2,5,6,7,8, 23	1,2,5,6,7, 23	IWC	7,8,23 D3, D5, D6,	Tech. Specification, Approved Drawings & Data Sheets, IS, Test certificates	8* for similar rating, Inspection to be done by TPI
3.	Distribution Transformer and Servo Stabilizer.		No.				1,2,3,4, 17,22	-	-	1,2,5,6, 7	1,2,5,6,7,15 22	1,2,5,6,7 15,19,22	7,8,16 D3, D5, D6	Tech. Specification, Approved Drawings & Data Sheets, IS, Test certificates	8*for similar rating, Inspection to be done by TPI
4.	UPS-System		No				1,2,3,4, 19,22	-	-	1,2,4,7, 15,19,22	1,2,4,7,15, 18,19,22	1,2,4,5,6 7,11,15, 18,19,22, 23,24	D1, D2, D3, D4, D5, D6, 16, 7,8*,11	Tech. Specification, Approved Drawings & Data Sheets, IS, Test certificates	11* Heat Run test upto temp stability.

5.	Battery Set-UPS		Set				1,2,3,4, 19,22	-	-	1,2,4,7, 8,23	1,2,23	IWC	D1, D3, D4, D5, D6, 7,8	Tech. Specification, Approved Drawings & Data Sheets, IS, Test certificates	7,8 Document to be reviewed by V C S
6.	Gas/DG Set & AMF Panel		Set				1,2,3,4, 19,22,23	-	-	1,2,4,7, 11,19	1,2,4,7, 11,19	1,2,4,5, 6,7, 11,15,19	D1,D2,D3,D4, D5,D6, 16,7,8	Tech. Specification, Approved Drawings & Data Sheets	11 is applicable for Gas Gen Set only.
SOLAR SYSTEM															
7.	Solar Array with complete hardware (PV Modules, JB's, Mounting Structure, Cables etc)		Set				1,2,3,4, 24, 27	-	-	1,2,3,12, 13, 29	1,2,3,12, 28, 29	IWC	D1, D2, D3, D4, D5, D6, 20, 12,13,17,29	Tech. Specification, Approved Drawings, IEC: 61215 & 60904 & Data Sheets	12, 13 Document to be reviewed by V C S
8.	Solar charge controller/Grid Charger/ Inverter/ PCU		Set				1,2,3,4, 24, 27			1,2,3,12, 16, 22, 23,24,27	1,2,3,12, 16, 22, 23,24,27	1,2,3,12, 16, 22, 23,24,27,	D1, D2, D3, D4, D5, D6, 20, 12,13	Tech. Specification, Approved Drawings & Data Sheets	(*) 12 hour heat run test 12, 13 Document to be reviewed by V C S
9.	Battery Set-Solar system		Set				1,2,3,4, 24,27	-	-	1,2,3,12, 13	1,2,28	IWC	D1, D3, D4, D5, D6, 12,13,20	Tech. Specification, Approved Drawings & Data Sheets Test certificates	12, 13 Document to be reviewed by V C S
For Manufacturer (Stamp & Signature) For CONTR (Stamp & Signature) For V C S (Stamp & Signature)											Q.A.P. NO. VCS/EL/NEGDCL/QAP/01				
											SHEET 1 OF 1 R-0				

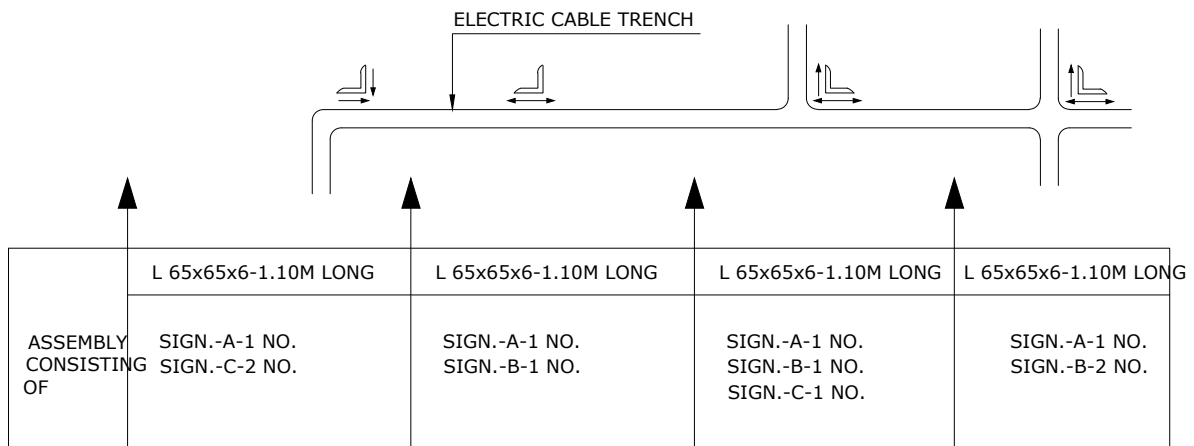
IWC- shall be issued based on TPI's IRN, Inspection Reports & other test reports.

STANDARD DRAWINGS



TYPICAL ARRANGEMENT OF MARKER

(SEE NOTE-1)

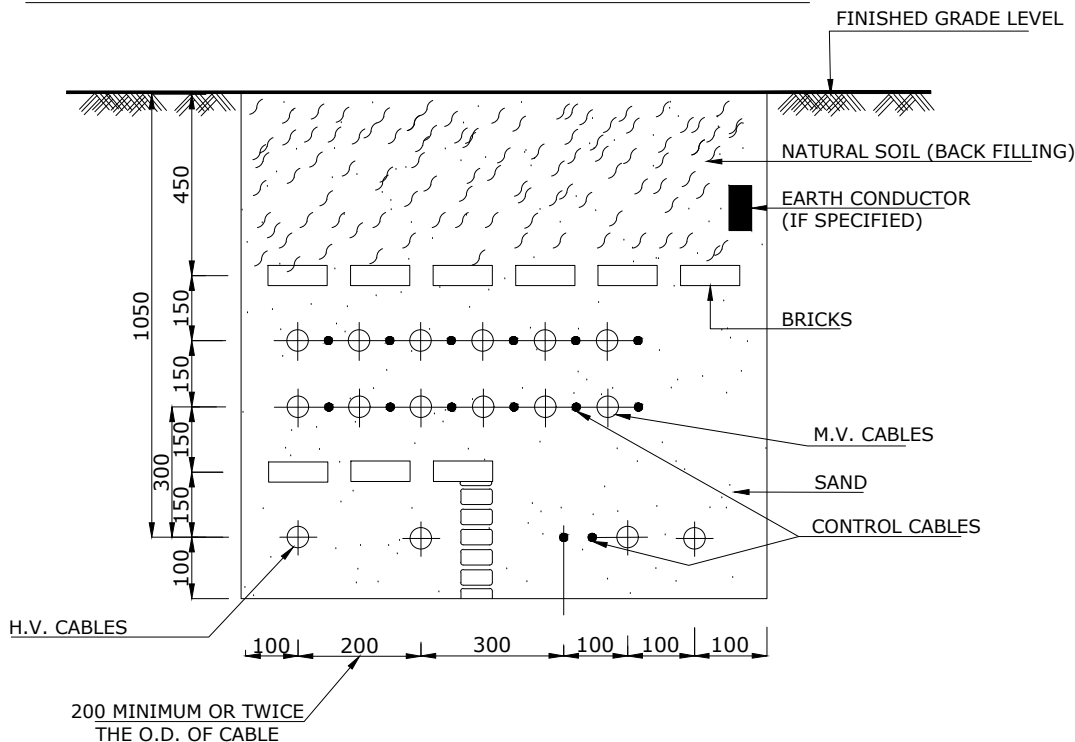


NOTES:

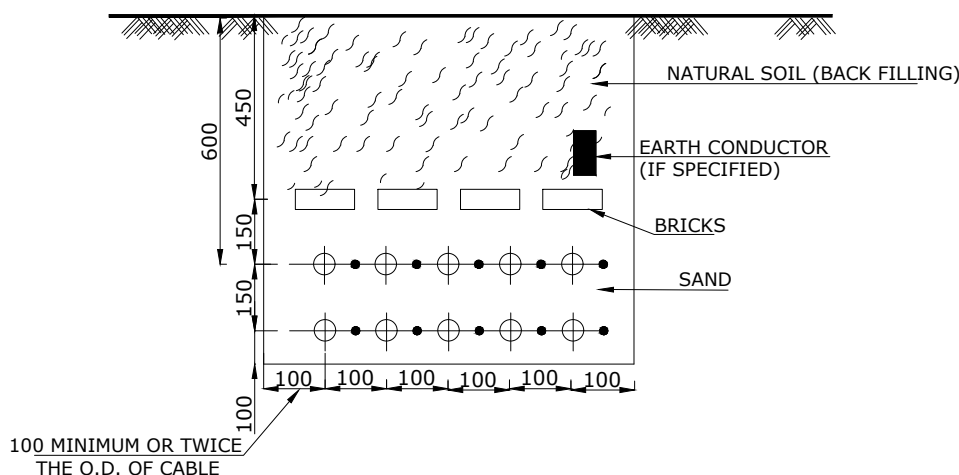
- TRENCHES SHALL BE MARKED AT ALL DIRECTION CHANGES, INTERSECTIONS AND STRAIGHT RUNS.
- SIGN BOARDS SHALL BE MADE OF 14G ENAMELLED STEEL PLATE WHITE LETTERING SHALL BE ON JADE GREEN BACKGROUND

02	22.03.22	RE-ISSUED AS STANDARD DRAWING	SY	RD	AA	HK
01	11.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY

TYPICAL SECTION WITH H.V. AND M.V. CABLES



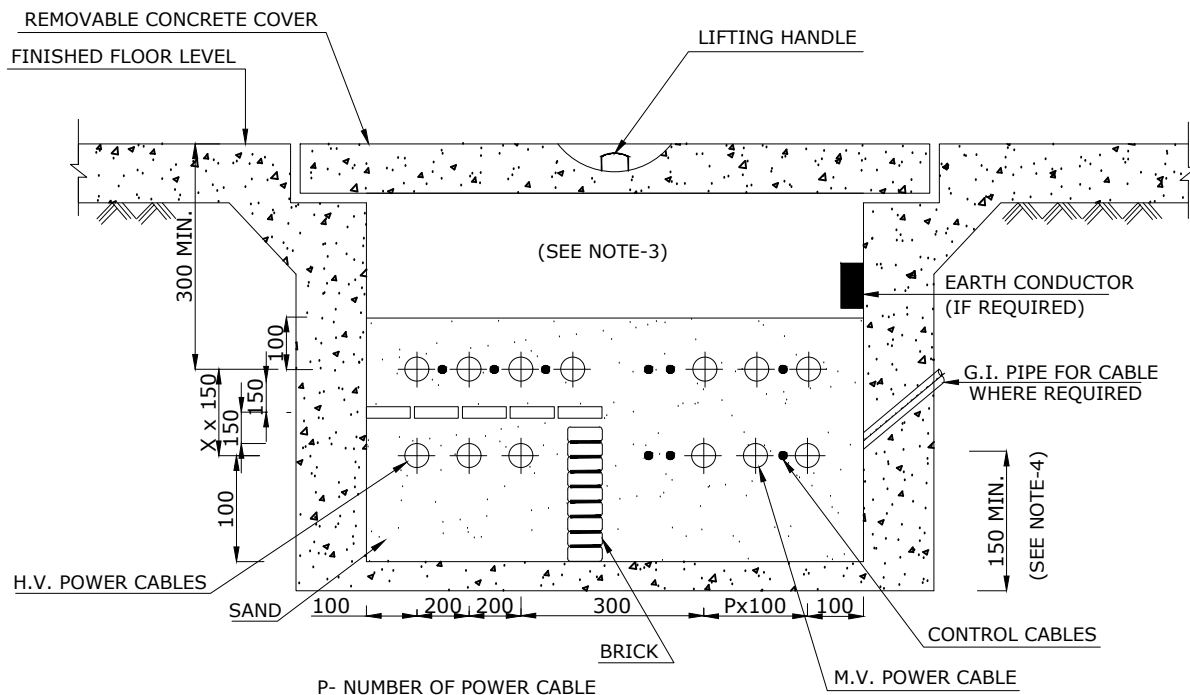
TYPICAL SECTION WITH M.V. CABLES ONLY



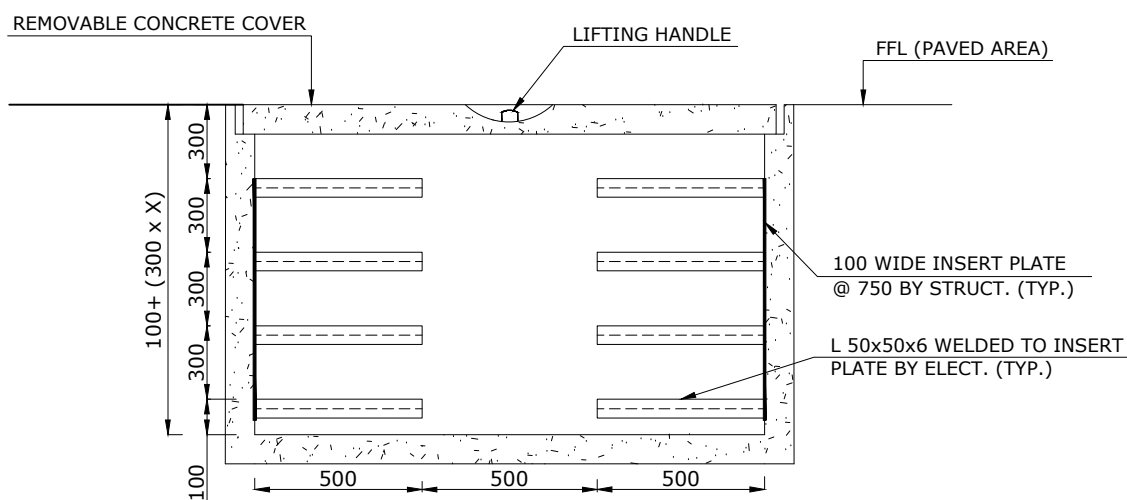
NOTES:

1. LEAVE SPACE FOR LATER ADDITION OF AT LEAST 2 CABLES OR 15% AVERAGE SPARE SPACE REGARDLESS OF FUTURE EXPANSION.
2. IF FIRE ALARM AND COMMUNICATION CABLES ARE LAID IN THE SAME TRENCH A CLEARANCE OF 300mm (MINIMUM) AWAY FROM

02	22.03.22	RE-ISSUED AS STANDARD DRAWING	SY	RD	AA	HK
01	11.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
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REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



ALT. -1

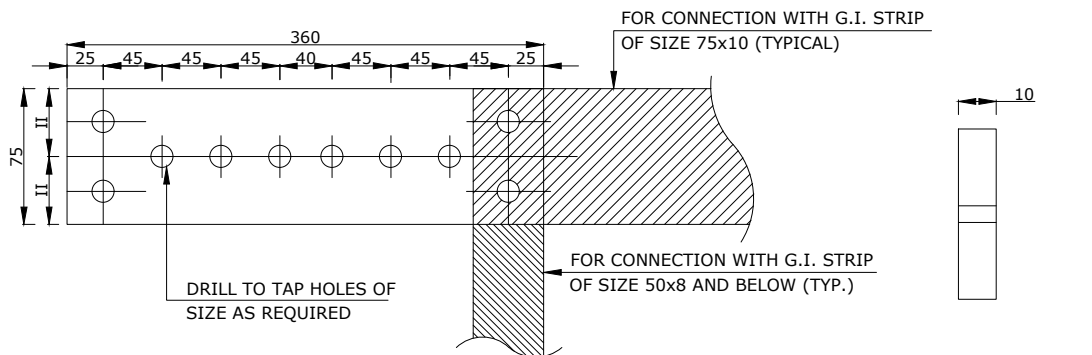


ALT. -2

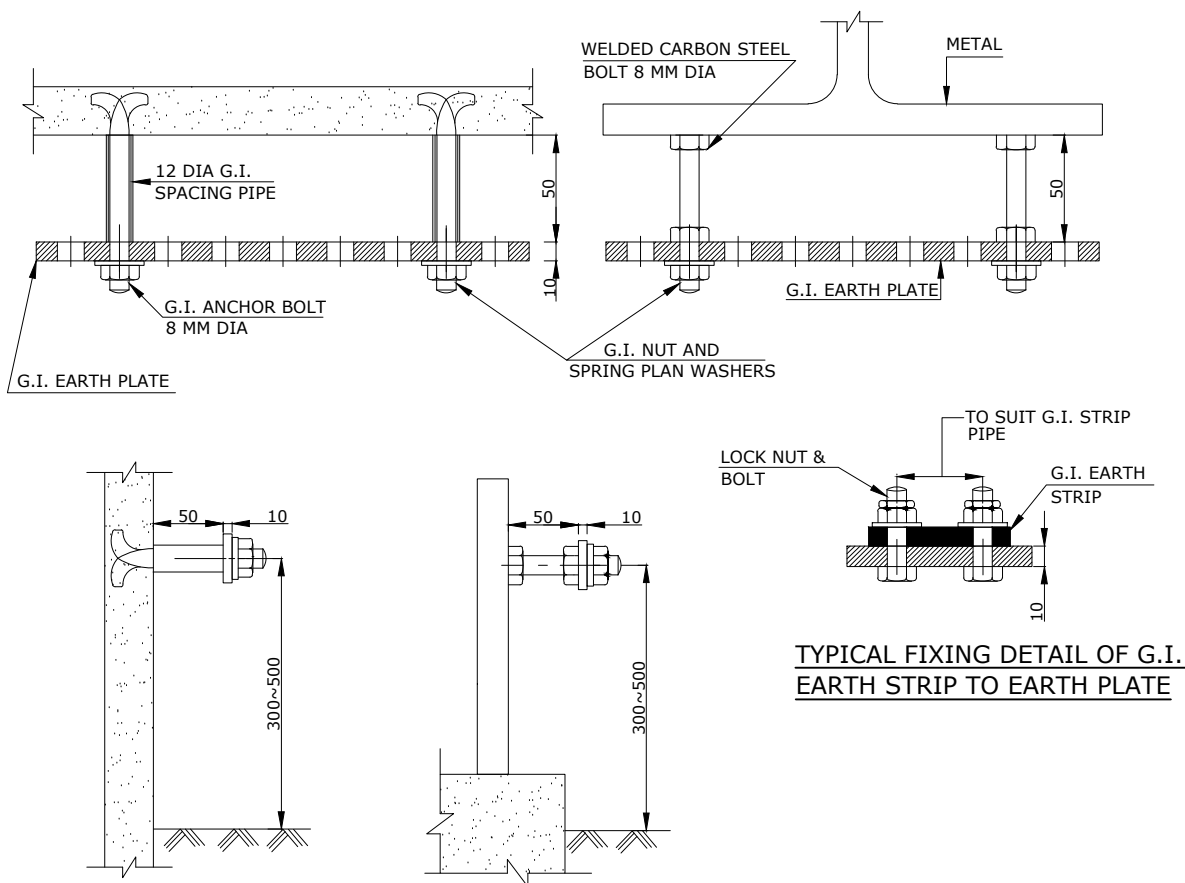
NOTES:

1. LEAVE SPACE FOR LATER ADDITION OF 15% AVERAGE SPARE SPACE FOR FUTURE EXPANSION.
2. REQUIREMENT OF RACKS ON ONE SIDE OR BOTH SIDES SHALL BE DECIDED AS PER JOB REQUIREMENT AND AVAILABILITY OF SPACE FOR TRENCH.
3. TRENCHES IN HAZARDOUS AREAS SHALL BE COMPLETELY FILLED WITH SAND.
4. THE EXACT HEIGHT OF OPENING IN TRENCH WALL FOR G.I. PIPE FOR TAKING CABLE SHALL BE SUITABLY DECIDED AT SITE.

02	22.03.22	RE-ISSUED AS STANDARD DRAWING	SY	RD	AA	HK
01	11.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



G.I. EARTH PLATE



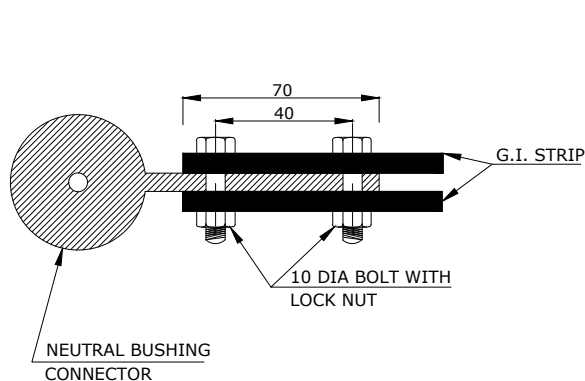
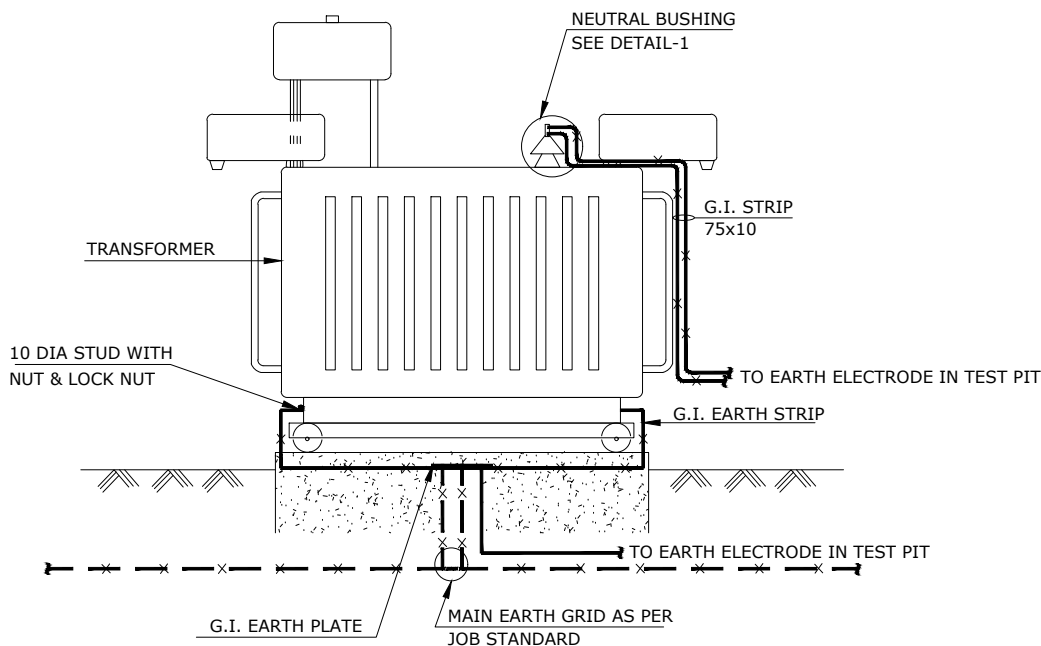
TYPICAL INSTALLATION OF EARTH PLATE ON R.C.C. STRUCTURES

TYPICAL INSTALLATION OF EARTH PLATE ON STEEL STRUCTURES

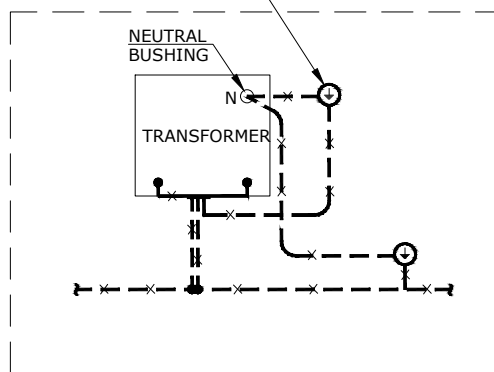
NOTES:

1. WHERE FIRE PROOFING OF STEEL STRUCTURES ARE ENCOUNTERED LENGTH OF CARBON STEEL BOLT SHALL BE INCREASED FOR FIXING OF EARTH PLATE.
2. ALL CONNECTIONS WITH EARTH PLATE SHALL BE MADE WITH G.I. BOLT, NUT, SPRING AND PLAIN WASHERS.

02	01.02.22	RE-ISSUED AS STANDARD DRAWING	SY	RD	AA	HK
01	05.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



DETAIL-1

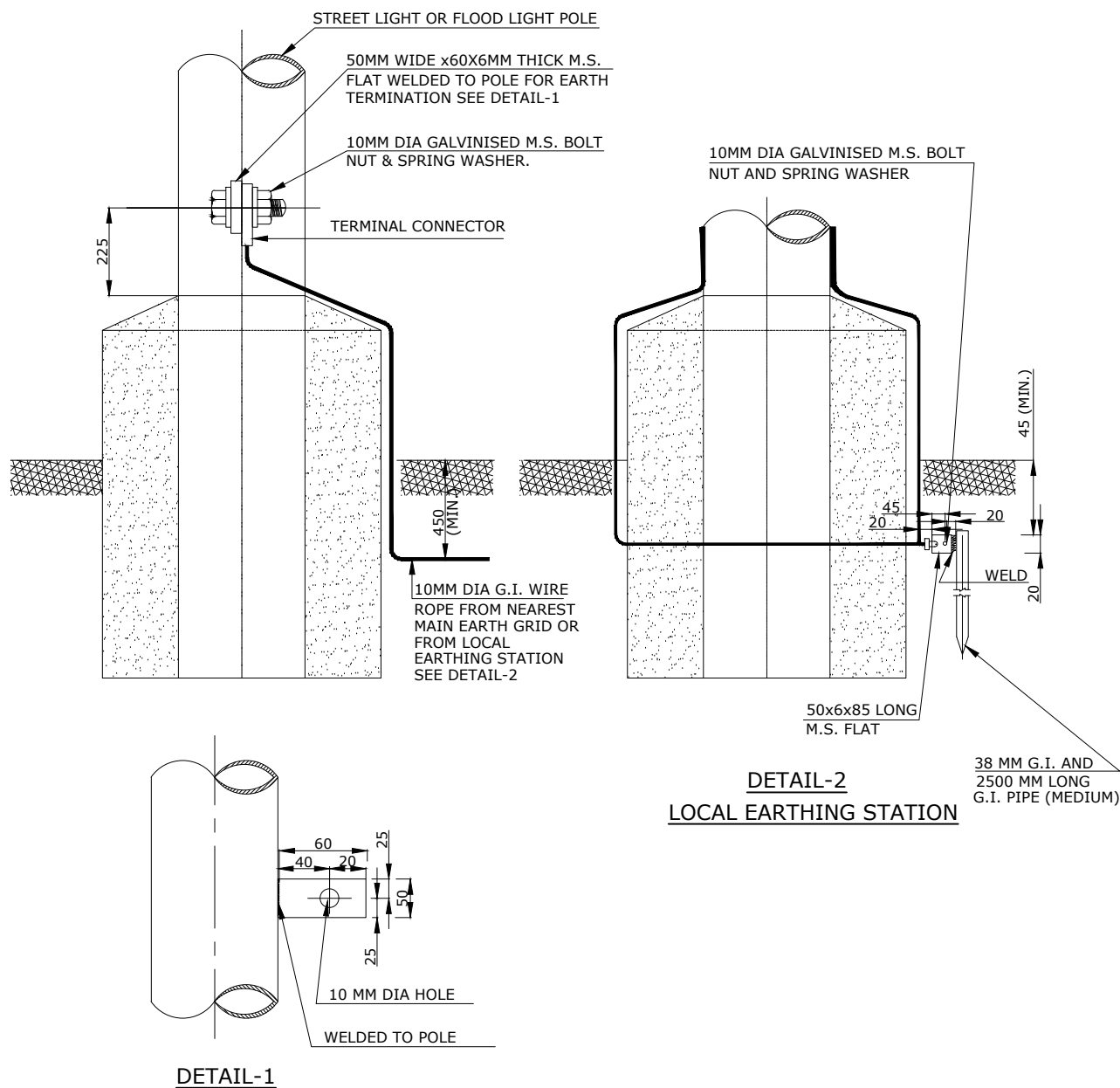


LING DIAGRAM

NOTES:

1. WHEREVER SEPERATE NEUTRAL BUSHING FOR EARTHING IS NOT PROVIDED THE NEUTRAL EARTHING SHALL BE DONE FROM BUS DUCT.
2. EARTH ELECTRODE IN TEST PITS SHALL BE SO LOCATED THAT DISTANCE BETWEEN TWO PITS SHALL BE MINIMUM 6 METER.
3. WHERE TRANSFORMERS NEUTRAL EARTHING IS DONE THROUGH N.G.R. THE CONNECTIONS BETWEEN NEUTRAL AND N.G.R. SHALL BE THROUGH CABLE. THE OTHER END END OF N.G.R. SHALL BE CONNECTED TO EARTH ELECTRODE.

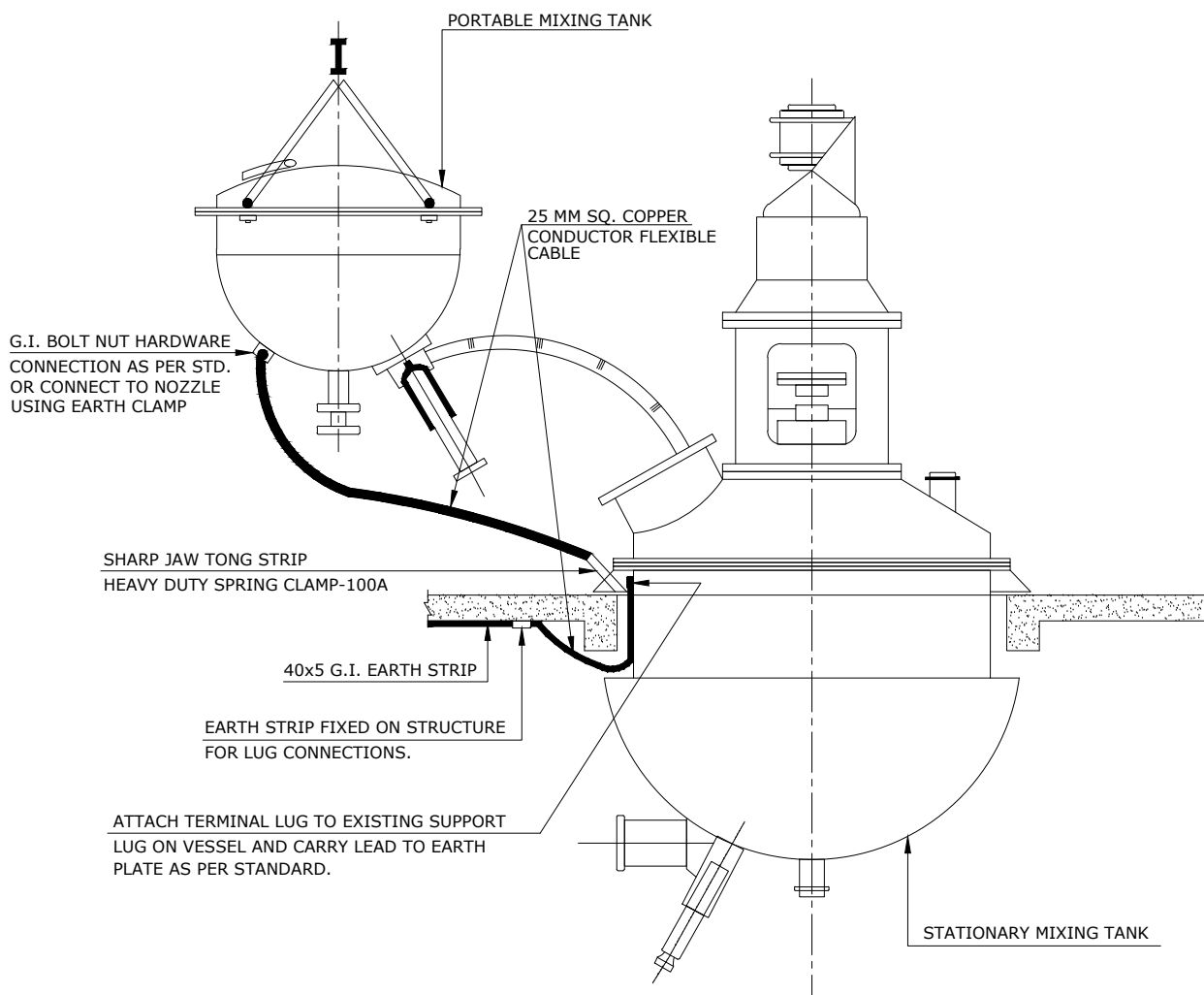
02	01.02.22	RE-ISSUED AS STANDARD DRAWING	SY	RD	AA	HK
01	05.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



NOTES:

1. USE TWO EARTH WIRES IF VOLTAGE IN THE POLE JUNCTION BOX IS 415 VOLTS.

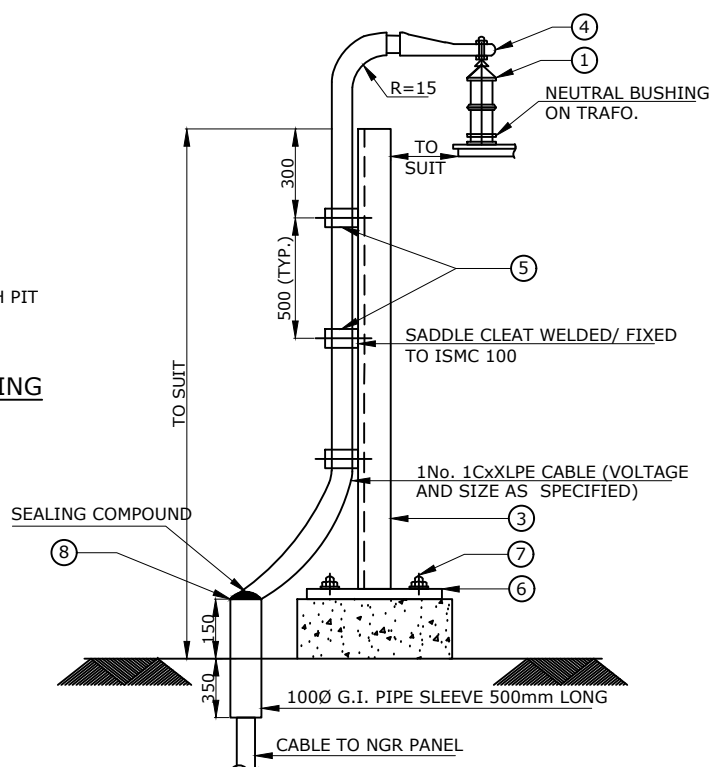
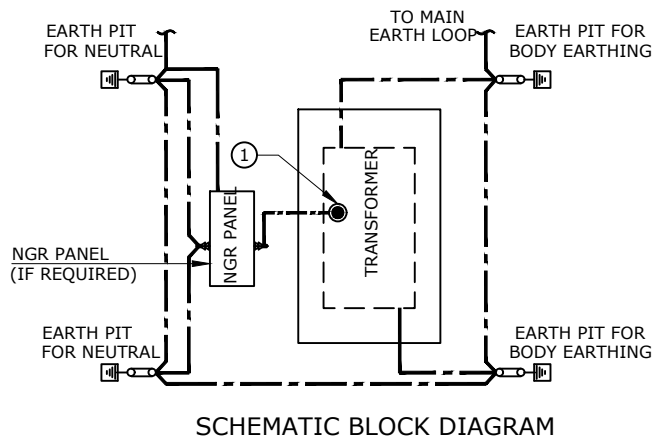
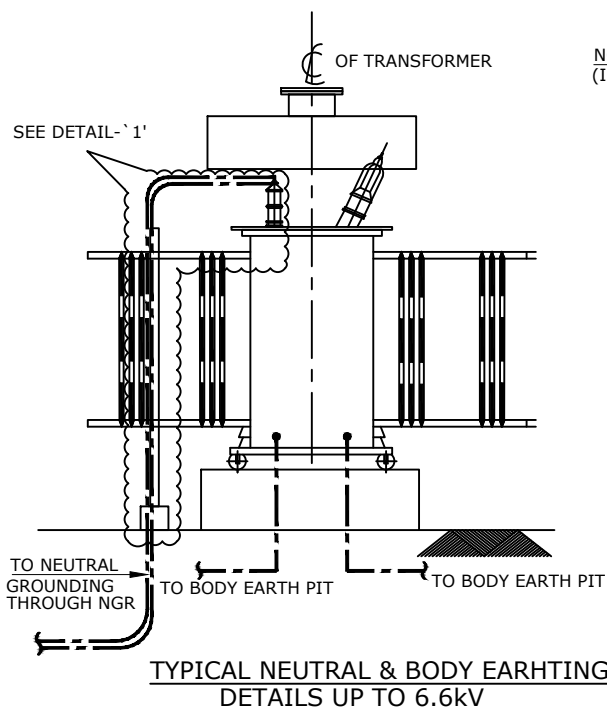
02	02.02.22	RE-ISSUED AS STANDARD DRAWING	SY	RD	AA	HK
01	05.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



NOTES:

1. ALL PROCESSING EQUIPMENT SUCH AS MIXTURES, CHURNS, AUTOCLAVES, COLUMNS, CENTRIFUGES, FILTER PRESS PUMPS ETC. SHALL BE EARTHED IF NOT INDIRECT CONTACT WITH PROPERLY EARTHED STEEL MEMBERS.
2. ALL TEMPORARY EARTH CONNECTIONS SHALL BE MADE BEFORE OPENING THE VESSEL.

02	07.02.22	RE-ISSUED AS STANDARD DRAWING	SY	RD	AA	HK
01	05.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



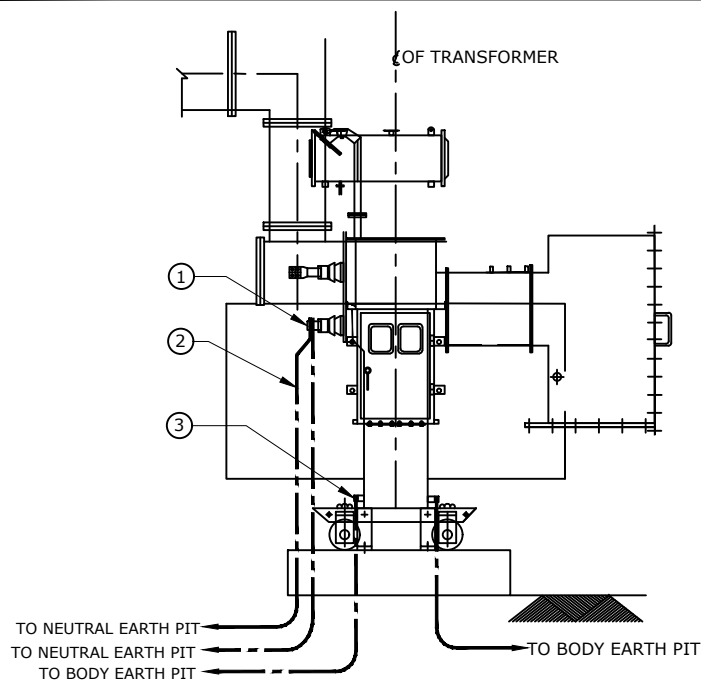
MATERIAL TAKE-OFF

ITEM No.	DESCRIPTION	QUANTITY	REMARKS
1.	NEUTRAL BUSHING	1 No.	
2.	NUT & SPRING WASHERS TO SUIT TRANSFORMER BODY EARTHING	2 No.	
3.	ISMC 100-LENGTH TO SUIT	1 No.	
4.	CABLE LUG SUITABLE FOR CABLE SIZE	1 No.	
5.	MS SADDLE/ CLEAT TO SUIT CABLE DIA.	AS REQUIRED	
6.	150x150x6mm THICK PLATE WITH 4 No. 12Ø HOLES.	1 No.	
7.	M10 ANCHOR STUD WITH PLAIN AND SPRING WASHERS.	4 No.	
8.	SEALING COMPOUND	AS REQUIRED	

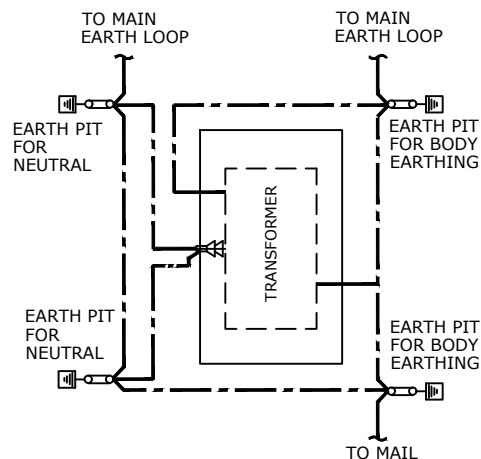
NOTES :-

1. ALL HARDWARE SHALL BE OF STAINLESS STEEL.
2. ALL STEEL STRUCTURE USED FOR ELECTRICAL INSTALLATION SHALL BE APPLIED TWO COATS OF ANTI CORROSIVE PRIMER AND EPOXY PAINT OF APPROVED SHADE.

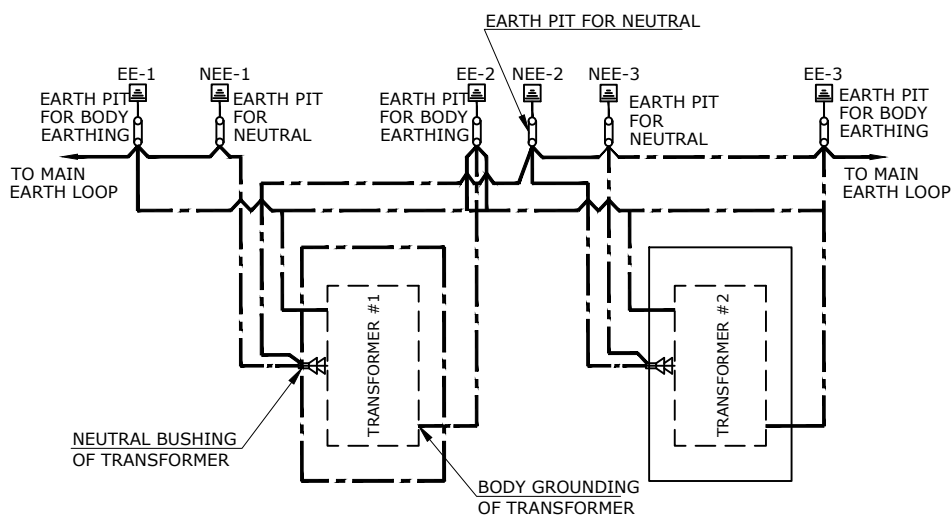
02	08.02.22	RE-ISSUED AS STANDARD DRAWING	SY	RD	AA	HK
01	05.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



TYPICAL NEUTRAL & BODY EARTHING
DETAILS UP TO 0.433kV



SCHEMATIC DIAGRAM
FOR SINGLE TRANSFORMER



SCHEMATIC DIAGRAM
FOR TWO TRANSFORMER

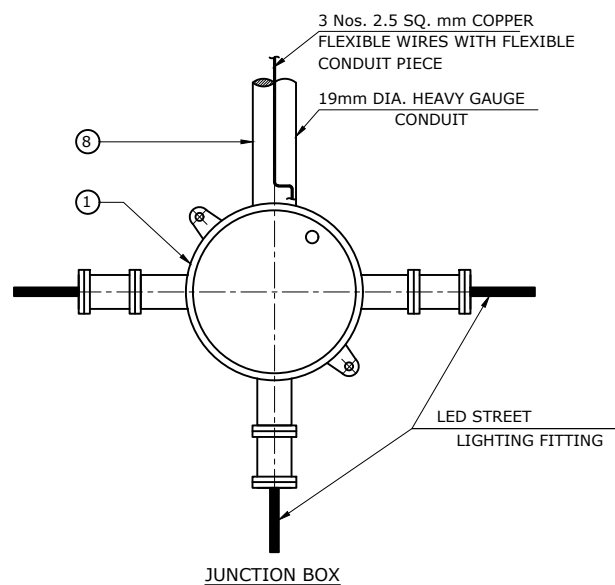
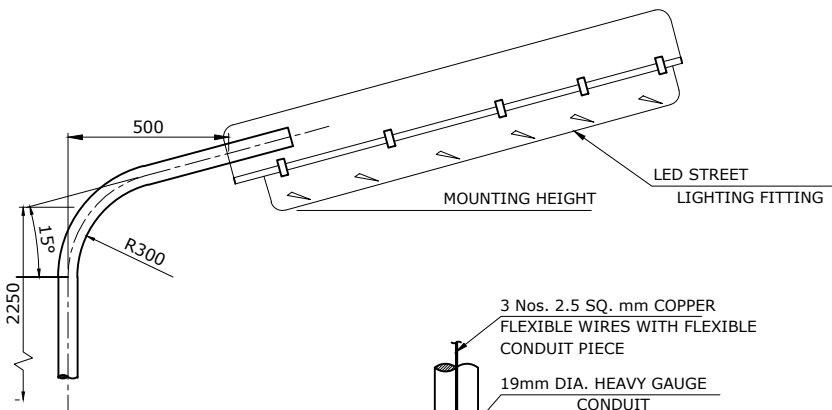
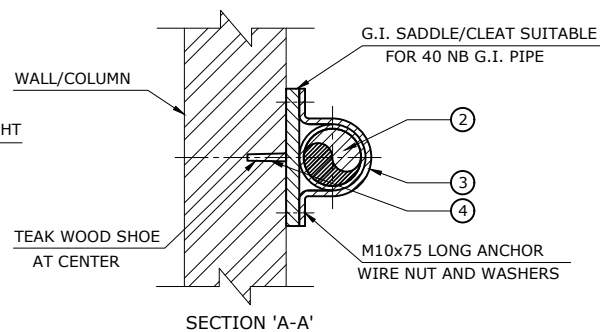
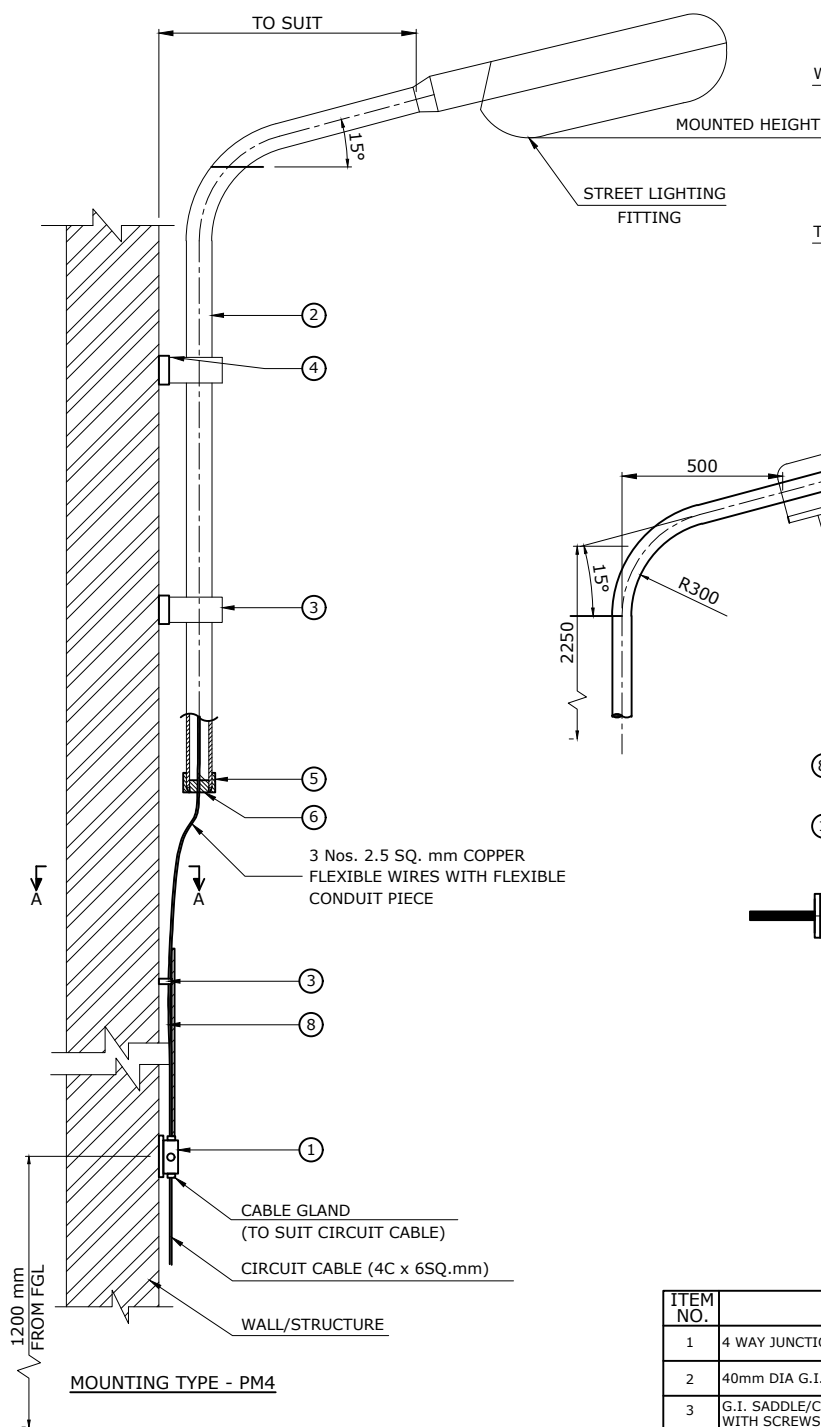
MATERIAL TAKE-OFF

ITEM No.	DESCRIPTION	QUANTITY	REMARKS
1.	NEUTRAL BUSHING BY TRANSFORMER VENDOR	-	
2.	G.I. EARTH STRIP	AS PER DRG.	
3.	EARTHING PAD WITH BOLT NUT & SPRING WASHERS BY TRANSFORMER VENDOR	-	

NOTES :-

1. ALL HARDWARE SHALL BE OF STAINLESS STEEL.
2. ALL DAMAGE TO GALVANISED FINISHES SHALL BE PAINTED WITH ZINC RICH PAINT.
3. ALL STEEL STRUCTURE USED FOR ELECTRICAL INSTALLATION SHALL BE APPLIED TWO COATS OF ANTI CORROSIVE PRIMER AND EPOXY PAINT OF APPROVED SHADE.

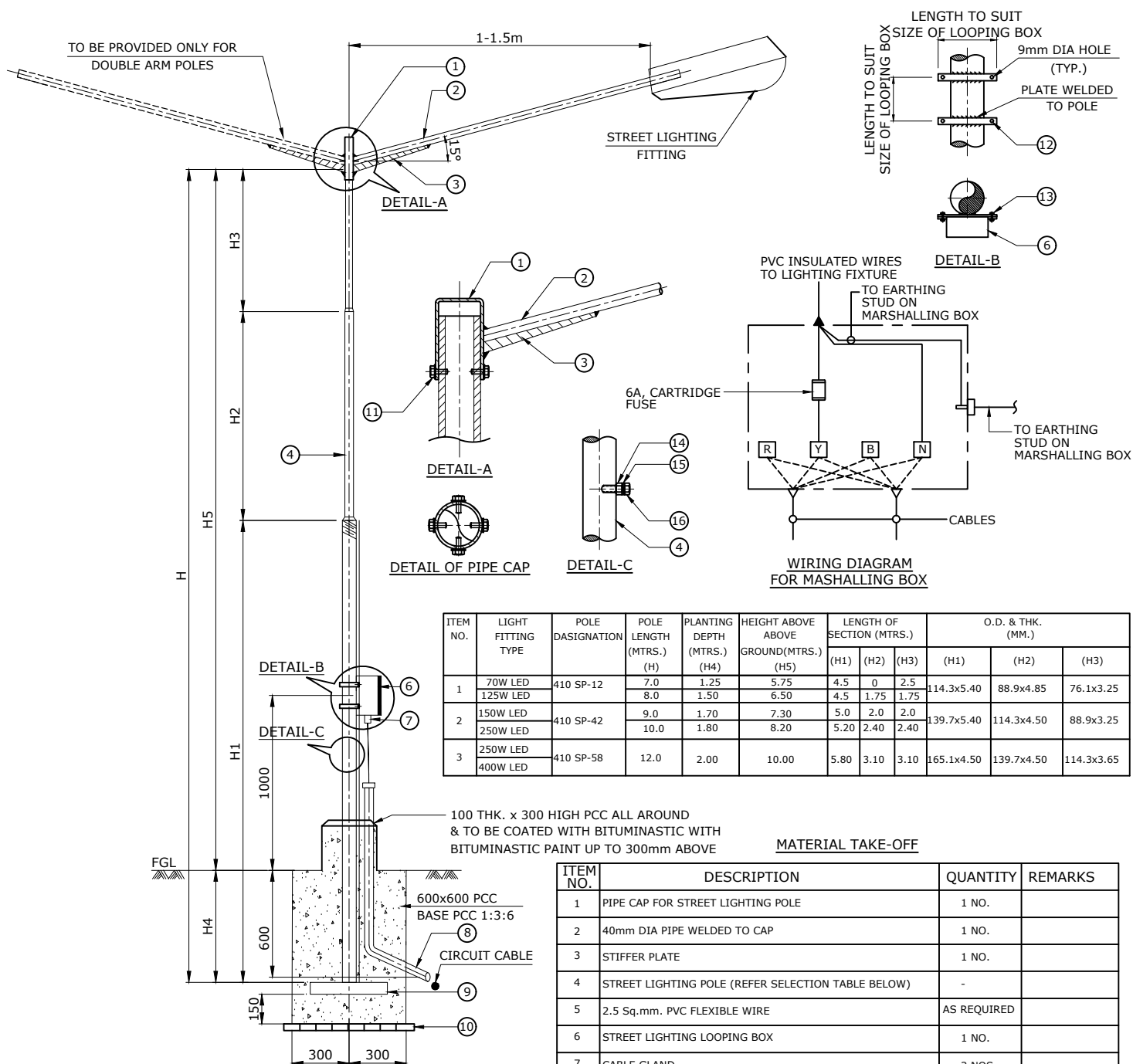
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01	05.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



MATERIAL TAKE-OFF

ITEM NO.	DESCRIPTION	QUANTITY	REMARKS
1	4 WAY JUNCTION BOX	1 NO.	
2	40mm DIA G.I. PIPE (CLASS HEAVY)	1 NO.	
3	G.I. SADDLE/CLEAT TO SUITABLE FOR 40mm Ø & G.I. PIPE WITH SCREWS, PLAIN WASHERS AND SPRING WASHERS	2 NOS.	
4	15mm THK. TEAK WOOD SHOE WITH BITUMINOUS PAINT	1 BLOCK	
5	G.I. PIPE COUPLING (TO SUIT 40mm Ø G.I. PIPE)	1 NO.	
6	RURDER GROMMET (TO SUIT 40mm Ø G.I. PIPE)	1 NO.	
7	50mm DIA G.I. PIPE SLEAVE	1 NO.	
8	19mm DIA G.I. HEAVY GAUGE CONDUIT	AS REQUIRED	
9	10A, 250V D.P WEATHER PROOF LIGHTING SWITCH WITH BOTTOM ENTRY	1 NO.	
10	SCREW WITH PLAIN WASHER AND RAWAL PLUG FOR FIXING JB & LIGHTING SWITCH	8 NOS.	

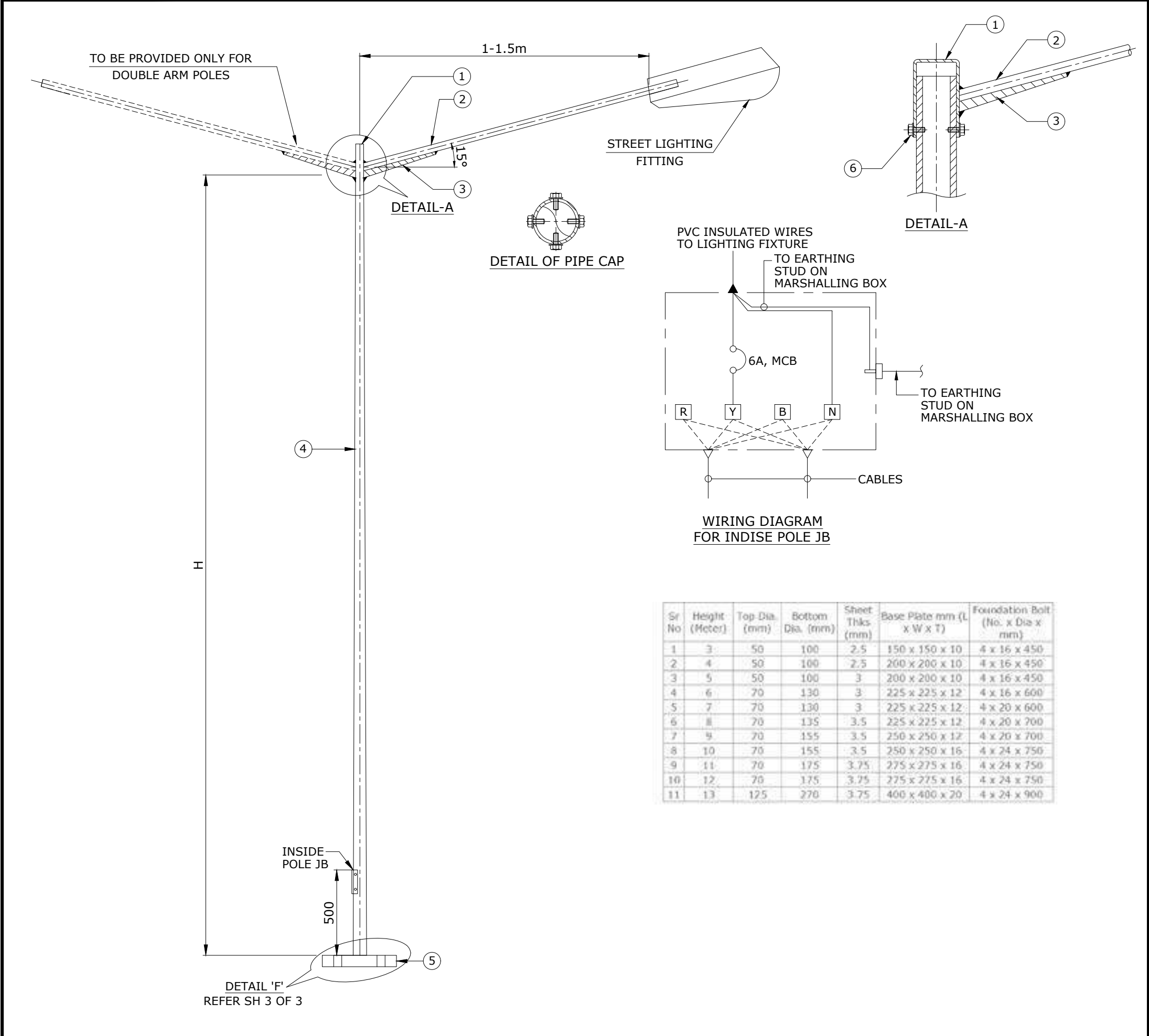
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01	02.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



NOTES:

- ALL DIMENSIONS ARE IN MILLIMETERS.
- POLE MATERIAL SHALL BE G.I. OR M.S AS PER PROJECT CONTRACT REQUIREMENTS.
- AFTER INSTALLATION THE ASSEMBLY IS TO BE PREPARED, PRIMED AND PAINTED IN ACCORDANCE WITH THE PROJECT PAINTING SPECIFICATION IF MATERIAL IS M.S.
- LIGHT FITTING FIXING DETAILS TO BE FURNISHED BY SITE.
- EARTHING TERMINAL ARE LOCATED DIAMETRICALLY OPPOSITE.
- ALL NUTS, BOLTS AND WASHERS SHALL BE GALVANISED AND ZINC PASSIVATED.
- MOUNTING DETAILS OF CONTROL GEAR BOX AND LOOPING BOX REFER INSTALLATION DETAILS.
- ALL SHARP EDGES AND BURRS SHALL BE REMOVED.
- POLE SHALL BE MADE FROM TUBULAR STEEL PIPES SWAGED AND WELDED CONFORMING TO DESIGNATION AS MENTIONED IN ABOVE TABLE- AS IS-2713 (PART III) - 1980.
- DOUBLE ARM SHALL BE EITHER AT 180° OR 30° AS PER THE LOCATION OF THE LIGHTING FITTING & SITE REQUIREMENT.

02	02.02.22	RE-ISSUED AS STANDARD DRAWING	SY	RD	AA	HK
01	02.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



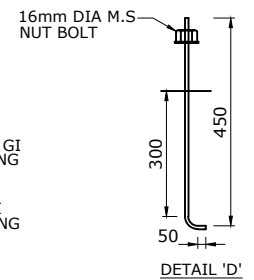
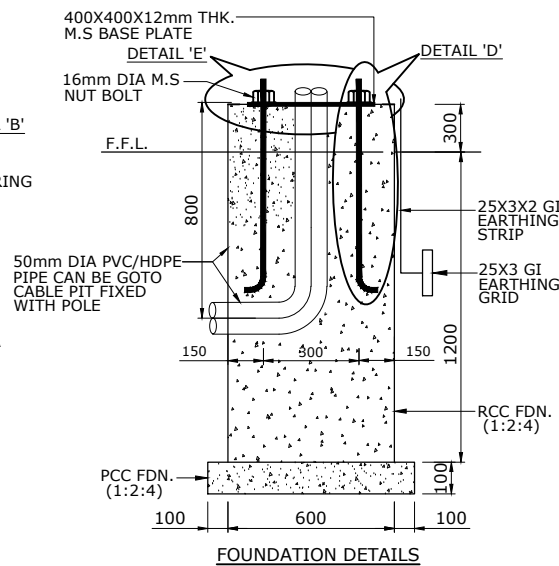
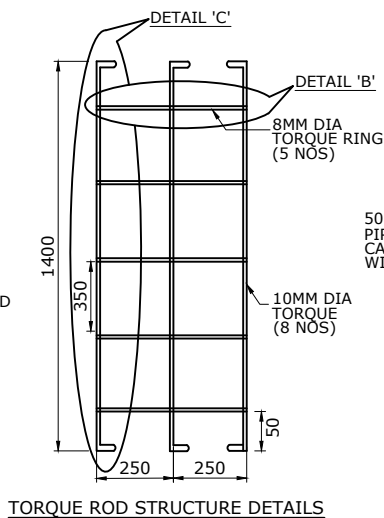
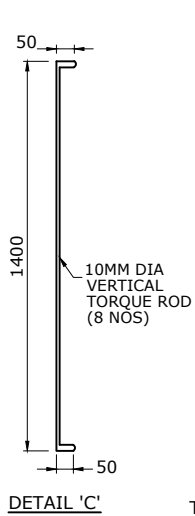
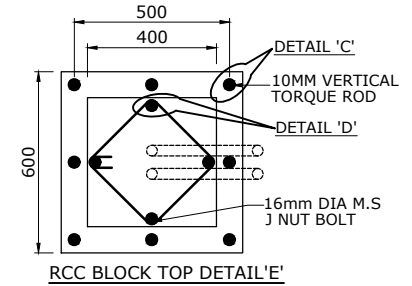
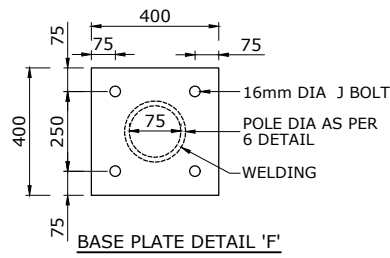
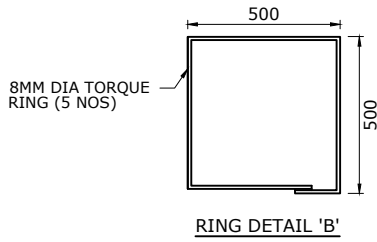
NOTES:

- 1. ALL DIMENSIONS ARE IN MILLIMETERS.
- 2. LIGHTING POLE SHALL BE GI COATED.
- 3. LIGHT FITTING FIXING DETAILS TO BE FURNISHED BY SITE.
- 4. EARTHING TERMINAL ARE LOCATED DIAMETRICALLY OPPOSITE.
- 5. ALL NUTS, BOLTS AND WASHERS SHALL BE GALVANIZED AND ZINC PASSIVATED.
- 6. MOUNTING DETAILS OF CONTROL GEAR BOX AND LOOPING BOX REFER INSTALLATION DETAILS.
- 7. ALL SHARP EDGES AND BURRS SHALL BE REMOVED BEFORE GI COATING.
- 8. POLE SHALL BE HEXAGONAL MADE FROM TUBULAR STEEL MATERIAL CONFORMING TO DESIGNATION AS MENTIONED IN ABOVE TABLE- AS IS-2713 (LATEST)
- 9. DOUBLE ARM SHALL BE EITHER AT 180° OR 30° AS PER THE LOCATION OF THE LIGHTING FITTING & SITE REQUIREMENT.

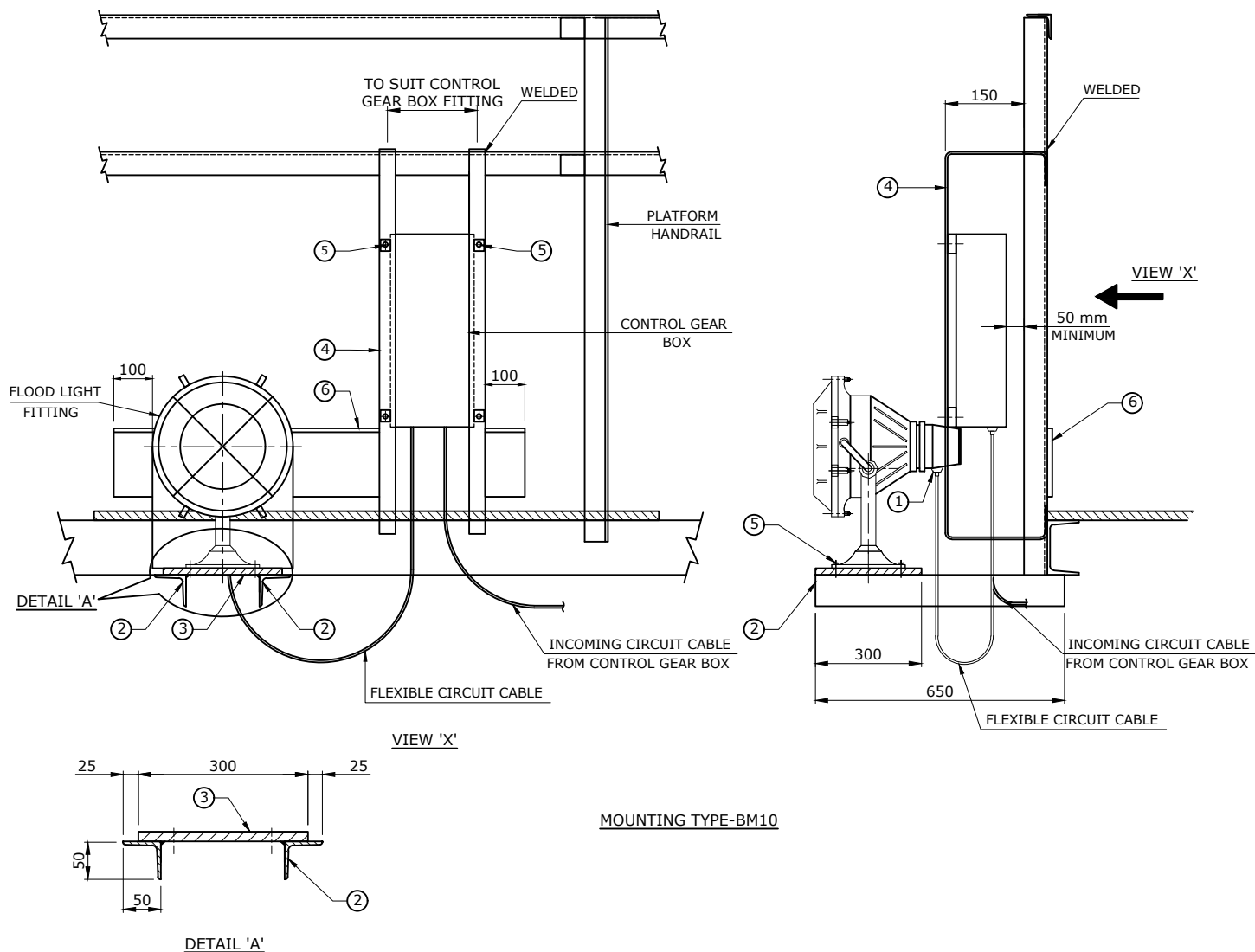
MATERIAL TAKE-OFF

ITEM NO.	DESCRIPTION	QUANTITY	REMARKS
1	PIPE CAP FOR STREET LIGHTING POLE	1 NO.	
2	40mm DIA PIPE WELDED TO CAP	1 NO.	
3	STIFFER PLATE	1 NO.	
4	STREET LIGHTING POLE (REFER SELECTION TABLE BELOW)	-	
5	400x400x12mm THK. M.S. PLATE WITH 1 Nos. 20mm Ø HOLES	1 NO.	
6	M10 x 30mm LONG FULL THREADED BOLT	4 NOS.	

02	02.02.22	RE-ISSUED AS STANDARD DRAWING	SY	RD	AA	HK
01	02.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



02	02.02.22	RE-ISSUED AS STANDARD DRAWING	SY	RD	AA	HK
01	02.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



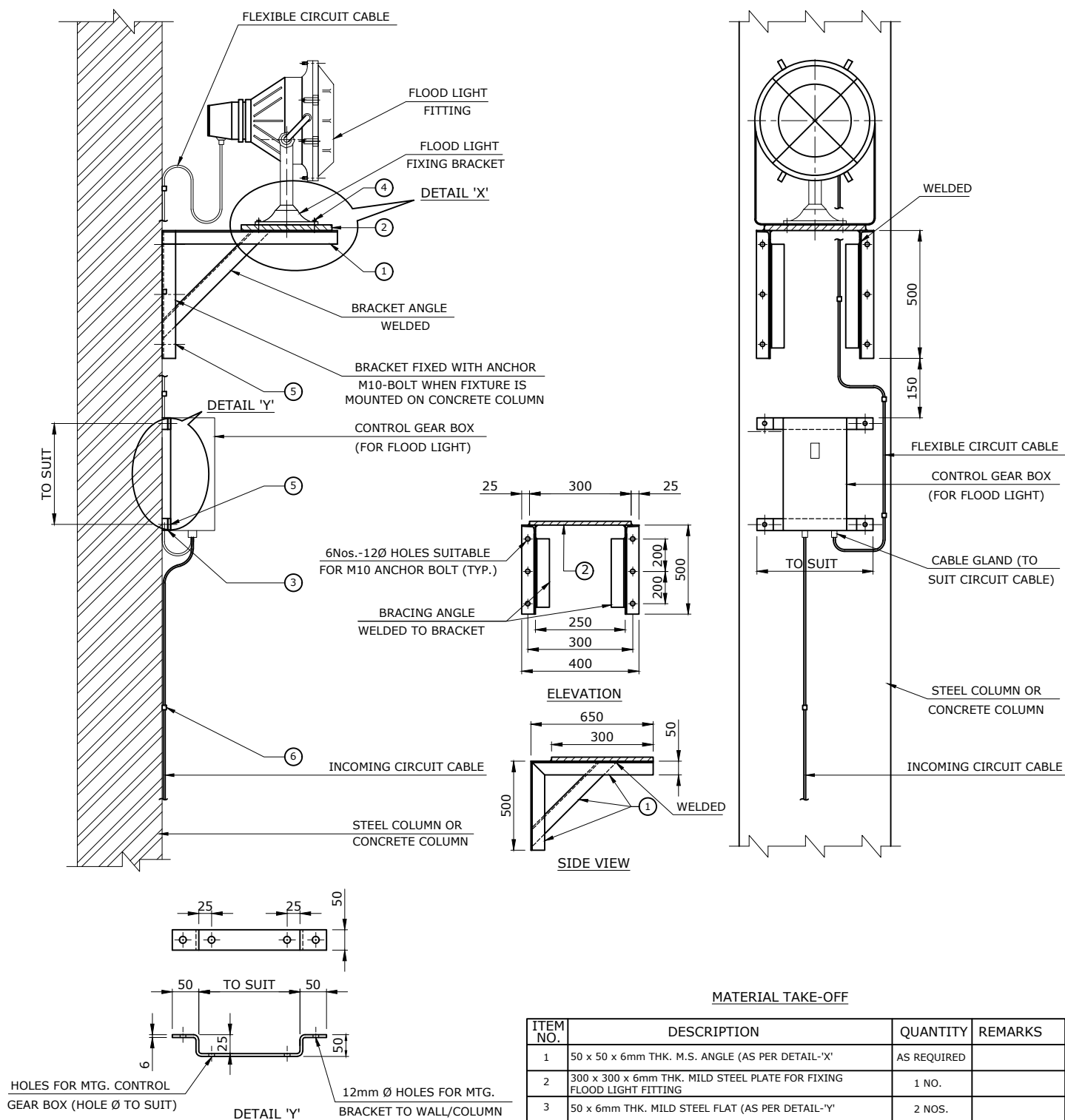
MATERIAL TAKE-OFF

ITEM NO.	DESCRIPTION	QUANTITY	REMARKS
1	CABLE GLAND (SIZE TO SUIT CIRCUIT CABLE)	AS REQUIRED	
2	50 x 50 x 6mm THK. 650mm LONG M.S. ANGLE	2 NOS.	
3	300 x 300 x 6mm THK. MILD STEEL FLAT	AS REQUIRED	
4	50 x 6mm THK. MILD STEEL FLAT (LENGTH TO SUIT)	AS REQUIRED	
5	M10 x 50 LONG M.S. BOLT WITH NUT & WASHER	AS REQUIRED	
6	3 mm THK. KICK PLATE (SIZE TO SUIT AT SITE)	AS REQUIRED	

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. AFTER INSTALLATION THE ASSEMBLY IS TO BE PREPARED, PRIMED AND PAINTED.

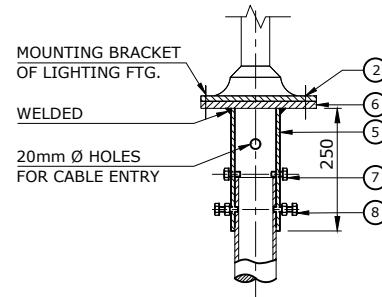
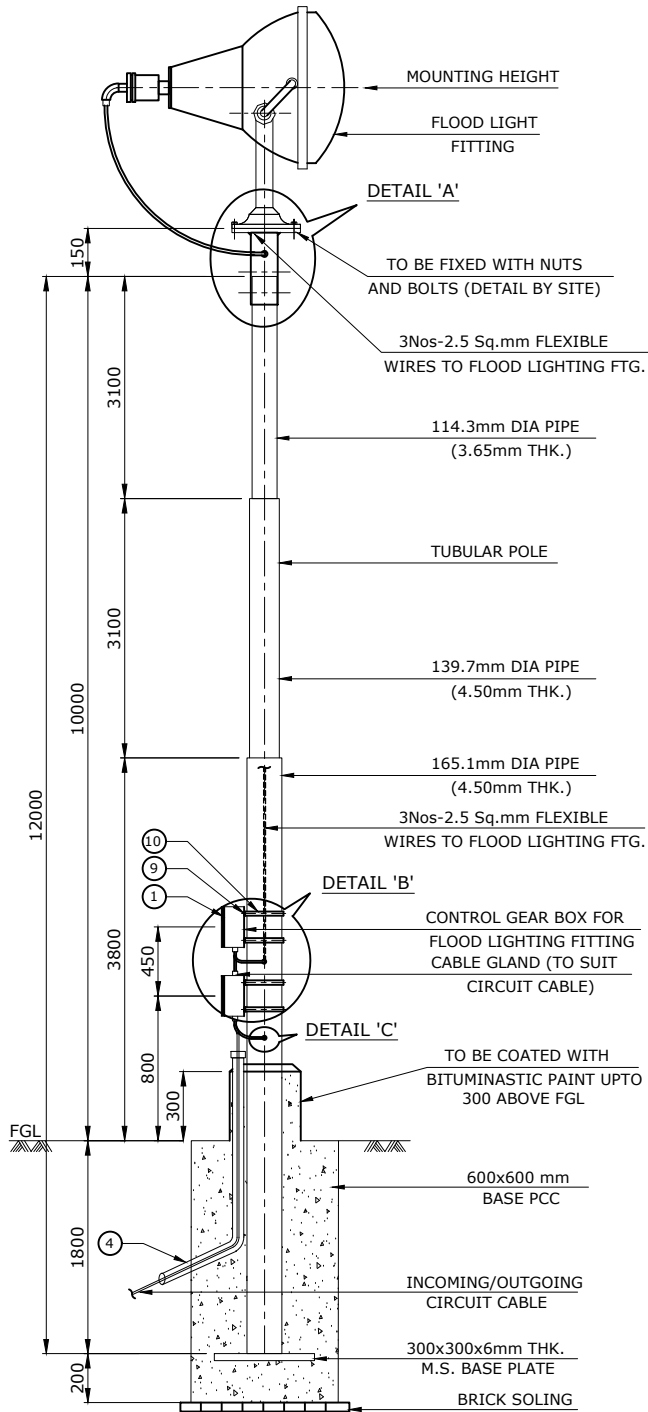
02	03.02.22	RE-ISSUED AS STANDARD DRAWING	SY	RD	AA	HK
01	02.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



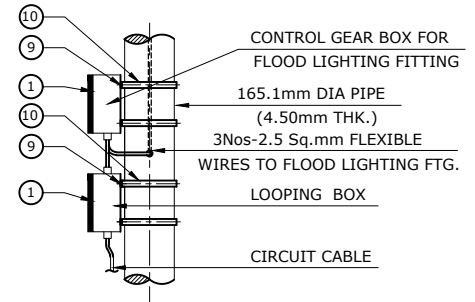
NOTES:

- ALL DIMENSIONS ARE IN MILLIMETERS.
- AFTER INSTALLATION THE ASSEMBLY IS TO BE PAINTED WITH TWO COATS OF ANTI-CORROSIVE PAINT AND TWO COATS OF EPOXY PAINTS.

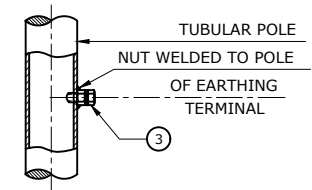
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01	02.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



DETAIL 'A'



DETAIL 'B'



DETAIL 'C'

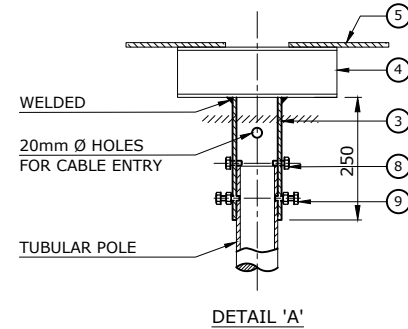
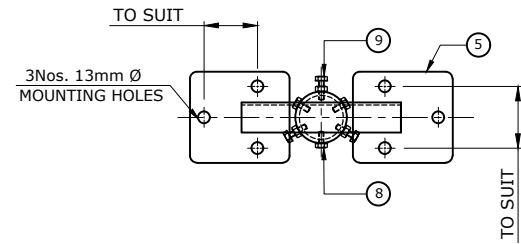
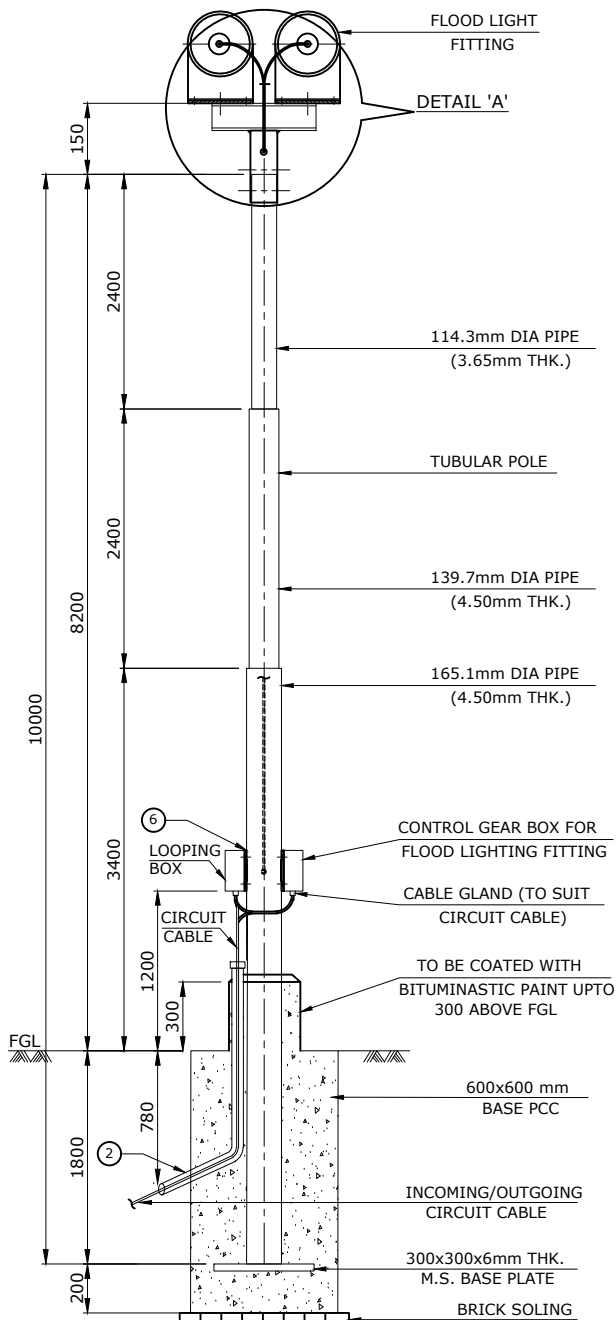
MATERIAL TAKE-OFF

ITEM NO.	DESCRIPTION	QUANTITY	REMARKS
1	STREET LIGHTING LOOPING BOX	1 NO.	
2	M8 x 40mm LONG BOLT WITH NUTS & PLAIN WASHER FOR FIXING FLOOD LIGHT	AS REQUIRED	
3	EARTHING TERMINAL M10-40mm LONG BOLT WITH NUTS, 2Nos. SPRING WASHERS & 2Nos. PLAIN WASHERS	1 NO.	
4	75mm NB G.I. PIPE SLEAVE	2 NOS.	
5	M.S PIPE CAP TO SUIT 114.30mm DIA PIPE	1 NO.	
6	300 x 300 x 10mm THICK M.S. PLATE	1 NO.	
7	M10-40mm LONG BOLT TO BE USED AS STOPPER	3 NOS.	
8	M10 x 40mm LONG BOLT WITH LOCK NUT TO BE USED AS HOLDER	3 NOS.	
9	M8-40mm LONG BOLT WITH NUTS & PLAIN WASHER FOR FIXING OF CONTROL GEAR BOX & LOOPING BOX	8 NOS.	
10	BRACKET/CLAMP MADE OUT FROM 25x6mm THK. M.S. FLAT FOR FIXING OF CONTROL GEAR BOX & LOOPING BOX	4 NOS.	

NOTES:

- LIGHTING FITTING FIXING DETAILS TO BE FURNISHED BY SITE.
- EARTHING TERMINALS ARE LOCATED DIAMETRICALLY OPPOSITE.
- ALL NUTS, BOLTS AND WASHER SHALL BE GALVANISED OR ZINC PASSIVATED.
- MOUNTING DETAILS OF CONTROL GEAR BOX & LOOPING BOX REFER INSTALLATION DETAILS.
- ALL SHARP EDGES AND BURRS SHALL BE REMOVED.
- POLE SHALL BE MADE FROM TUBULAR STEEL PIPES SWAGED AND WELDED CONFORMING TO DESIGNATION 410TP-60 AS PER IS-2713 (PART II) - 1980.

02	03.02.22	RE-ISSUED AS STANDARD DRAWING	SY	RD	AA	HK
01	02.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



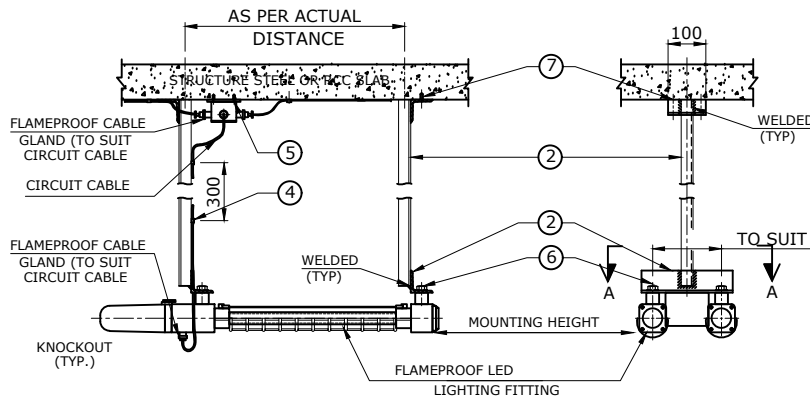
NOTES:

1. FIXING DETAILS TO BE FURNISHED BY SITE.
2. EARTHING TERMINALS ARE LOCATED DIAMETRICALLY OPPOSITE.
3. 2 Nos. 20mm Ø HOLES LOCATED DIAMETRICALLY OPPOSITE.
4. MOUNTING DETAILS OF CONTROL GEAR BOX & LOOPING BOX TO BE FIXED BY SITE.
5. FOR INCANDESCENT LAMP, FLEXIBLE CABLE TO GO DIRECTLY TO FITTING.
6. ALL SHARP EDGES AND BURRS SHALL BE REMOVED.
7. ALL NUTS, BOLTS AND WASHER SHALL BE GALVANISED OR ZINC PASSIVATED.
8. POLE SHALL BE MADE FROM TUBULAR STEEL PIPES SWAGED AND WELDED CONFORMING TO DESIGNATION 410TP-60 AS PER IS-2713 (PART II) - 1980.

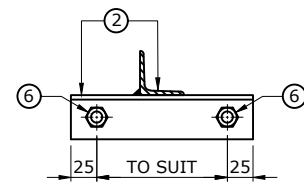
MATERIAL TAKE-OFF

ITEM NO.	DESCRIPTION	QUANTITY	REMARKS
1	STREET LIGHTING LOOPING BOX	-	
2	75mm NB G.I. PIPE SLEEVE	2 NOS.	
3	M.S PIPE CAP (TO SUIT 1114.30mm DIA PIPE)	1 NO.	
4	100 x 50 x 6mm THK. M.S. CHANNEL (LENGTH TO SUIT)	AS REQUIRED	
5	300 x 300 x 6mm THICK M.S. PLATE	2 NOS.	
6	50 x 6mm THICK M.S. FLAT (LENGTH TO SUIT)	AS REQUIRED	
7	M10-30mm LONG BOLT WITH NUT, WASHER FOR FIXING FLOOD LIGHT	AS REQUIRED	
8	M10 BOLT (TO BE USED AS STOPPER)	3 NOS.	
9	M10 BOLT WITH LOCK NUT (TO BE USED AS HOLDER)	3 NOS.	

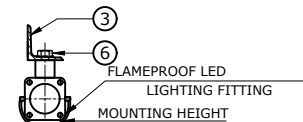
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01	02.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY



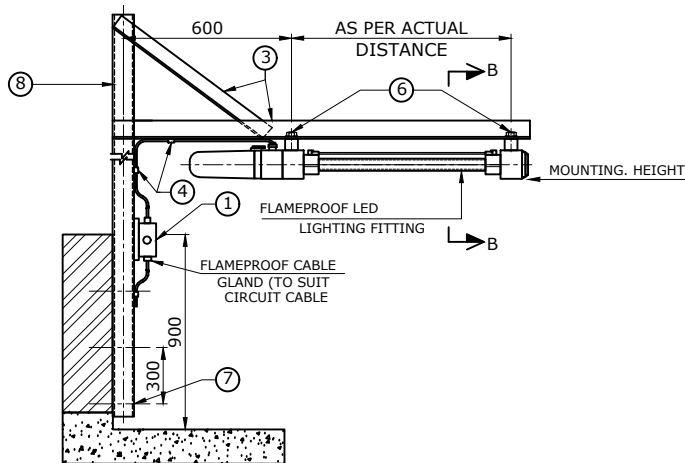
DETAIL FOR SUSPENSION MOUNTING
MOUNTING TYPE : SM9



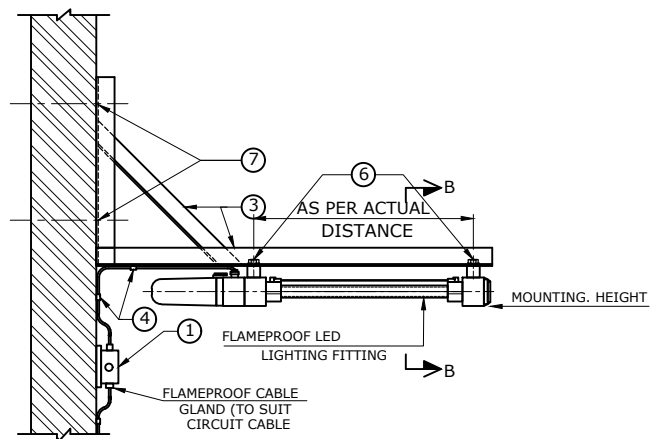
SECTION 'A-A'



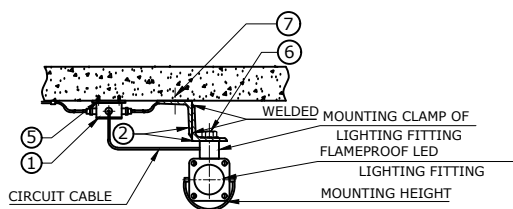
SECTION 'B-B'



DETAIL FOR ROOF/TERRACE MOUNTING
MOUNTING TYPE : BM9



DETAIL FOR BRACKET MOUNTING
MOUNTING TYPE : BM9



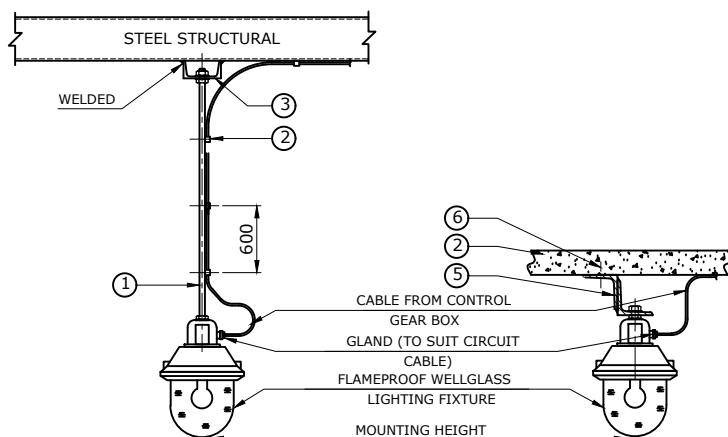
DETAIL FOR CEILING MOUNTING
MOUNTING TYPE : CM9

MATERIAL TAKE-OFF

ITEM NO.	DESCRIPTION	QUANTITY			REMARKS
		CM	SM	BM	
1	FLAMEPROOF JUNCTION BOX WITH TERMINAL BLOCK.	1 NO.	1 NO.	1 NO.	
2	ISA 50 x 50 x 6mm THK. (LENGTH TO SUIT)	AS REQD.	AS REQD.	-	
3	BRACKET MADE OUT FROM ISA 75 x 75 x 6mm THK. (LENGTH TO SUIT).	-	-	AS REQD.	
4	SADDLE/CLEAT ALONG WITH SUITABLE SIZE OF FIXING SCREWS TO SUIT FOR CIRCUIT CABLE.	AS REQD.	AS REQD.	AS REQD.	
5	M8-68mm LONG STUD ANCHOR WITH NUT & LOCK WASHER FOR JUNCTION BOX FIXING TO CEILING/WALL.	2 NOS.	2 NOS.	2 NOS.	
6	M10x40mm LONG BOLT NUT & PLAIN WASHER.	2 NOS.	4 NOS.	4 NOS.	
7	M10-68mm LONG STUD ANCHOR WITH NUT & LOCK WASHER FOR FIXING OF ISA TO CEILING/WALL.	2 NOS.	4 NOS.	4 NOS.	
8	ISMC -150 (LENGTH TO SUIT)	-	-	AS REQD.	

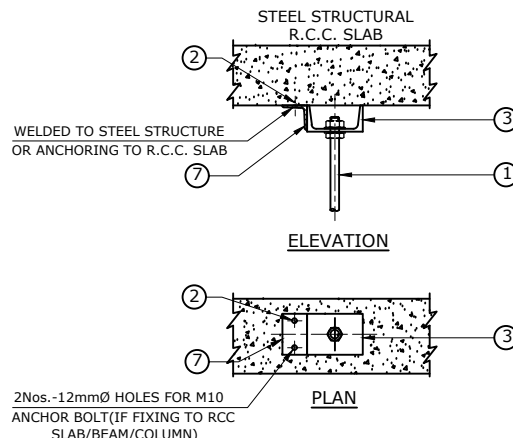
NOTES:

02	26.04.22	RE-ISSUED AS STANDARD DRAWING	SY	RD	AA	HK
01	02.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY

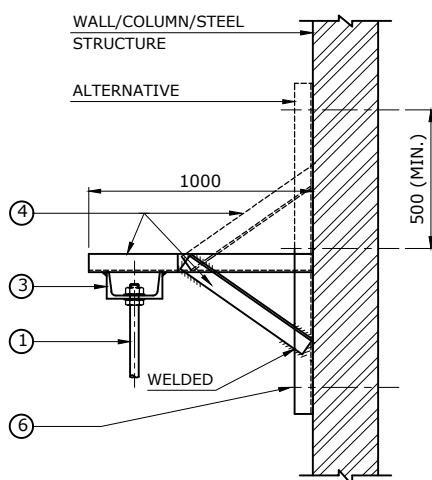


SUSPENSION MOUNTING
MOUNTING TYPE : SM8

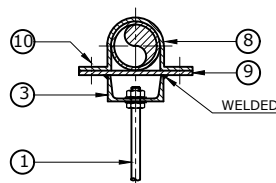
CEILING MOUNTING
MOUNTING TYPE : CM8



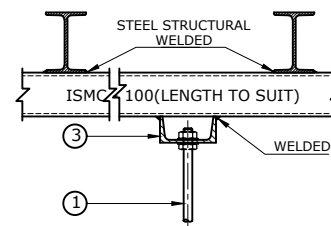
MOUNTING DETAIL ON
R.C.C. SLAB



WALL/COLUMN BRACKET
MOUNTING TYPE : BM8



TUBULAR TRUSS
MOUNTING TYPE : PM8



SUSPENSION FROM STEEL
STRUCTURE
MOUNTING TYPE-SM8

MATERIAL TAKE-OFF

ITEM NO.	DESCRIPTION	QUANTITY	REMARKS
1	19mm Ø M.S. ROD (LONG AS REQUIRED) THREADED WITH BOTH ENDS WITH 2 Nos. NUTS, 2Nos. PLAIN/SPRING WASHERS	2 NOS.	
2	SADDLE/CLEAT ALONG WITH SUITABLE SIZE OF FIXING SCREWS. TO SUIT FOR CIRCUIT CABLE.	AS REQUIRED	
3	ISM 100 x 50 - 75mm LONG (OR MORE LONG AS REQUIRED)	1 NO.	
4	BRACKET MADE OUT FROM ISA 50 x 50 x 6mm THK.	AS REQUIRED	
5	ISM 75 x 40 - 50mm LONG (OR MORE LONG AS REQUIRED)	1 NO.	
6	M10-40mm LONG ANCHOR BOLT FOR MOUNTING OF PLATE/ BRACKET/ISM TO WALL/COLUMN/CEILING	AS REQUIRED	
7	ISA 50 x 50 x 6mm THK. WITH 2 Nos.-Ø12mm HOLES	AS REQUIRED	
8	CLAMP/SADDLE (TO BE MADE OUT OF 50 x 6mm M.S. FLAT) WITH FIXING SCREWS. (CLAMP TO SUIT SIZE OF TRUSS/PIPE)	1 NO.	
9	50 x 6mm THK. M.S. FLAT (FOR SADDLE/CLAMP FIXING) LENGTH TO SUIT SIZE OF TRUSS/PIPE	1 NO.	
10	M10-40mm LONG BOLT WITH NUT & WASHER FOR CLAMP/ SADDLE BOLTED	2 NOS.	

NOTES:

02	26.04.22	RE-ISSUED AS STANDARD DRAWING	SY	RD	AA	HK
01	02.12.19	RE-ISSUED AS STANDARD DRAWING	SY	VV	AD	SK
0	15.05.17	ISSUED AS STANDARD	SY	RD	AD	SK
REV NO.	DATE	PURPOSE	PREPARED BY	CHECKED BY	APPROVED BY	AUTHORIZED BY

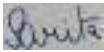
**VOLUME D
(INSTRUMENTATION)**



VCS Quality Services Pvt. Ltd.

STANDARD SPECIFICATION FOR PRESSURE GAUGE

VCS-SS-IN-5001_02

					
02	11.05.2022	SV	KNC	HK	GVW
01	18.01.2020	KS	VB	KNC	AD
00	23.05.2019	ND	UM	KP	KNC
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By
UNCONTROLLED COPY : If printed					
CONTROLLED COPY : If in soft and signed					

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	23.05.2018	Neha Dev	Udit Manichanda	K.Prasanth	Anupam Das	
01	18.01.2020					Format change and document numbering is revised.
		Karan Singh	Vinod Babu	Kedarnath Chakraborty	Anupam Das	
02	11.05.2022					VCS QMS Integration
		Sarita Verma	Kedar Nath Chakraborty	Hashim khan	GV Walimbe	

□

ABBREVIATION

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
BS	British Standards
DIN	Deutsches institute fur Normung
FAT	Factory Acceptance Test
IEC	International Electro-technical Commission
IP	Ingress Protection
IS	Indian Standards
ISA	Instrument Society of America
ISO	International Organization for Standardization
NACE	National Association of Corrosion Engineers
NPT	Nominal Pipe Thread
SAT	Site Acceptance Test
SS	Stainless Steel

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1 **SCOPE**

This Standard Specification, together with the Data Sheets attached herewith, establishes the minimum technical and functional requirements for design, engineering, materials, fabrication, painting, inspection and testing, documentation, marking, packing and shipping of Pressure Gauge along with its accessories.

2 **DEFINITIONS**

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

Owner/ Purchaser/ Company	Owner of the particular Project (Project Specific).
Consultant	The party which comes out all or part of the engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
Bidder/ Manufacturer / Supplier / Vendor	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.
Works/ Shop	The place where the ITEM / UNIT is fabricated and tested and transported to Purchaser.
Datasheet	Technical data provided by the Purchaser / Owner / Company.
Standard Specification	Specifications Developed as Standard by the Company.
Job Specification	Specifications Developed pertaining to particular project / Job in regard.
Material Requisition	Requisition as raised to Supplier for Quotation of the item
Purchase Requisition	Requisition as raised to Supplier for Procurement of the item
Purchase Order	Legal Order supplied to Supplier for procurement of the Engineered Item
Site	The work place where the equipment is installed and commissioned.

3 ☐ REFERENCE DOCUMENTS

3.1 ☐ Codes & Standards

The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the Purchaser's enquiry.

American Society of Mechanical Engineers

ASME B1.20.1	Pipe Threads
ASME B 16.5	Steel Pipe Flanges and Flanged Fitting
ASME B 16.20	Ring Joint Gaskets and Grooves for Steel Pipe Flanges

British Standards

BS 1780	Specifications for Bourdon Tube Pressure and Vacuum Gauges

Deutsches Institute fur Normung

DIN 50049	Document on Material Testing

Indian Standards

IS 3624	Specification for Pressure and Vacuum Gauges
IS 2147	Degree of Protection provided for Enclosures

International Electro technical Commission

IEC 529	Degree of Protection by providing Enclosures
EN 837	Pressure Gauges Part-t: Bourdon Type Pressure Gauges, Dimensions, Metrology, Requirements and Testing

3.2 ☐ Order of Precedence

In the event of conflict between Specifications, Data sheets, related standards, codes etc., the order of precedence shall be as follows:

- a. Data sheets
- b. Job Specifications
- c. Standard Specifications
- d. Codes and Standards

Vendor shall refer the matter to the Purchaser for clarification and only after obtaining the approval in writing, the same should proceed with the manufacture of the items in question.

4□ MATERIALS

Materials selected shall be in accordance with the Data Sheets and Standard Specifications. For corrosion service the material selected shall be in compliance with the requirements of NACE MR-0175 / ISO-15156 latest editions.

5□ DESIGN

5.1□ Pressure Element, Gauge Movement and Socket

The Pressure Gauges shall be used for local indication.

Pressure Gauge sensing element shall be SS316 and movement of SS304, as a minimum. Pressure Gauge measuring element shall generally be Bourdon / Bellows / Diaphragm type. In case of Bourdon type of Gauges, the size of the Bourdon tube shall not be less than 75% of the nominal diameter of the dial size.

The wetted parts of the Pressure Gauge, the Bourdon tube and socket must be compatible with the process media. If not compatible with the wetted parts of the Gauge, corrosion will occur. Corrosion of Gauge wetted parts will eventually cause gauge failure and possibly safety issues.

The material of construction of all accessories wetted by process shall be as per socket material.

Gauge construction shall ensure no leakage of process fluid from the sensor elements to atmosphere and between the high pressure and low-pressure side (in case of differential Pressure Gauges) under normal condition.

Primary elements shall withstand the specified overpressure for at least 30 minutes without having their elastic characteristics affected.

When any Gauge is used for steam pressures, a siphon filled with water must be installed between the Gauge and the line.

All Pressure Gauges with maximum operating pressure exceeding 60 Kg/cm² shall be solid front type.

Over range protector and pulsation dampener, whenever used shall be of SS304, as a minimum. Pulsation Dampener shall be used for all pulsating services. It shall be floating pin type, externally mounted and externally adjustable.

5.2□ Cases Dials

Unless specified otherwise the gauges shall be weather proof to IP 65 as per IEC 529/IS 2147 as a minimum.

When safety type cases are specified, they shall consist of a solid partition isolating the pressure element from the dial.

Pressure Gauge dial shall be white, non-rusting plastic with black figures. The dial face shall be marked with pressure element material; dial size shall be 150mm. Pointers shall have micrometer adjustment.

Cases shall normally be cast aluminum alloy or black phenol.

In general, dial markings and dial color shall be as per IS 3624. Protect Gauges from frequent pressure pulsations by using liquid-filled.

5.3 □ Diaphragm Seals

Diaphragm seals, filled type or mechanical type shall be furnished where plugging of the element may occur or where suitable material is not available in highly corrosive services. When chemical seals are required, they shall be of the clean out type with flushing connection. Gauges specified with diaphragm seals shall have their diaphragms integral with the Gauges.

The sealing liquid for diaphragm seal Gauges shall be an inert liquid, compatible with the process fluid temperature.

For Gauges in oxygen and chlorine service, the sealing liquid shall be fluoro lube or equivalent compatible with the specified service.

For diaphragm seal Pressure Gauges with flanged ends, the diaphragm shall be rated for the maximum allowable pressure of the associated flange.

5.4 □ End Connection

Process Pressure Gauges with 150mm dial sizes or larger are most often supplied with a ½ NPTM connection to best support the gauge. Where NPT connections have been specified, the threading shall be to ANSI/ASM 81.20.1.

When flanges are specified, unless otherwise stated, they shall be to ANSI / ASME B 16.5. Process connection shall be bottom entry type.

5.5 □ Accuracy

For a mechanical Pressure Gauge, accuracy is defined as a percentage of the full scale range. The following are general guidelines:

- a. Test Gauges and standards: 0.25% through 0.10% full scale.
- b. Critical processes: 0.5% full scale.
- c. General industrial processes: 1.0% Less Critical Commercial Uses:2.0%

5.6 □ Range

Ranges shall be so specified that the Gauge normally operates in the middle third of the scale and shall conform to IS-3624 standard dials, wherever possible.

Pressure range is approximately twice the normal operating pressure. The maximum operating pressure should not exceed approximately 75% of the full scale range. Pressure Gauges shall have an accuracy of $\pm 0.5\%$ as a minimum. Over range protection of 130% shall be used.

5.7 □ Name Plate

All Pressure Gauges shall be marked as per Manufacturer's standard and shall have a permanently attached stainless steel plate with the following, as a minimum detail:

- d. Tag number as per Data Sheet
- e. Manufacturer's name and trade mark
- f. Gauge type, model no. Serial no.
- g. Range of the Instrument.
- h. Maximum working pressure and maximum vacuum rating of the element.

- i. Area classification

6 ☐ FABRICATION AND PAINTING

Vendor shall obtain approval in writing from the Purchaser before start of fabrication of Pressure Gauge. Vendor shall submit the required Specification, drawings & documents for approval. Also Vendor shall refer the relevant codes and standards for manufacturing herein.

7 ☐ INSPECTION AND TESTING

Vendor shall perform all inspection and testing as per Job Specification requirements, and as per relevant codes, prior to shipment. The inspection and testing for Pressure Gauge shall be carried out as per approved Inspection and Test Plan. Vendor shall submit the Inspection and Testing for Approval. Vendor shall submit the test certificates to the Company for the tests conducted during the manufacturing process like hydro test, material test, hazardous area certification test, calibration test and any other before Factory Acceptance Testing (FAT).

7.1 ☐ Factory Acceptance Testing (FAT)

Prior to FAT, Vendor shall submit to the Company a detailed FAT procedure, for review and approval, listing all the Pressure Gauges complete with the project approved tags, and highlighting the inspection and testing requirements of all such devices. FAT shall be carried out as per approved Inspection and Test Plan. FAT shall be carried out prior to shipment of the Pressure Gauge.

FAT procedures shall be submitted at least 4 weeks prior to FAT testing taking place. FAT shall be carried out at the manufacturing facilities. The tests shall be witnessed by the Company or their approved representative. FAT procedure will be signed off by the Vendor and Company or their approved representative at the successful completion and conclusion of testing.

The FAT shall be consisting of the following as a minimum:

- a. Visual inspection
- b. Dimensional check
- c. Chemical and mechanical properties as per relevant material standards
- d. Calibration
- e. Functional test
- f. A certificate to detail the results and records obtained during the FAT shall be made available for ratification by the Vendor on the date of test. Following certificates shall be submitted by the Vendor:
- g. Mill test certificates relevant to the chemical analysis and mechanical properties of the materials as per the relevant Standards and Specifications.
- h. NOT reports for radiography, ultrasonic, magnetic particle and liquid penetrate inspection.
- i. Test report on operation of Gauges including operating time.

- j. Test report on hydrostatic test of Gauges.
- k. Test report on Gauge assembly tests.
- l. All other test reports and certificates as required by this Specification.
- m. The certificates shall be valid only when signed by Purchaser's Inspector. Only those Gauges which have been certified by Purchaser's Inspector shall be dispatched from Manufacturer's works.

7.2 Site Acceptance Testing (SAT)

A SAT shall be carried out on completion of the installation of the equipment at site which shall be witnessed by the company / owner's representative. SAT shall be performed on the Pressure Gauge as per the approved test procedure. A comprehensive test procedure in compliance with the company specification shall be developed and issued to company / owner for review and approval.

The Site Acceptance Test (SAT), in general, shall demonstrate that the Gauge functions correctly and properly in accordance with the specified requirements.

8 MARKING, PACKING AND SHIPMENT

Following FAT completion, Vendor responsible for the Pressure Gauge shall ensure that all equipment and associated materials and accessories are designed properly, marked and packed, and secured for transit to site without damage.

Vendor shall provide and submit his standard "Marking, Packing and Shipping Procedures" for review by Company / Owner.

Vendor shall specify any conditions, normal or special, to be verified in intermediate storage and during transport.

Equipment shall be suitably packed including any dismantling, transit fastening and bracing necessary to prevent distortion or damage during transit.

Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the jobsite.

Preparation for shipment and packing will be subject to inspection and rejection by Company's inspectors. All costs occasioned by such rejection shall be to account of the Vendor.

9 SPARES AND ACCESSORIES

The following spare philosophy shall be followed in case it is not covered in Job Specification.

The Vendor shall include recommended Spare Parts List for start-up, pre-commissioning and two years operation as per the following;

- a. Itemized recommended spare parts list for start-up and pre-commissioning.
- b. Itemized recommended spare parts list for two years operation.

Vendor shall recommend accessories and special tools required for operation and maintenance of Pressure Gauge, for Company review.

All the spare parts furnished by Vendor shall be wrapped and packaged to preserve an original as-new condition under normal conditions of storage. The same parts shall be properly tagged with stainless steel tags and coded so that later identification as to their intended equipment usage shall be clear.

All items supplied shall be packaged separately and clearly marked as "Spare Parts" and shipped with the equipment.

10 □ DOCUMENTATION

The following documentation shall be fulfilled by the Vendor, if it is not covered in Job Specification.

10.1 □ Documentation Required with Technical Bid

During bidding stage Vendor shall submit in his offer the following documents as a minimum:

- a. Standard Specification, Data Sheets;
- b. Bill of Materials including Vendor list, details of third party items;
- c. Catalogues and Manuals;
- d. Quality Assurance Plan;
- e. A list of accessory items together with Manufacturer's name and part number;
- f. Any other documents.

10.2 □ Documentation Required for Approval

Upon placement of Purchase Order, Vendor shall submit as a minimum the following drawings, documents and specifications for the Company's approval:

- g. Specifications, Data Sheets;
- h. Bill of materials including Vendor list, details for third party items;
- i. Catalogues, Manuals and relevant drawings and documents;
- j. Dimensional drawings;
- k. Calibration certificates;
- l. Material test certificates;
- m. Procedures for FAT;
- n. Quality Assurance Plan;
- o. Any Other documents.

10.3 □ Guarantee & Warranty

Vendor shall guarantee that the complete scope of supply shall be safely and reliably meet all of the requirements of this Company Specification.

Vendor shall provide warranty support for a period of 12 months from the date of supply or 18 months from the date of manufacturing. Warranty shall apply to defective material workmanship and facility design. The cost of correction / replacement of any warranty items shall be borne by the Vendor, as per the purchase conditions of the Material / Purchase Requisition.



**STANDARD SPECIFICATION
FOR
PRESSURE GAUGE**

**DOC NO : VCS-SS-IN-5001
Rev No : 02**

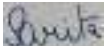
The Job specifications / Data sheets shall be referred for any specific warranty / guarantee.



VCS Quality Services Pvt. Ltd.

STANDARD SPECIFICATION FOR FIRE AND GAS DETECTION SYSTEM

VCS-SS-IN-5905_02

					
02	11.05.2022	SV	KNC	HK	GVW
01	18.01.2020	RB	VB	KNC	AD
00	23.05.2018	ND	UM	KP	AD
Rev. No	Date	Prepared By	Checked By	Approved By	Authorized By

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**STANDARD SPECIFICATION
FOR
FIRE AND GAS DETECTION SYSTEM**

**DOCNO: VCS-SS-IN-5905
Rev No : 02**

REVISION RECORD						
Rev.	Revision Date	Prepared by	Checked by	Approved by	Authorized by	Revision Description
00	23.05.2018	Neha Dev	Udit Manichanda	K.Prasanth	Anupam Das	
01	18.01.2020					Format change and document numbering is revised.
		Rakesh Bhardwaj	Vinod Babu	Kedarnath Chakraborty	Anupam Das	
02	11.05.2022					VCS QMS Integration
		Sarita Verma	Kedar Nath Chakraborty	Hashim khan	GV Walimbe	



ABBREVIATION

NFPA	National Fire Protection Association
SCADA	Supervisory Control and Data Acquisition
IEC	International Electrotechnical Commission
EPIC	Engineering, Procurement, Installation and Commissioning
1ooN	One out of N (any number) logic voting principle
2ooN	Two out of N (any number) logic voting principle
2oo3	Two out of three logic voting principle
PLC	Programmable Logic Controller
MCB	Miniature Circuit Breaker
MAC	Manual Alarm Call Point
RTU	Remote Terminal Unit
SIL	Safety Integrity Level
LED	Light Emitting Diode
PVC	Poly Venial Chloride
F&G	Fire & Gas
EN	European Standard
BS	British Standard
IP	Ingress Protection



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1.0 SCOPE

This standard specification establishes the minimum technical and functional requirements for design, engineering, materials, fabrication, painting, inspection and testing, documentation, marking, packing and shipping of fire & gas detection system.

2.0 DEFINITIONS

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

Owner/ Purchaser/ Company	Owner of the particular Project (Project Specific).
Consultant	The party which comes out all or part of the engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
Bidder/ Manufacturer / Supplier / Vendor	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.
Works/ Shop	The place where the ITEM / UNIT is fabricated and tested and transported to Purchaser.
Datasheet	Technical data provided by the Purchaser / Owner / Company.
Standard Specification	Specifications Developed as Standard by the Company.
Job Specification	Specifications Developed pertaining to particular project / Job in regard.
Material Requisition	Requisition as raised to Supplier for Quotation of the item
Purchase Requisition	Requisition as raised to Supplier for Procurement of the item
Purchase Order	Legal Order supplied to Supplier for procurement of the Engineered Item
Site	The work place where the equipment is installed and commissioned.



3.0 ☐ REFERENCE DOCUMENTS

3.1 ☐ Codes & Standards

The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the Purchaser's enquiry.

IEC-61508	Functional safety of electrical/electronic / programmable electronic safety related system.
IEC-61131	Programming Industrial Control System
BS 6266	Code of practice for Fire Protection for Electronic data Processing Installations
BS EN50014-39	Electrical Apparatus for Potentially Explosive Atmospheres
BS 7430	Code of practice for Earthing
EN 50018	Constructions and Testing of Electrical Apparatus with Flameproof Enclosures
EN 10204	Metallic products type of inspection Documents
BS EN 60529	Degrees of protection provided by Enclosures
NFPA 70	National Electric Codes
NFPA 72	National Fire Alarm Code

3.2 ☐ Order of Precedence

In the event of conflict between specifications, data sheets, related standards, codes etc., and the order of precedence shall be as follows:

- a. Data sheets;
- b. Job Specifications;
- c. Standard Specifications;
- d. Codes and Standards.

Vendor shall refer the matter to the Purchaser for clarification and only after obtaining the approval in writing, the same should proceed with the manufacture of the items in question.

4.0 ☐ FIRE AND GAS DETECTION SYSTEM

4.1 ☐ General

This Specification generally covers overall F & G system general requirements and minimum technical requirements.



The fire & gas detection systems shall be used to automatically detect fire, presence of toxic gas (H₂S) and flammable gas.

The F&G systems shall be PLC-based, redundant and SIL-3 certified unless otherwise specified. For exact SIL requirement and its certification refer Project I&C design basis. The system shall employ separate processors with redundant I/O and bus structure, chassis and software, with all systems running in parallel.

Detector signals shall be separated into isolated paths via input module(s), and sent via separate paths to each processor, where 2003 voting is performed on the data.

Each processor shall execute its individual application program simultaneously and independently; verifying data, executing logic instructions, control calculations, clock and voter / synchronization signals and performing comprehensive system diagnostics and discrepancy monitoring. Outputs shall be sent to output modules where they are again voted (2003) to ensure logic and output integrity.

The system shall be self-monitoring to detect faults that may affect the operation of the system. The system shall be physically arranged so that a single failure in it is unlikely to cause critical impairment of the system's safety function.

The F&G panels shall drive the switched and fused outputs to visual and audible alarm devices in the field. The system alarms shall be generated upon a single detector, not only on voted signals.

The system shall also be used to monitor the Manual Alarm Call points (MAC) located in the plant areas as well as in the buildings

The systems shall be remotely monitored by the SCADA system via serial links. In addition to this, selected alarm signals as identified in the F&G I/O schedule shall be hardwired to the SCADA.PLC.

The fire and gas detection panels shall meet the following functional requirements, as a minimum:

- a. Continuous monitoring of all detectors for alarms and circuit integrity conditions;
- b. For H₂S and flammable gas, a continuous readout of concentration shall be provided;
- c. Generate outputs for sounders and beacons;
- d. Generate potential free alarm outputs for connection to the SCADA PLC as specified;
- e. Generate potential free trip signal outputs to diesel generator, power incomer/feeder, as specified in the Job Specifications;
- f. Provide a serial link interface for communication with the SCADA system as specified;
- g. Provide a serial link interface for monitoring of FACP where applicable;
- h. Provide a graphical presentation of the station with LED indicating the location of gas or fire detection or AC activation or modification of existing if applicable;
- i. Provide lamp test facilities;



- j. Provide logic functionality to achieve the above;
- k. Alarm initiation shall be based on voted circuits where specified.

4.2□ Input/ Output Requirements

4.2.1 General

The system shall be designed with a minimum of 30% installed spare capacity in I/O's. In addition spare card slots shall be provided.

Intrinsically safe barriers and signal isolators where required shall be installed within the F&G cabinet.

4.2.2 Digital Inputs

Digital input shall be fully redundant' (triplicated), fault-tolerant and testable. The SIL 3 level triplication shall be based on the project requirements.

Input cards shall be capable of accepting potential free contacts.

4.2.3 Analog Inputs

The 4-20 mA analogue input cards shall be fully redundant (triplicated), testable and able to connect 4-20 mA: current sinking or sourcing, 24 VDC. The SIL 3 level triplication shall be based on the project requirements.

Analogue inputs shall have incorporated open, short, and out-of-range circuit detection

4.2.4 Digital Outputs

The F&G system shall provide fault-tolerant potential free contact outputs for connection to the SCADA PLC. The output circuits shall be quad-voted and fully tested. Line monitoring shall be user configurable to detect-short and open circuit failures at the field side of the circuit.

The F&G system shall be able to provide low power outputs, e.g. lamps, if required, with a power consumption of approximately 3 Watt.

The F&G system shall also be able to provide dedicated 24 VDC high power outputs for sounders and flashing beacons. The outputs shall be fail-safe, testable and "short circuit" proof. Short-circuiting of one output shall not affect other outputs.

4.3□ Interface Requirements

4.3.1 Hardwired

The F&G System shall be provided with the following potential free contacts, as a minimum:

- a. 100N Manual Call Alarm;



- b. 100N H₂S detection alarm per fire zone;
- c. 200N H₂S detection alarm per fire zone;
- d. 100N Flammable gas detection alarm per fire zone;
- e. 200N Flammable gas detection alarm per fire zone;
- f. 100N Flame detection alarm per fire zone;
- g. 200N Flame detection alarm per fire zone;
- h. 100N Heat detection alarm per fire zone;
- i. 200N Heat detection alarm per fire zone.

The contacts shall open on alarm or fault condition

4.3.2 Serial Link

The F&G system shall have a minimum of two serial links to communicate with other systems.

The serial ports shall comply with Modbus RTU / Ethernet communication protocol.

All indication and alarm signals within the F&G system shall be transmitted via serial link to the SCADA PLC for remote monitoring.

4.4 Minimum Requirements for F&G Cabinets

A standard panel from a reputable Manufacturer shall be used.

- a. Vendor shall assume that the panel "will be positioned against a wall- unless otherwise specified All access required shall be possible from the front of the cabinet. There should be easy access to terminations;
- b. The panel shall be designed to house the following instrument / accessories Monitors/ controllers for Fire detectors, Alarm annunciator , relays / logic cards for shutdown / protection system, Pushbuttons /switches as required (including lamp. test pushbuttons), any other items which are not listed above but essential to make the system operational and to meet requirements specified in Job Specification;
- c. Cabinet doors shall be of the window type so that alarms and status indications can be viewed without the need to open doors;
- d. The cabinet shall have a minimum of IP-42 degree of Ingress protection, as per BS EN 60529, and shall be fitted with a tamperproof locking system;
- e. The cable entry shall be from the bottom of the cabinet;
- f. All required cooling, venting and air filtering facilities shall be included;
- g. Suitable Cable clamps and rails shall be provided for all incoming cables for adequate cable connection stress relief;
- h. All unused card locations shall be fitted with cover plates;
- i. Galvanic isolators for intrinsically safe circuits;
- j. A separate insulated IS earth bar;
- k. The Vendor shall apply a universal method as per referred Codes & Standards, of allocating inputs, outputs and other components to the cabinet, to provide an easy maintainable system;



- l. The cabinet shall have lifting eyes to facilitate handling during transportation and installation;
- m. Cabinets shall have 30% spare space;
- n. Each cabinet shall be provided with a nameplate;
- o. The nameplate made from Traffolyte engraved with black letters on white background;
- p. Final tagging details shall be advised at order placement.

4.5 □ Wiring Details

- a. The EPIC supplied field cabling shall terminate directly on the terminal strips in the pre-wired F&G cabinet.
- b. All metallic equipment within the cabinets shall be connected to a single safety earthpoint. The cabinet shall be provided with a M8 earthing bolt for connection to the plant safety earthing system.
- c. Terminals carrying voltages higher than 24 volts shall be physically separated and protected against accidental contact by removable cover plates and be labelled accordingly.
- d. The Vendor shall supply all wire required for panel internal wiring. Interconnecting wires shall be standard copper conductor, with 600 volt rated fire retardant PVC insulation.
- e. Stranded copper wire shall be installed, wire ends at terminal points shall be provided with suitable type wire crimp pins/lugs and markers.
- f. All internal wiring, except cross-wiring of hardwired logic, shall be laid in PVC close slotted ducting with covering lid.' The wire ducting shall have a minimum of 35% spare capacity.
- g. Terminal arrangements shall be such that all single cores (including spares) of the multicore cables can be connected in the same sequential order as the pattern and layout of the cores in the cable.
- h. Separate Junction Boxes for IS and Non-IS signals shall be provided. Cable entries shall be located at the bottom and side only via removable gland plates. Suitable flameproof cable glands shall be used and spare cable entries shall be provided with plugs, labels shall be provided stating Junction Boxes contain IS circuits.

4.6 □ Marking

Terminals and (main) wiring shall be clearly identified in strict accordance with the system documentation. Earthing for IS, screens, AC and DC systems shall be segregated and identified.

The cabinet and all major system components, modules, boards, terminals,' blocks, cables, card files and individual card locations shall be clearly labelled and identified with a tag number. Individual wires shall be tagged with the terminal number. Nameplates shall be in the English language. In addition all equipment shall be identified-with the Vendor type and serial number to facilitate future reference.

The wiring shall be colour coded in accordance with the following standards

24 V DC Power supply	Positive	Red
	Negative	Black
24 V DC Digital signals	Positive	Light gray (with "+" sleeve marker)
	Negative	Light gray (with "-" sleeve marker)
24 V DC Analog signals	Positive	Purple (with "+" sleeve marker)
	Negative	Purple (with "-" sleeve marker)
Intrinsic Safe signals	Positive	Blue (with "+" sleeve marker)
	Negative	Blue (with "-" sleeve marker)

Panel wiring shall be sized in accordance with the following:

24 V DC Power output	Tinned ,stranded, 2.5 mm ² minimum and copper conductors 600V grade
24 V DC Digital signals	Tinned ,stranded, 1.0 mm ² minimum and copper conductors 600V grade
24 V DC Analog signals	Tinned ,stranded, 0.75 mm ² minimum and copper conductors 600V grade
Signal Earth	Yellow with black stripe
I.S Signal Earth	Yellow

Notice giving details of the wiring colour scheme shall be fixed to the inside of the cabinet, using a plastic-laminated sheet. A document holder shall be installed on the inside of the cabinet door

All power and signal wiring shall be clearly marked with reference codes and/or tag numbers.

All signal wires terminated to incoming or outgoing cabinet terminals shall be marked with the terminal number.

4.7 Power Supply Requirements

4.7.1 Power Supply Facilities

Two (2) secure 24 V DC power supply feeders will be available from the Plant UPS system.

DC Voltage	24 V DC ($\pm 5\%$)
Ripple at full load	100 mV PIP

The system shall be fed by the two main supplies with blocking diodes to allow uninterrupted supply in case one of the main feeders fails. A main feeder failure alarm shall be generated.



The internal distributions of the 24 V DC supply shall be as per indicated standard. The F&G system shall supply the required power for 24 VDC digital output signals to sounders and beacons as well as to analogue input signals.

The power supply to the logic input and. output circuits shall be floating (non-earthed).

The main power supply to the cabinet -shall be protected and isolated by means of a thermal circuit breaker (MCB type C). Separate Mini Circuit Breakers (MCB type B) shall be provided for each power supply unit. Vendor shall guarantee proper selectivity.

4.7.2 Power Distribution Features

Within the F&G cabinet the power supply system shall have the following minimum features:

- a. The provision of all the necessary power, voltage, frequency etc. That individual components and modules require, .with full redundancy.
- b. Proper power distribution to all systems, with necessary isolation and fusing.
- c. Isolation of individual racks within the cabinet.
- d. Isolation of I/O cards within a "logic entity". Fuse blowout indication shall be provided, while it shall be possible to easily replace fuses.

4.7.3 Power Consumption

The Vendor shall submit a calculation of the estimated power consumption and heat dissipation of the F&G cabinet, two weeks after order placement.

5.0 ☐ FABRICATION

Vendor shall obtain approval in writing from the Purchaser before start of fabrication of Fire & Gas detection panel. Vendor shall submit the required specification, drawings & documents for approval. Also, Vendor shall refer the relevant codes and standards for manufacturing mentioned herein. Painting of Fire & Gas detection panel shall be in accordance with Company painting specifications.

6.0 ☐ INSPECTION AND TESTING

Vendor shall perform all inspection and testing as per project specification requirements, and as per relevant codes, prior to shipment. The inspection and testing for F&G system devices & panels shall be carried out as per approved Inspection and Test Plan.

Vendor shall submit the Inspection and Test Plan for proprietary items / special items for approval. Vendor shall submit the test certificates to the Company for the tests conducted during the manufacturing process such as material test, hazardous area certification test, calibration test and any other before Factory Acceptance Testing (FAT).



6.1 □ Factory Acceptance Testing

Prior to FAT, Vendor shall submit to the Company a detailed FAT procedure, 'for review and approval, listing all the F&G system complete with the project approved tags, and highlighting the inspection and testing requirements of all such devices' & panels.

FAT shall be carried out as per approved Inspection and Test Plan. FAT shall be carried out prior to shipment of the F&G system devices & panels.

FAT procedures shall be submitted at least 4 weeks prior to FAT testing taking place.

FAT shall be carried out at the manufacturing facilities. The tests shall be witnessed by the Company or their approved representative. FAT procedure will be signed off by the Vendor and Company or their approved representative at the successful completion and conclusion of testing.

The FAT shall be consisting of the following as a- minimum:

- a. Visual Inspection;
- b. Dimensional checks which shall be carried out as per the approved drawings;
- c. Material checks in accordance with the appropriate instrumental standards & codes;
- d. Simulation of the serial link interface to prove that the Modbus / Ethernet protocol is properly functioning;
- e. Functional Test;
- f. Calibration Test;
- g. Paint checks;
- h. Any other relevant test.

A certificate to detail the results and records obtained during the FAT shall be made available for ratification by the Vendor on the date of test.

6.2 □ Site Acceptance Testing (SAT)

A SAT shall be carried out on completion of the installation of the equipment at site which shall be witnessed by the Company / Owner's representative. SAT shall be performed on the F&G system devices as per the approved test procedure. A comprehensive test procedure in compliance with the Company Specification shall be developed and issued to Company / Owner for review and approval.

The Site Acceptance Test (SAT), in general, shall demonstrate that the F&G system functions correctly and properly in accordance with the specified requirements.

7.0 □ MARKING, PACKING AND SHIPMENT

Following FAT completion, Vendor responsible for F&G system shall ensure that all equipment and associated materials and accessories are designed properly, marked and packed, and secured for transit to site without damage.



Vendor shall provide and submit his standard 'Marking, Packing and Shipping Procedures' for review by Company / Owner.

Vendor shall specify any conditions, normal or special, to be verified in intermediate storage and during transport.

Equipment shall be suitably packed including any dismantling, transit fastening and bracing necessary to prevent distortion or damage during transit.

Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the jobsite.

Preparation for shipment and packing will be subject to inspection and rejection by Company's / Contractor's inspectors. All costs occasioned by such rejection shall be to account of the Vendor.

8.0 □ SPARES AND ACCESSORIES

The Vendor shall include recommended spare parts list for start-up, pre commissioning and two years operation as per the following:

- a. Itemized recommended spare parts list for start-up and pre commissioning;
- b. Itemized recommended spare parts list for two years operation;

Vendor shall recommend accessories and special tools required for operation and maintenance of F&G System, for Company review.

All the spare parts furnished by Vendor shall be wrapped and packaged to preserve an original as-new condition under normal conditions of storage. The same parts shall be properly tagged with stainless steel tags and coded so that later identification as to their intended equipment usage shall be clear.

All items supplied shall be packaged separately and clearly marked as "Spare Parts" and shipped with the equipment.

9.0 □ DOCUMENTATION

The following documentation shall be fulfilled by the Vendor, if it is not covered in Job Specification.

9.1 □ Documentation Required With Technical BID

During bidding stage Vendor shall submit in his offer the following documents as a minimum:

- a. Specification, Data Sheets;
- b. Bill of Materials including Vendor list, details for third party items;
- c. Catalogues and manuals;
- d. Quality assurance plan ;



9.2□ Documentation Required For Approval

Upon placement of Purchase Order, Vendor shall submit as a minimum the following drawings, documents and Specifications for the Company's approval:

- a. Specifications, Data Sheets;
- b. Bill of Materials including Vendor list, details for third-party items;
- c. Catalogues, manuals and relevant drawings and documents;
- d. Dimensional drawings;
- e. Calibration certificates;
- f. Material Test certificates;
- g. Procedures for FAT;
- h. Quality Assurance.

9.3□ Guarantee / Warranty

Vendor shall guarantee that the complete scope of supply shall be safely and reliably meet all of the requirements of this Company Specification.

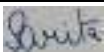
Generally Vendor shall provide warranty support for a period of 12 months from the 'date of supply or 18 months from the date of manufacturing. Warranty shall apply to defective' material workmanship and facility design. Warranty work shall be done at Owner's local facilities. The cost of correction / replacement of any warranty items shall be borne by the Vendor.



VCS Quality Services Pvt. Ltd.

STANDARD SPECIFICATION FOR FIRE DETECTION AND ALARM PANEL

VCS-SPC-IN-5902_02

					
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**STANDARD SPECIFICATION
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FIRE DETECTION AND ALARM PANEL**

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ABBREVIATION

BASEEFA	British Approval Service for Electrical Equipment in Flammable Atmospheres
BGU	Break Glass Unit
BIS	Bureau of Indian Standards
BS	British Standard
FACP	Fire Alarm Control Panel
CMRI	Central Mining Research Institute
CRCA	Cold Rolled Close Annealed
DC	Direct Current
DG	Diesel Generator
EEPROM	Electrically Erasable Programmable Read Only Memory
EN	European Standard
FA	Fire Alarm
FAT	Factory Acceptance Test
FM	Factory Mutuals
FO	Fibre Optic
FR	Fire Retardant
IP	Ingress Protection
IR	Infra Red
IS	Indian Standards
ITU	International Telecommunication Union
LED	Light Emitting Diode
LIFO	Last In First Out
MCP	Manual Call Point
MMI	Man Machine Interface



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NC	Normally Close
NFPA	National Fire Protection Interface
NO	Normally Open
PCB	Printed Circuit Board
PLC	Programmable Logic Controller
PVC	Poly Vinyl Chloride
SAT	Site Acceptance Test
UL	Underwriters Laboratory
ZFAP	Zonal Fire Alarm Panel



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1 □ SCOPE

This Standard Specification establishes the minimum technical and functional requirements for design, engineering, materials, fabrication, painting, inspection and testing, documentation, marking, packing and shipping of an integrated Fire Alarm System.

2 □ DEFINITIONS

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

Owner/ Purchaser/ Company	Owner of the particular Project (Project Specific).
Consultant	The party which comes out all or part of the engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
Bidder/ Manufacturer / Supplier / Vendor	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.
Works/ Shop	The place where the ITEM / UNIT is fabricated and tested and transported to Purchaser.
Datasheet	Technical data provided by the Purchaser / Owner / Company.
Standard Specification	Specifications Developed as Standard by the Company.
Job Specification	Specifications Developed pertaining to particular project / Job in regard.
Material Requisition	Requisition as raised to Supplier for Quotation of the item
Purchase Requisition	Requisition as raised to Supplier for Procurement of the item
Purchase Order	Legal Order supplied to Supplier for procurement of the Engineered Item
Site	The work place where the equipment is installed and commissioned.



3 □ REFERENCE DOCUMENTS

3.1 □ Codes & Standards

The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the Purchaser's enquiry.

IS-5	Colours for ready mixed paints and emulsions
IS-513	Specifications for cold rolled low carbon steel sheets and strips
IS-2148	Flameproof enclosure for electrical apparatus
IS-1646	Code of practice for fire safety of buildings (general): electrical installation
IS-2189	Code of practice for selection; installation and maintenance of automatic fire detection and alarm
IS-3034	Code of practice for fire safety of industrial buildings: electrical generating and distributing standards
IS-3700	Essential ratings and characteristics of semi conducting devices (applicable parts).
IS-3826	Connectors for frequencies below 3KHz general requirements part-1 and tests.
IS-5469	Code of practice for the use of semi-conductor junction devices (applicable parts).
IS-5780	Specification for intrinsically safe electrical apparatus and circuits.
IS-11360	Specification for smoke detectors for use in automatic electrical fire alarm system.
IS-12459	Code of practice for fire safety in cable runs.
IS-13346	General requirement for electrical for explosive gas Atmosphere.
IS-14154 (Part-2)	Electrical apparatus with protection of enclosure for use in the presence of combustible dust.
NFPA-72 VOL.4	National fire alarm code
LPC	Loss prevention council recommendations
BS-5839	specification for manual call points, part-2
BS-EN50081-1	EMC (electromagnetic compatibility test)
BS-EN50082-1	EMC (electromagnetic compatibility test)
CMRI	Central Mining Research Institute



3.2□ Order of Precedence

In the event of conflict between Specifications, Data sheets, related standards, codes etc., the order of precedence shall be as follows:

- a. Data sheets
- b. Job Specifications
- c. Standard Specifications
- d. Codes and Standards

Vendor shall refer the matter to the Purchaser for clarification and only after obtaining the approval in writing, the same should proceed with the manufacture of the items in question.

4□ DESIGN

The following design requirement covers the general requirements of fire alarm system and its accessories. But for the exact requirements and applications, the relevant, project specifications and design basis shall be referred and complied.

4.1□ General

Fire alarm system under this specification is envisaged to provide fire monitoring in Plant / Process / Pipeline / Pig Launcher / Receiver area and non-plant buildings. The system shall be designed to detect incipient fires and generate audio / visual alarm in case of fire.

The system shall consist of automatic fire detectors and manual call point or break glass unit. Automatic fire detector shall work on the principle of sensing of smoke, heat or infrared rays. Depending on the type of scope, optical or ionization type detector shall be used. Detectors shall generally be provided in plant / non plant buildings. Manual call point shall be provided at exit doors of the buildings and at exit route of Process I Plant area. Number of detectors and break glass unit shall be decided as per guidelines given in applicable codes and standards.

The plant / building shall be divided in to fire monitoring zones. Detectors and MCP at these buildings and plants shall be connected to fire panels. These panels shall continuously monitor the state of these devices. On sensing fire condition, an audio/visual alarm shall be initiated identifying the zone where fire is detected. Panels shall continuously monitor the health of the cabling and in case of short circuit or open circuit fault alarm shall be actuated. Fire alarm panels shall also have powered outputs for switching on exit signs and hooters. Further, Panels shall provide required output for interfacing with Purchaser's system such as air conditioning system or pressurization system or fire protection system.

Alarms, if specified, shall be relayed to repeater panel provided in buildings like control rooms / administrative buildings to provide zone wise annunciation. In addition facility shall be provided to actuate siren / hooter.

4.2□ Design Features

The system shall be modular and scalable facilitating further extension / modification. The design of common facility and hard ware shall be provided for required future extension of zones.



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PCBs shall have watchdog features for self diagnostic. Each PCB shall have LED for annunciating card failure. Following self diagnostic features may be considered as minimum:

- a. open loop detection;
- b. Short circuit detection;
- c. Earth faults;
- d. Power supply failure e.g. low battery voltage main incoming supply fails;
- e. System faults (PCB failure).

Logic of operation shall be built on "Fail Safe" feature i.e. NC contact of field devices shall be considered as healthy condition and NO as fire condition. 1NO +1 NC contact of output relays shall be wired to terminal block for interface with Purchase's other equipment.

It shall be possible to test lamps, hooters, flasher circuit, and functional tests etc. through common "Test" push button.

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.

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. If required noise filter shall be provided at fire alarm panel.

Detectors and MCPs in a loop shall be wired through 1.5 mm² multi cores copper conductors, PVC insulated, armoured cables. Limiting distance from fire alarm panel to last detector / MCP shall be Vendor specific. Generally it shall be 2 kms or more.

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.

If zone is protected with clean agent / CO₂ system, the detectors and MCPs of the zone shall be wired in cross-zones by providing minimum two loops in a zone. The last device in each loop shall be provided with end of line resistor of suitable value as per circuit design to facilitate cable open circuit and short circuit detection.

Scheme for FIRE / FAULT annunciation shall be as per the following:

SYSTEM CONDITION	AUDIO	VISUAL
Normal	OFF	OFF
Fire	ON (Tone 1)	Flasher ON, Fire LED steady ON
Accept	OFF	Flasher steady, Fire LED steady ON
Reset	OFF	Flasher OFF, Fault LED off

Fault	ON (Tone 2)	Flasher OFF, Fault LED steady ON
Accept	OFF	Flasher OFF, Fault LED steady ON
Reset	OFF	Flasher OFF, Fault LED OFF

Fire Alarm Panels including repeater panels and Central Fire alarm panel shall be certified I approved by applicable approving agency of country of origin as required.

4.3 Fire Alarm Control Panel

The FACP shall be located in fire station in plants or in building control room. Fire and fault annunciation for each zone or group of zones at ZFAP shall be repeated at FACP. Annunciation scheme at FACP shall be provided as per the above table.

FACP shall be in vertical panel construction or desk type construction having controls such as accept, test and reset push buttons, auto / manual control of sirens etc.

Unless otherwise specified, FACP shall have mimic to display geographical location of fire. Mimic shall form an integral part of the FACP and shall be located at the top of the panel. When separate mimic panel is specified, it shall either be provided for each zone on mimic panel for display of fire alarm. Mimic panel shall be powered by FACP. Mimic made out of plastic sticker shall not be acceptable.

4.4 Integration With Various Plant Systems

Fire alarm system shall have required hardware to have interface with following plant systems as specified:

- Public alarm announcement;
- Paging and plant intercom system;
- Plant data network;
- Fire suppression system.

For micro processor based system the system architecture and all the activities shall be same as specified above, and the system shall have following as a minimum:

- Dual redundant at processor level (communication processor and I/O card processor);
- Dual redundant communication port;
- Dual redundant data highway cable;
- Dual redundant microprocessor at CFAP;
- Dual redundant work station / MMI (Engineering Work Station + Operator's WorkStation);
- Dual redundant power supply card at all fire panels (but with single source of battery backup).



Systems shall have provided adequate EEPROM size to store minimum of 10 events fire / fault. The event shall be stored in LIFO structure. All events shall be time stamped.

Software access for either zone programming or access to plant /building graphic on monitor shall be password protected. For viewing status of various field devices e.g. fire and fault status password protection shall not be given.

4.5 □ Panel Construction

All fire alarm panels shall be free standing, floor mounting type unless specified otherwise and shall be fabricated out of minimum 2 mm thick CRCA sheets and doors shall be fabricated out of minimum 1.6 mm CRCA sheets. Panel shall be naturally ventilated in IP-42 enclosure protection as a minimum.

In equipment mounting, all apparatus display screen, instruments and indicating lamps mounted on the panel front shall be flush mounting type. External cabling shall not be terminated directly on the base connector of PCBs but shall be terminated on separate terminal block. Further connection to PCBs shall be as per manufacturing standard. Routine calibration, adjustment, programming and operation shall be acceptable from the front of the panel without opening the door. External cabling shall preferably be done from the rear.

Power supply system including battery bank shall be mounted inside the panel.

Doors shall be provided with pistol grip handle with lock. Lamps shall be provided inside the panel to provide adequate light for maintenance of equipments.

Cable entry shall be from bottom unless otherwise specified. Terminal strips shall be provided for incoming / outgoing cables.

In wiring and terminals, wiring within the panel shall be laid in slotted plastic raceways enclosed with cover. Control connection shall be done with 660 V grade PVC insulated wires having stranded copper conductors. 1.5 sq.mm size of wire shall normally be used for circuits with control fuse rating of 10A or less. Control wiring for electronic circuits shall be through ribbon cable or through copper wire minimum of 0.5 mm dia. Panels shall supplied completely pre-wired, such that only field termination shall be required at site before it is energized.

PCBs for identical function shall be interchangeable. PCBs shall be plug in type having pin / edge connectors. PCBs shall be suitable for use in tropical, humid and dusty environment. These shall be protected with anti fungus treatment.

The cables shall be terminated on the terminal blocks. Clamp type terminals shall be spring loaded, stacking type, mounted on rails. Terminals shall be sized to accept as a minimum 2.5 sq.mm cross section conductors. Not more than one conductor shall be provided in each panel for termination of spare cores of cables.

In earthing, a common earth bar of minimum 25 X 3 mm. copper or equivalent aluminium shall be provided through the length of the panel. All noncurrent carrying metallic parts of the panel-mounted equipment shall be earthed. Flexible jumpers shall connect all doors and movable parts to the earth bus, two number earth lugs shall be provided outside the panel.

In name plates / warning plates, all name plates for panel shall be engraved out of 3 ply (black - white- black) lamicoid sheets or anodized aluminium. Back engraved perspex sheet nameplates will also be acceptable. Engraving shall be done with square groove cutters. Hard paper or self-adhesive plastic tape nameplates shall not be acceptable.



Label shall be provided for each component on cards, connecting wires as well as for the terminals in the terminal strip inside the panel. Wiring diagram shall be pasted inside the panel door as required for termination and maintenance.

Special warning plates shall be provided on all removable covers or doors giving access to energize metallic parts above 24 volts.

4.6 □ Cable And Cable Accessories

Vendor, as a part of integration and selection of fire alarm equipment, shall furnish detailed specification for loop /zone cables, data highway cables, cables for hooter/exit signs etc. giving details such as type of cables, number of pairs, size of cable, inductance and capacitance data number of fibers / connectors etc. the cables should be as per fire Vendor specification.

In data highway cables, unless specified otherwise Vendor shall supply copper cable / FO type data highway cable to suit system design and equipment specification. Copper cables, if supplied shall be of adequate size, twisted pair, PVC insulated, overall screened. PVC inner sheathed, armoured, FR type PVC outer sheathed as the minimum requirement. Fiber optic cables, if supplied shall be armoured, overall FR PVC outer sheathed and shall be as per ITU-T recommendation as a medium.

Vendor shall supply and install all hardware and cabling accessories as per data highway design including modems, repeaters etc. as part of the FA system. Modems / repeaters shall be powered by the supply provided for fire panel.

In cable glands / accessories, all cable glands / lugs / connectors as required for the equipment shall be included in Vendor's scope and shall be supplied along with the system, irrespective of whether installation is to be performed by Vendor or not.

All the cable glands for outdoor application shall be weatherproof, nickel-plated brass and double compression type, whereas those for indoor application shall be single compression type.

Cable glands for hazardous area equipment shall be flameproof, weather proof and nickel plated brass double compression type.

4.7 □ Automatic Fire Detector And Accessories

Any simulators required for checking, calibrating the automatic fire detectors shall be provided along with detectors / fire alarm system.

Heat detectors – fixed type shall use negative temperature coefficient thermistors for sensing and for reference. The detector shall be carefully calibrated to ignore any normal fluctuation in temperature but to respond quickly when the temperature and the rate of rise in temperature.

The rate of rise element shall be carefully calibrated to ignore any normal fluctuation in temperature, but to respond quickly when the temperature rise is 9 degree centigrade or more per minute.

The fixed temperature feature should be entirely independent of the rate of rise element. The operating temperature of fixed temperature element should be factory set at $57 \text{ degC} \pm 5 \text{ degC}$.

The detector shall be self-restoring type ensuring repeated use and easy maintenance.

Ionization smoke detector shall be solid state type, working on ionization principle and shall preferably be of dual chamber and dual source type.

The detector shall be able to sense incipient fire by detecting the presence of visible and invisible products of combustion like wood, paper ammonia processing paper,



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cloth, PVC, bakelite nylon foam, acrylic thermocol, photo film, nylon, polyester, painted sheets, Teflon, leather etc.

The sensitivity of the detector shall not vary with change in ambient temperature, humidity, pressure or permissible voltage variation, its performance shall not be affected by an air current of 5 m/sec. it shall have an inbuilt arrangement such that puffs of smoke or hot air pockets do not inadvertently trigger the alarm. The detector shall be protected against dust accumulation / ingress. It shall have insect resistant screen to prevent nuisance alarms.

Where air velocity is expected to be higher, smoke guard / baffle shall be used.

IR detector shall work on the principle of a single wavelength infrared flame detector using one of several different photocell types to detect the infrared emission in a single wavelength band that are produced by flame.

It shall react to the infrared rays of a flame. Flame detector shall be sensitive enough to detect smoky fires in which flame is hardly recognizable. The detector should not react to extremely glaring artificial light or direct sunlight. The detector shall be completely solid state type.

Where specified, combination of UV-IR detectors shall be used.

Manual Call Point (MCP) / Break Glass Unit (BGU) shall be fabricated out of 14 -gauge cold rolled sheet steel. Alternatively the break glass unit may be made of die cast aluminium alloy such as LM-6. It shall have IP-65 enclosure and weather proof construction suitable for outdoor installation. The break glass unit shall have a minimum dimension of 100 mm X 100 mm X 80 mm.

The box shall be fabricated in such a way, that it can be mounted flush to the wall or on the surface without any modification. Two nos. 19 mm knockouts shall be provided at the bottom of the box to facilitate cable / conduit entry. The glass shall cover atleast 30 sq. cm area and shall have a thickness not exceeding 2 mm.

The box shall have a push button element kept in pressed condition by a glass sheet fitted in the front of the box.

The enclosure shall be painted with the fire red colour (shade 536 of IS-5) epoxy paint and an inscription "break glass in case of fire", shall be painted in white letter or riveted on the enclosure by a steel nameplate. A suitable nickel-plated brass hammer, duly chained to the box with stainless steel chain shall be provided with each box for breaking the glass. Each box shall have a distinct identification number boldly painted on it. Hazardous area break glass unit shall meet the requirement of field devices and hazardous area clause.

Hooters unit shall consist of solid-state circuitry on a printed circuit board, a loud speaker and a flashing lamp housed in a weather proof dust tight, wall mounted type enclosure. The hooter shall at least have 102db (A) output measured at 1 meter distance. The unit shall be powered from the fire alarm panel and operate on DG power. In the event of fire, the hooter shall raise pulsating audio alarm and lamp shall start flashing.

Acknowledgement switches shall be provided at exit doors of building to mute the hooters after evacuation.

Flashing lights (Beacons) unit shall consist of solid-state circuitry on a printed circuit board and a red-capped incandescent lamp and audio unit housed in a dust tight, wall ceiling mounting type enclosure. It shall derive power from the fire panel and shall operate on DC supply.

It shall be installed in the enclosed areas where clean agent / CO₂ are to be released. In the event of a signal for clean agent / CO₂ release is given, the lamp shall start



blinking with a warning sound enabling operating personnel to evacuate the area. The audio unit (hooter) shall have 102db (a) output measured at 1 meter distance.

Clean agent / CO₂ release and inhibit switches unit is required to be provided at the exit of the protected buildings / rooms. This shall consist of pull type release and inhibit switches clean / agent CO₂. This unit shall be fabricated out of 2mm thick cold rolled sheet steel suitable for wall mounting. Switches shall be pulled to release or inhibit the clean agent / CO₂.

Release switches shall have inscription: "PULL TO RELEASE CLEAN AGENT / CO₂"

Inhibit switches shall have inscription: "PULL TO INHIBIT CLEAN AGENT / CO₂"

Exit Sign shall be fabricated out of 1.6 mm thick cold rolled sheet steel. This shall be suitable for wall mounting or suspension from ceiling. Exit signs suspended from the ceiling shall have text / direction printed on both the sides of exit sign.

Fire exit shall be displayed by means of 5 mm dia LEDs or backlit text. It shall be powered from the fire alarm panel. Exit sign shall operate on DC power supply.

The exit sign shall be either in red letters on white background or white letters on green background.

If specified self luminous exit sign shall be provided.

Zener barrier preferably flameproof (Ex'd') equipment that does not require the use of Zener barrier. When necessary, intrinsically safe (Ex 'i') detectors and MCPs. Zener barriers shall be provided. These shall be located in unclassified / non-hazardous area.

Normally not more than 10 detectors shall be connected to one Zener barrier. However, Vendor shall indicate maximum number of detectors / MCPs that can be connected to one Zener barrier without compromising on working of loop / zone. Vendor shall also indicate the maximum loop length from Zener barrier considering 1.5 mm² - copper conductors, screened cable.

Fault isolator shall be designed to provide short circuit protection to an addressable detector loop. It shall be possible to wire the fault isolator at any point in the detector loop.

On occurrence of a fault (short circuit), the isolator shall cut power to all devices installed between the two isolators minimizing the outage of all the detectors in a loop.

The fault isolator shall have the capability to continuously check the faulted side of the loop to determine if the fault still exists, on rectification of the fault, the isolator shall automatically reset itself.

Fault isolator module shall be housed in an enclosure having IP-65 degree of protection as a minimum, if located in hazardous area; it shall also be tested and approved for use in area classification defined.

Field devices shall be suitable for installation in hazardous area as per specified area classification.

Field devices such as detectors, MCPs, fault isolator, beacons, hooters etc. for use in hazardous area, if specified in the data sheet shall have flame proof enclosure conforming to IS-2148. All equipment for hazardous area installation shall be complete with flame proof, weather proof cable glands.

Equipment, which cannot have flameproof construction, shall be intrinsically safe in design and shall be used with Zener barriers located in safe area.

Equipment that are tested / certified by a recognized test laboratory for the country of origin shall only be offered. The Vendor shall possess valid test certificate issued by a



recognized independent test house such as CMRI / BASEEFA / UL / FM or equivalent for the offered equipment.

All equipment (ingenious or imported) shall have valid statutory approval as applicable for the specified hazardous location from any applicable statutory authority. All indigenous flameproof equipment shall also have valid BIS license and corresponding marking as required by statutory authority.

A separate name plate shall also be provided on each equipment to indicate details of testing agency, test certificate number with date, statutory approval number with date, approval agency, SIS license number with date, applicable gas group, temperature class etc. the name plate shall be riveted / fixed with screw and hot pasted. Incase above information are embossed on the enclosure, the same need to be repeated.

5 □ FABRICATION AND PAINTING

Vendor shall perform all inspection and testing as per job specification requirements, and as per relevant codes, prior to shipment. The inspection and testing for fire alarm system shall be carried out as per approved Inspection and Test Plan. Vendor shall submit the Inspection and Test Plan for proprietary items / special items for approval. Vendor shall submit the test certificates to the Company for the tests conducted during the manufacturing process like material test, hazardous area certification test, calibration test and any other before Factory Acceptance Testing (FAT).

6 □ FACTORY ACCEPTANCE TESTING (FAT)

Prior to FAT, Vendor shall submit to the Company a detailed FAT procedure, for review and approval, listing all the FA system complete with the project approved tags, and highlighting the inspection and testing requirements of all such devices and panels. FAT shall be carried out as per approved Inspection and Test Plan. FAT shall be carried out prior to shipment of fire alarm systems.

FAT procedures shall be submitted at least 4 weeks prior to FAT testing taking place. FAT shall be carried out at the manufacturing facilities. The tests shall be witnessed by the Company or their approved representative. FAT procedure will be signed off by the Vendor and Company or their approved representative at the successful completion and conclusion of testing.

The FAT shall be consisting of the following as a minimum:

- a. Visual Inspection;
- b. Simulation of operational field conditions;
- c. Test for functional adequacy;
- d. Calibration test;
- e. Dimensional checks which shall be carried out as per the approved drawings;
- f. Any other relevant test.

A certificate to detail the results and records obtained during the FAT shall be made available for ratification by the Vendor on the date of test.

6.1 □ Site Acceptance Testing (SAT)

A SAT shall be carried out on completion of the installation of the equipment at site which shall be witnessed by the Company / Owner's representative. SAT shall be performed on the Fire Alarm System as per the approved test procedure. A



comprehensive test procedure in compliance with the Company Specification shall be developed and issued to Company / Owner for review and approval.

The SAT, in general, shall demonstrate that the fire alarm system functions correctly and properly in accordance with the specified requirements.

7 □ MARKING, PACKING AND SHIPMENT

Following FAT completion, Vendor responsible for fire alarm system shall ensure that all equipment and associated materials and accessories are designed properly, marked and packed, and secured for transit to site without damage.

Vendor shall provide and submit his standard 'Marking, Packing and Shipping Procedures' for review by Company / Owner.

Vendor shall specify any conditions, normal or special, to be verified in intermediate storage and during transport.

Equipment shall be suitably packed including any dismantling, transit fastening and bracing necessary to prevent distortion or damage during transit.

All equipment shall be divided into several sections for protection and ease of handling during transportation. The panels shall be wrapped in polythene sheets before being placed in crates to prevent damage to finish. Crates shall have skid bottom for handling. Special notation such as "Fragile", "This side up", "centre of gravity", "weight" etc. shall be clearly marked on the package together with Tag Nos. Purchase order Nos. etc.

Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the jobsite.

Preparation for shipment and packing will be subject to inspection and rejection by Company's / Contractor's inspectors. All costs occasioned by such rejection shall be to account of the Vendor.

7.1 □ Rejection

Vendor shall make his offer in detail, with respect to every item of the Purchaser's Specification. Any offer not conforming to this shall be summarily rejected.

8 □ SPARES AND ACCESSORIES

The following spare philosophy shall be followed in case it is not covered in Job Specification.

The Vendor shall include fire detectors simulators (if any), recommended Spare Parts List for start-up, pre-commissioning and two years operation as per the following;

- a. Itemized recommended spare parts list for start-up and precommissioning.
- b. Itemized recommended spare parts list for two years operation.

Vendor shall recommend accessories and special tools required for operation and maintenance of fire alarm system, for Company review.

All the spare parts furnished by Vendor shall be wrapped and packaged to preserve an original as-new condition under normal conditions of storage. The same parts shall be properly tagged with stainless steel tags and coded so that later identification as to their intended equipment usage shall be clear.

All items supplied shall be packaged separately and clearly marked as "Spare Parts" and shipped with the equipment.



9 □ DOCUMENTATION

The following documentation shall be fulfilled by the Vendor.

9.1 □ Documentation Required With Technical BID

During bidding stage Vendor shall submit in his offer the following documents as a minimum:

- a. Specification, Data Sheets;
- b. Bill of Materials including Vendor list, details for third party items;
- c. Catalogues and manuals;
- d. Quality Assurance plan;

9.2 □ Documentation Required For Approval

Upon placement of Purchase Order, Vendor shall submit as a minimum the following drawings, documents and Specifications for the Company's approval:

- a. Specifications, Data Sheets;
- b. Bill of Materials including Vendor list, details for third party items;
- c. Catalogues, Manuals and relevant drawings and documents;
- d. Calibration Certificates;
- e. Material Test Certificates;
- f. Procedures for FAT;
- g. Procedures for SAT;
- h. Quality Assurance plan;

9.3 □ Guarantee / Warranty

Vendor shall guarantee that the complete scope of supply shall be safely and reliably meet all of the requirements of this Job Specification.

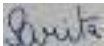
Generally Vendor shall provide warranty support for a period of 12 months from the date of supply or 18 months from the date of manufacturing. Warranty shall apply to defective material workmanship and facility design. Warranty work shall be done at Owner's Local facilities. The cost of correction / replacement of any warranty items shall be borne by the Vendor.



VCS Quality Services Pvt. Ltd.

STANDARD SPECIFICATION FOR FIRE & GAS DETECTORS

VCS-SS-IN-5901_02

					
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		Sarita Verma	Kedar Nath Chakraborty	Hashim khan	GV Walimbe	



ABBREVIATION

BS	British Standard
CENELEC	European Committee for Electrotechnical Standardization
FG	Flammable Gas
F&G	Fire & Gas
FAP	Fire Alarm Panel
GGDS	Gas Gathering and Distribution Station
HSSD	High Sensitivity Smoke Detector
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
IR	Infra-Red
LASER	Light Amplification by Stimulated Emission of Radiation
LED	Light Emitting Diode
LEL	Lower Explosive Limit
MAC	Manual Alarm Call-point
NACE	National Association of Corrosion Engineers
NFPA	National Fire Protection Association
PLC	Programmable Logic Controller
PO	Purchase Order
PPM	Parts Per Million
SCADA	Supervisory Control And Data Acquisition
SPIR	Spare Parts lists and Inter-changeability Record
SSL	Solid State Logic control system
UV	Ultraviolet
1ooN	one out of N (any number) logic voting principle



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2ooN	Two out of N (any number) logic voting principle
2oo3	Two out of Three logic voting principle
EPIC	Engineering, Procurement, Installation and Commissioning
UL	Underwriters Laboratories Inc., USA
FM	Factory Mutual, USA
LPCB	Loss Prevention Certifying Board, UK
VdS	Verband der Sachversicherer e.v, Germany
SSL	Scientific Services Laboratory, Australia
TUV	Technischer Überwachungs Verein
NPT	Nominal / National Pipe Thread



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1.0 SCOPE

This Standard Specification, together with the Data Sheets attached herewith, establishes the minimum technical and functional requirements for design, engineering, materials, Name plate marking, inspection and testing, documentation, packing and shipping of Fire & Gas Detectors.

2.0 DEFINITIONS

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

Owner/ Purchaser/ Company	Owner of the particular Project (Project Specific).
Consultant	The party which comes out all or part of the engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
Bidder/ Manufacturer / Supplier / Vendor	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.
Works/ Shop	The place where the ITEM / UNIT is fabricated and tested and transported to Purchaser.
Datasheet	Technical data provided by the Purchaser / Owner / Company.
Standard Specification	Specifications Developed as Standard by the Company.
Job Specification	Specifications Developed pertaining to particular project / Job in regard.
Material Requisition	Requisition as raised to Supplier for Quotation of the item
Purchase Requisition	Requisition as raised to Supplier for Procurement of the item
Purchase Order	Legal Order supplied to Supplier for procurement of the Engineered Item
Site	The work place where the equipment is installed and commissioned.



3.0 □ REFERENCE DOCUMENTS

3.1 □ Codes & Standards

The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the Purchaser's enquiry.

British Standards

- a. BS 6266, Code of Practice for Fire Protection for Electronic Data Processing Installations.
- b. BS EN50014-39, Electrical Apparatus for Potentially Explosive Atmospheres.
- c. BS 7430, Code of Practice for Earthing.
- d. BS 6755, Testing of Valves - Part 2 Fire Type Testing Requirements.
- e. BFPSA, British Fire Protection Systems Association: Code of Practice for Category 1 - Aspirating Detection Systems.

Instrumentation Systems and Automation Society (ISA)

- a. ANSI/ISA-12.15, Installation, Operation and Maintenance of Hydrogen Sulphide Detection Instruments Part '1 &2

European Standards (EN)

- a. EN 50054, Electrical apparatus for the detection and measurement of flammable gases.
- b. EN 50018, Constructions and Testing Of Electrical Apparatus with Flameproof Enclosures.
- c. EN 10204, Metallic Products Type of Inspection Documents.
- d. BS EN 60529, Degrees of Protection provided by Enclosures.

International Electrotechnical Commission (IEC)

- a. IEC 68-2-34, Vibration Testing for Electrical Apparatus.
- b. IEC 61508, Functional safety of electrical/electronic/programmable electronic safety related systems
- c. IEC 60801, EMC for Industrial Process Measurement and Control Equipment
- d. IEC 61131, Programming Industrial Control Systems

International Organization for Standardization (ISO)

- a. ISO-9001, Quality Assurance System - Edition 1994.



National Fire Protection Association (NFPA)

- a. NFPA 72, National Fire Alarm Code

Institute of Petroleum (IP)

- a. IP 15, Model code of Safe Practice Part-15 (Hazardous Area Classification)

3.2□ Order of Precedence

In the event of conflict between Specifications, Data Sheets, related standards, codes etc., and the order of precedence shall be as follows:

- a. Data sheets
- b. Job Specifications
- c. Standard Specifications
- d. Codes and Standards

Vendor shall refer the matter to the Purchaser for clarification and only after obtaining the approval in writing, the same should proceed with the manufacture of the items in question.

4.0□ MATERIAL

The material used for the Fire & Gas Detectors shall be SS 316 as minimum unless and otherwise specified in the Specifications / Datasheets.

All field-mounted devices shall be certified for use in hazardous area Zone 1, Gas Group IIC, Temperature Class T6, Ingress Protection IP 65 or better and shall be suitable for dusty, saline, sand laden and H₂S Environment. All Detectors shall be microprocessor based.

Field mounted-detectors, manual alarm call points, beacons and sounders shall be suitable for the ambient conditions as mentioned as per Job Specifications.

Selection of makes and types of field detectors shall be based on Client Preferred Vendor List. Vendor shall indicate in his bid compliance with this requirement.

Detectors shall be installed in the plant areas and at the control buildings as indicated on the drawings referenced as part of this Specification.

No order shall be placed with any sub-Vendor until Client has given approval in writing, even when the Vendor is on Client's Preferred Vendor List.

5.0□ DESIGN

The Fire & Gas Detectors and devices are responsible for the protection of facility, equipment and workmen in the Station or the pipeline. The Fire & Gas Detectors shall be intelligent type Detectors which shall alarm or trip depending on the level of



severity. The Job Specifications / Data Sheets shall be referred for the exact requirements of the Fire & Gas Detectors.

5.1□ Fire Detection

Fire Detectors shall be designed to detect one or more of three characteristics of fire, smoke, heat or radiation (flame). The prime function of a Fire Detector shall be to detect a fire in its early stage by one of its characteristic phenomena like combustion gases in fire infrared radiation from flame, rise of temperature due to fire and convert the same into an electrical signal for initiating the local and remote alarms.

- a. The electronic circuit shall be of solid state and of failsafe design and virtually hermetically sealed to have resistance to humidity and corrosion and to prevent its operation from being impaired by dust and dirt.
- b. The circuit shall be protected against usual electrical transients, electromagnetic and electrostatic interference (EMI & RFI) normally present at the functioning station.
- c. Reverse polarity or fault in the field wiring shall not damage the Detector.
- d. No moving parts subject to wear & tear shall be provided.
- e. The response sensitivity shall also be field adjustable and not only from fire panel over a wide range to suit site conditions. It shall be possible to test the sensitivity of a detector in the field. The sensitivity / threshold value of detectors which are cross zoned must be compatible.
- f. The visual (alarm) response of a Detector (by a LED) shall be clearly visible from the outside by a steady / flashing light of sufficient brightness.
- g. The base plate of the Detector shall be suitable for mounting on a four way standard outlet box and a single junction box for terminating directly the field cable run in conduit. The field terminals shall be suitable for field wires of core size upto 1.5 mm².
- h. The Fire Detectors shall be plug in type. Suitable locking device shall be supplied along with each Detector. It shall be inserted into or removed from the standard base by simple push twist mechanism to facilitate easy exchange for cleaning and maintenance.
- i. All types of Detectors offered shall have inbuilt electronic circuit for addressing capability for individual address on the fire alarm panel. In case of manual call points where the addressing capability is not an integral part, a separate addressable interface unit shall be provided.
- j. All types of Detectors shall be suitable for connection in any particular loop / circuit with any other type of Detector. In case of non-addressable type of Detector or group of such Detectors shall also be suitable for connection in the same loop / circuit by providing suitable addressable interface units.



- k. The Detector shall confirm to relevant Standards such as IS, BS, NFPA, etc. Test certificates shall be supplied along with the tender.

The Fire Detection shall comprise of a variety of Fire Detection devices and sensors, including:-

- a. Optical Flame Detectors.
- b. Smoke detectors.
- c. Thermal detectors.
- d. Fusible plug loops.
- e. Manual Alarm calls points.

5.1.1 Optical Flame Detectors

- a. Optical Flame detectors shall be Infrared / Ultra violet (IR/UV) type and shall make use of such sensor, filters and / or design to reject phenomena such as electric arcs, heaters, artificial light sources, lightening and shall be completely "Solar Blind".
- b. The detectors shall be able to detect all types of Flaming Fires.
- c. UV detectors may be used where they are not exposed to external UV rays, such as in compressors and power generating enclosures.
- d. Detectors shall be powered from 24 V DC, with a 4-20 mA signal loop to cover the calibrated range. Detector faults shall be signalled by a 4 mA signal. Sufficient margin shall be allowed between fault, normal and alarm levels to minimize spurious alarms.
- e. Optical Flame Detectors shall have automatic, self-diagnostic circuitry that continuously monitors the optical surfaces, sensor sensitivity and electronic circuitry, and shall give fault status. Any Detector malfunction shall be alarmed on the Fire and Gas detection system panel and DCS.

5.1.2 Smoke Detectors

- a. Smoke Detectors shall be installed indoors in all rooms, including concealed floor and ceiling voids.
- b. The Smoke Detectors shall incorporate an integral LED indicator for confirmation that the unit is active.
- c. Detectors that are not visible, such as ceiling void or under floor, shall be provided with remote LED's located in the room being monitored.
- d. Two independent Smoke Detector loops shall be installed in each area where executive action is required on detection of fire.



- e. Ionization Smoke Detectors shall be used in general-purpose areas to provide early response to smouldering or flaming fires in their incipient stages. A Detector base shall be provided for connecting the individual Detectors to the Fire and Gas (F&G) control system.
- i. This Detector shall be capable of detecting a fire both in its incipient or smouldering stages as well as invisible flames. To meet this requirement the Detector shall respond to visible combustion products in the form of smoke as well as in - visible particles, aerosols and pyrolysis products from a clear burning fire.
- ii. The sensitivity / response threshold value, the design and construction of the detector shall be in accordance with IS - 11360, BS - 5445 Part - 7 (European Standard - EN54 - 7) or ANSI - UL. 268 as applicable. Test certificates for the same shall be submitted by the Vendor. The Detectors shall be marked with their normal sensitivity, sensitivity range listed spacing, radiation level of radioactive component etc. as per relevant standards.
- iii. Ionisation type Detectors quickly respond to smaller smoke particles which are normally produced by rapidly developing fire. Ionisation type Detectors are ideal for fire involving flammable liquid, and easily ignited free burning material such as wood, paper and cellulose materials. In ionisation type Detector, the change of current flowing through an ionisation chamber due to smoke particles entering the chamber is used to sense the fire.
- iv. This type of Detector comprises two ionisation chambers electrically connected in series each containing a radioactive source (emitter) generally Am 241 (Americium 241) with activity level not exceeding 1 - 5 μ Ci or Ra226 (Radium 226) with activity level 0 -1 μ Ci. One of the chambers is semi sealed and termed as 'reference chamber and the other is termed as 'smoke chamber. The air in the chamber is ionised. In the presence of voltage applied between electrodes in the chamber, the ionisation results in small current flow. Since the chambers are of identical design under normal condition, the applied voltage is distributed equally between the chambers. Smoke particles are comparatively larger than air. Movement of molecules icon is restricted when the products of combustion enter the smoke chamber, due to presence of smoke particles. Because of this, current flow in the smoke chamber reduces. However, the current in sealed chamber remains unchanged. This imbalance of current due to smoke in is used to trigger the associated electronic circuits to initiate the alarm.
- v. Smoke Detectors shall remain in alarm state until reset by the fire and gas control system.
- vi. Photoelectric smoke detectors shall be used in electric equipment and control room areas. A Detector base shall be provided for connecting the individual Detectors to the F & G control system.
- vii. This Detector working on the light scattering principle shall be capable of detecting visible smoke from smouldering fires long before the fire breaks out into visible flame. It shall respond quickly to smoke that is optically dense. It



shall detect the scattering / change in intensity of light by smoke particles in the light beam. The light source of SDO shall automatically adjust to compensate for possible effects of dirt and dust accumulation in the sensor. The smoke density in the chamber shall be measured by a symmetrical optical system. The Detector principle shall employ a multiple light pulse coincidence circuit, preventing false alarms.

- viii. The normal sensitivity / response threshold value, the design & construction of this smoke detector shall be in accordance with IS - 11360, BS - 5445, Part - 7 (European Standard, EN - 54 - 7) or ANSI. UL. 268 as applicable. Test certificate for the same shall be furnished along with the Tender. Smoke Detectors shall be marked with their normal sensitivity, tolerance limits and listed spacing as per relevant standards.
- ix. The optical type Detector is basically a photo electric Detector working on the principle of light obscuration & scattering. A beam of light from infrared LED travels across a light - tight chamber to a collector on the other side of the chamber. A photo cell senses no light as long as the air inside the chamber is clean. When the Smoke enters the chamber the light from the beam is reflected or scattered in all directions. Some of this scattered light reaches the photo cell which triggers to initiate fire alarm.

5.1.3 Thermal Detectors

- a. Thermal Detectors shall be used in all indoor spaces including all rooms and equipment enclosures, including concealed floor and ceilings voids.
- b. Rate of rise Thermal Detectors shall be used where an early warning of smouldering fires is required, such as storerooms and equipment rooms where air flow or high humidity may inhibit the response of Smoke Detectors.
- c. Fixed temperature or rate compensated type Heat Detectors shall be used within areas unsuitable for Smoke Detection where a rapidly achieved high temperature can be expected, such as machinery rooms or equipment enclosures. These shall be set at approximately 12°C above maximum ambient temperature within the area.
- d. Thermal Detectors shall remain in alarm state until reset by the fire and gas control system.
- e. All visible Detectors shall incorporate an LED indicator as an integral part of the detector head or its mounting base. Concealed Thermal Detectors shall be provided with an LED "repeater" that is located in a visible location. Normally, unmanned equipment rooms or offices shall have indicators in the corridor. The Detector circuitry shall cause the LED to remain illuminated while the Detector is the alarm condition.
- f. The sensitivity, setting, response grade, listed spacing, the design and construction of the Detector shall be in accordance with IS.2175, BS - 5445 - PART - 5 or



(European standard EN - 54 -5 or 8) or ANSI - UL - 521 as applicable. Test certificates shall be furnished along with the Tender.

5.1.4 Linear Heat Sensing Cable

- a. Linear Heat Sensor Cables shall be of temperature sensitive insulated wire type.
- b. This Linear Heat Sensor shall be in the form of continuous Cables consisting of copper conductors / cores and shall be of analogue type.
- c. Each core of analogue Linear Heat Sensor Cable shall be insulated with a color coded, negative temperature coefficient material. The cores shall be protected by an outer sheath of high temperature, flame retardant PVC insulation. Additional mechanical protection shall be provided over the cable in the form of bronze or tinned copper metallic braid. The outer sheath, as well as the metallic braid shall not affect the performance of the heat sensor.
- d. The Linear Heat Sensor Cable for each zone / area shall be connected to an electronic interface unit, which shall sense the temperature variations by continuously monitoring the resistance of the negative temperature coefficient core insulation. The electronic interface unit shall be located suitably in the area being protected.
- e. The analogue linear Heat Sensor Cable of every zone shall be continuously monitored for open and short circuit. A breakage, disconnection or a short between cores shall initiate a FAULT alarm on the fire alarm panel.
- f. All necessary accessories and jointing kits for both end of line terminations and in line jointing shall be supplied.
- g. Subsequent to an alarm / actuation due to a fire, the sensor cable shall automatically reset. In case a length of the sensor cable in the middle of a run gets damaged, it shall be possible to splice in a new cable for the length which has been damaged, without affecting the performance of the sensor in any manner.
- h. The design of the analog, linear heat sensor cable and corresponding electronic sensing circuits shall be such as to allow a maximum length of atleast 1000 metres to be connected as a single cable for monitoring one-zone. However, in case different grades of analog linear heat sensor cables are available, considering the constraints of the maximum length required and the maximum ambient, the most sensitive grade shall be used. The system shall be designed to have an optimum sensitivity.
- i. The linear heat sensor cable and the electronic interface unit shall be compatible with the microprocessor based addressable fire alarm panel, incorporating all the features required for the system.
- j. Details of the setting procedure for the analogue linear heat sensor cable along with the necessary monograms shall be supplied by the Tenderer along with the



Tender. Details of the response time of the linear sensor cable for different temperatures shall also be furnished.

- k. For a given length of sensor cables it shall be possible to set the alarm temperature over a wide range by means of a setting switch or other means provided on the electronic interface unit. Provision shall also be made for setting the alarm temperature from the fire alarm panel.
- l. The sensitivity, response time, type, the design and construction of the sensor cables shall be in accordance with relevant standards. All relevant details shall be marked on the electronic interface unit. Test certificate shall be furnished along with the Tender.
- m. All relevant catalogues, technical literature installation procedures etc. shall be furnished along with the Tender.

5.1.5 Manual Alarm Call Point

- a. Manual alarm stations shall be provided for following functions:
 - i. Fire alarm.
 - ii.
 - iii. Platform Abandonment.
- a. Manual alarm stations for fire alarm shall be located throughout all areas of the platform, especially at exits and in the main equipment rooms. These stations shall be located at easily accessible, well lighted, conspicuous areas and located no more than 30 meters apart.
- b. Manual alarm stations- platform abandonment shall be located adjacent to each survival craft.
- c. All manual alarm stations shall require a double action to activate the alarm. They shall be the break-glass, pushbutton type.
- d. Each unit shall be surface mounted at a height of 1.4 meters and shall be provided with a striker connected to the station by a chain.
- e. Each unit shall be wired to the F&G control system in the Control Room.
- f. The manual alarm stations- Fire alarm shall be red in color & manual alarm stations- Platform abandonment shall be black in color.

5.1.6 Flashing Alarm Beacons

- a. The Flashing Alarm Beacons shall be direct ignition, Xenon type. Flashing Alarm Beacons shall be powered from 24 V DC, -ve earthed supply or depending on project Specifications / manufacturing standards.
- b. The Flashing Alarm Beacons shall have flashing speed of 60 flashes per minute.



- c. Separate Flashing Alarm Beacons shall be provided for visual indication of confirmed HC-H₂ gas release & H₂S gas release.

5.1.7 Sounders

- d. Field Sounder shall be electronic type, and shall be powered from a 24 V DC, -ve earthed supply.
- e. Field Sounder shall be provided for audible alarm for confirmed HC-H₂ / H₂S gas release.
- f. Field Sounder shall be located near personnel rest room on Main deck of the platform.

5.1.8 High Sensitivity Smoke Detection System (HSSD)

The High Sensitivity Smoke Detection System shall be capable of detecting & analysing air-borne particles generated during the pre-combustion stage of an incipient fire, sampled through the protected zones via a network of air sampling pipes. The design of the smoke sampling zones shall be based on the principle of one smoke zone per room. The system shall comprise of a 200% balanced, air sampling network together with a detector & control unit with display & battery back-up power unit facilities, including display & historical logging.

5.1.9 Building Smoke Detection System

Where applicable a Building Smoke Detection System shall be provided for other building facilities not covered by HSSD System. The Building Smoke Detection System shall compose of a Fire Alarm Panel (FAP) and all of its accessories. The Building Smoke Detection System shall be of State of the Art, fully programmable, intelligent and addressable system. Details of the FAP and its accessories are as described below.

5.2 Gas Detection

The Gas Detection shall consist of Gas sensing devices or Detectors as required for protection of leakage of Gas.

5.2.1 H₂S Detectors

Sensor Type	Electrochemical/Metal Oxide Semiconductor
Output Signal	Analog 4-20 mA
Range	TO BE PROVIDED
Accuracy	+/-2 ppm or better
Set point	TO BE PROVIDED
Housing	Manufacturer Std. (To suit Environmental Conditions)



Cable entry Metric (M20)

Malfunction and true alarms shall latch until manually reset and normal conditions are restored.

The Detector shall be fast and reliable. Preference shall be given to speed of response over precision. The Vendor shall indicate the response time of the Detector for the detection levels.

In general, the Detector shall be mounted integral to the transmitter. However, remote mounting of the sensor from the transmitter is acceptable on inaccessible locations.

The transmitters shall have fault monitoring Detection capability. A malfunction alarm shall be raised on under or over-ranging.

The Vendor shall supply a full set of support equipment, including test gas for calibration purposes for a period of 6 months. The support equipment shall contain all elements required for to calibrate for all the Detectors for a period of 2 years including commissioning.

5.2.2 Flammable Gas Detectors

Sensor Type	Infrared (Point Type)
Output Signal	Analog 4-20 mA
Range	0- 100 % LEL
Accuracy	± 3% LEL up to 50% LEL; ± 5% LEL for > 51% LEL
Set point	20 % and 50 % LEL
Housing	Manufacturer Std. (To suit Environmental Conditions)
Cable entry	Metric (M20)

Malfunction and true alarms shall latch until manually reset following the restoration of normal conditions. It shall also be provided with continuous self-testing/indication of fault due to dirty optics. Once fault is detected, the transmitter shall send a pre-set current output.

The transmitters shall have fault monitoring detection capability. A malfunction alarm shall be raised on under or over-ranging. The accuracy of the transmitter shall be ± 2% LEL at ≤ 50% LEL and ± 5% LEL at ~ 50% LEL reading.

Detection shall be fast and reliable. Preference shall be given to speed of response over precision. The Vendor shall indicate the response time the detector for the Detection levels of 20% LEL and 50% LEL.

The Detector shall preferably be integral to the transmitter and shall have over range protection in case of sudden exposure to high hydrocarbon gases.



Zero Drift shall be less than 2% of full scale over a period of 2 years.

The Vendor shall supply a full set of support equipment, including test gas for calibration purposes for a period of 6 months. The support equipment shall contain all elements required for to calibrate for all the Detectors for a period of 2 years including commissioning.

High-high flammable gas voting logic shall not latch the logic input.

5.3 □ Name Plate

- a. The Tag Nos. for Detector and Devices shall be as per various layout of Buildings / areas enclosed.
- b. All panels shall have Tag number and the same shall appear on the front and rear along with a descriptive name.
- c. Each item shall be provided with a name plate or label designating the service of the particular equipment.
- d. The shape and size of the plate and inscriptions shall be approved by Purchaser. Such name plates shall be anodized aluminium plates having engraved black lettering or the plate shall be of multi layered laminated plastic material with black lettering engraved on a white background.
- e. The name plates shall be screwed to the body of the equipment.

6.0 □ FABRICATION AND PAINTING

Vendor shall obtain approval in writing from the Purchaser before start of fabrication of Fire & Gas Detectors. Vendor shall submit the required Specification, calculations, drawings & documents for approval. Also Vendor shall refer the relevant codes and standards for manufacturing herein.

7.0 □ INSPECTION AND TESTING

Vendor shall perform all inspection and testing as per job Specification requirements, and as per relevant codes, prior to shipment. The inspection and testing for Fire & Gas Detectors shall be carried out as per approved Inspection and Test Plan. Vendor shall submit the Inspection and Testing Plan for Proprietary items / Special items for Approval. Vendor shall submit the test certificates to the Company for the tests conducted during the manufacturing process like hydrostatic test, hazardous area certification test, Radiography test, calibration test and any other before Factory Acceptance Testing (FAT).

7.1 □ Factory Acceptance Testing (FAT)

Prior to FAT, Vendor shall submit to the Company a detailed FAT procedure, for review and approval, listing all the Self Actuated Control Valve/ Regulators complete with the project approved tags, and highlighting the inspection and testing requirements of all such devices. FAT shall be carried out as per approved Inspection and Test Plan. FAT shall be carried out prior to shipment of the F&G Detectors.



FAT procedures shall be submitted at least 4 weeks prior to FAT testing taking place. FAT shall be carried out at the manufacturing facilities. The tests shall be witnessed by the Company or their approved representative. FAT procedure will be signed off by the Vendor and Company or their approved representative at the successful completion and conclusion of testing.

The FAT shall be consisting of the following as a minimum:

- a. Visual Inspection
- b. Calibration
- c. Functional Test

A certificate to detail the results and records obtained during the FAT shall be made available for ratification by the Vendor on the date of test.

7.2 Site Acceptance Testing (SAT)

A SAT shall be carried out on completion of the installation of the equipment at site which shall be witnessed by the Company / Owner's representative. SAT shall be performed on the Fire & Gas Detectors as per the approved test procedure. A comprehensive test procedure in compliance with the Standard Specification shall be developed and issued to Company / Owner for review and approval.

The Site Acceptance Test (SAT), in general, shall demonstrate that the F&G System with its Fire & Gas Detectors functions correctly and properly in accordance with the specified requirements.

8.0 MARKING, PACKING AND SHIPMENT

Following FAT completion, Vendor responsible for Fire & Gas Detectors shall ensure that all equipment and associated materials and accessories are designed properly, marked and packed, and secured for transit to site without damage.

Vendor shall provide and submit his standard 'Marking, Packing and Shipping Procedures' for review by Company / Owner.

Vendor shall specify any conditions, normal or special, to be verified in intermediate storage and during transport.

Equipment shall be suitably packed including any dismantling, transit fastening and bracing necessary to prevent distortion or damage during transit.

Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the job site.

Preparation for shipment and packing will be subject to inspection and rejection by Company's / Contractor's inspectors. All costs occasioned by such rejection shall be to account of the Vendor.



8.1 ☐ **Rejection**

Vendor shall make his offer in detail, with respect to every item of the Purchaser's Specification. Any offer not conforming to this shall be summarily rejected.

9.0 ☐ **SPARES AND ACCESSORIES**

The following spare philosophy shall be followed in case it is not covered in Job Specification.

The Vendor shall include recommended spare parts list for start-up, pre-commissioning and two years operation as per the following:

- a. Itemized recommended spare parts list for start-up and pre-commissioning.
- b. Itemized recommended spare parts list for two years operation.

Vendor shall recommend accessories and special tools required for operation and maintenance of Fire & Gas Detectors for Company review.

All the spare parts furnished by Vendor shall be wrapped and packaged to preserve an original as-new condition under normal conditions of storage. The same parts shall be properly tagged with stainless steel tags and coded so that later identification as to their intended equipment usage shall be clear.

All items supplied shall be packaged separately and clearly marked as "Spare Parts" and shipped with the equipment.

10.0 ☐ **DOCUMENTATION**

The following documentation shall be fulfilled by the Vendor, if it is not covered in Job Specification.

10.1 ☐ **Documentation Required with Technical Bid**

During bidding stage Vendor shall submit in his offer the following documents as a minimum:

- a. Specification of Fire & Gas Detectors;
- b. Bill of Materials including Vendor list, details for third party items;
- c. Catalogues and manuals;
- d. Quality Assurance Plan;
- e. Any other documents (Project Specific).

10.2 ☐ **Documentation Required for Approval**

Upon placement of Purchase Order, Vendor shall submit as a minimum the following drawings, documents and Specifications for the Company's approval:

- a. Standard Specifications, Data Sheets;



- b. Bill of Materials including Vendor list, details for third party items;
- c. Catalogues and manuals and relevant drawings and documents;
- d. Dimensional drawings;
- e. Material test certificates;
- f. Procedures for FAT;
- g. Quality Assurance Plan;
- h. Any other documents (Project Specific).

10.3 ☐ Guarantee / Warranty

Vendor shall guarantee that the complete scope of supply shall be safely and reliably meet all of the requirements of this Company Specification.

Vendor shall provide warranty support for a period of 12 months from the date of supply or 18 months from the date of manufacturing. Warranty shall apply to defective material workmanship and facility design. Warranty work shall be done at Owner's local facilities. The cost of correction / replacement of any warranty items shall be borne by the Vendor.

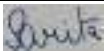
The Job Specifications/Data Sheets Shall be referred for any specific warranty / guarantee.



VCS Quality Services Pvt. Ltd.

STANDARD SPECIFICATION FOR CLOSED CIRCUIT TELEVISION (CCTV) NETWORK SYSTEM

VCS-SS-IN-5907_02

					
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**STANDARD SPECIFICATION
FOR
CCTV NETWORK SYSTEMS**

**DOCNO: VCS-SS-IN-5907
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02	11.05.2022					VCS QMS Integration
		Sarita Verma	Kedar Nath Chakraborty	Hashim khan	GV Walimbe	

□



ABBREVIATION

CCD	Charge Coupled Device
CCTV	Close Circuit Tele Vision
CCITT	International Telegraph and Telephone Consultative Committee
CENELEC	European Committee for Electro technical Standardization
DCS	Distributed Control System
ECR	Emergency Control Room
EMI	Electro Magnetic Interference
EPC	Engineering, Procurement & Commissioning
FEED	Front End Engineering & Design
IEC	International Electro technical Commission
IEEE	Institute of Electrical and Electronics Engineers
IES	Instrument Equipment Shelter
IP	Ingress Protection
ITU	International Telecommunication Union
LCD	Liquid Crystal Display
LTG	L&T-GULF Pvt. Ltd.
MCR	Main Control Room
OFC	Optical Fiber Cable
RFI	Radio Frequency Interference
SC	Subscriber / Standard Connector
TRR	Telecom Rack Room
UPS	Uninterrupted Power Supply
VCR	Video Cassette Record



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1 SCOPE

This Specification covers the minimum requirements for the design, materials, construction, fabrication inspection, testing and commissioning of the Closed Circuit Television Camera (CCTV) system. The Vendor shall be responsible for integrating all CCTV hardware, software, system testing, documentation, delivery, training, installation supervision and field support for the CCTV systems as defined within this specification.

The Vendor shall also be responsible for installation supervision and field support as required for pre-commissioning and commissioning of the CCTV system during the plant startup

2 DEFINITIONS

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

Owner/ Purchaser/ Company	Owner of the particular Project (Project Specific).
Consultant	The party which comes out all or part of the engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
Bidder/ Manufacturer / Supplier / Vendor	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.
Works/ Shop	The place where the ITEM / UNIT is fabricated and tested and transported to Purchaser.
Datasheet	Technical data provided by the Purchaser / Owner / Company.
Standard Specification	Specifications Developed as Standard by the Company.
Job Specification	Specifications Developed pertaining to particular project / Job in regard.
Material Requisition	Requisition as raised to Supplier for Quotation of the item
Purchase Requisition	Requisition as raised to Supplier for Procurement of the item
Purchase Order	Legal Order supplied to Supplier for procurement of the Engineered Item



Site	The work place where the equipment is installed and commissioned.

3▣ REFERENCE DOCUMENTS

3.1▣ Codes & Standards

The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the Purchaser's enquiry.

American Society of Mechanical Engineers

IEC 60028	International Standard of Resistance for Copper
IEC 60228	Conductors of insulated cables
IEC 60255	Electrical relays all or nothing
IEC 60331	Fire resistance characteristics of electric cables
IEC 60326	Printed circuit boards
IEC 60529	Degrees for protection provided by enclosures (IP Code)
IEC 60801	Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment
IEC 60885	Electrical test methods for electric cables
ITU-T	Standards and Recommendation including those previously published under the CCITT regulations
IEEE-472	Surge Withstand Capability

3.2▣ Order of Precedence

In the event of conflict between Specifications, Data sheets, related standards, codes etc., the order of precedence shall be as follows:

- Data sheets
- Job Specifications
- Standard Specifications
- Codes and Standards

Vendor shall refer the matter to the Purchaser for clarification and only after obtaining the approval in writing, the same should proceed with the manufacture of the items in question.



4 DESIGN

The following design requirement covers the general requirements of CCTV Network System and its accessories etc., but for the exact requirements and applications, the relevant, project specifications and design basis shall be referred and complied.

4.1 GENERAL

The system shall include, but not limited to, the following equipment's:

- a. A Central Control Rack providing the interface between the control and monitoring facilities and field installed camera equipment.
- b. Field installed colour cameras, equipped with auto focus, and zoom lens. A number of cameras shall be mounted on motorized pan and tilt units which enables orientation of both Azimuth and Elevation. Also, necessary Mast and Support should be provided.
- c. Control facilities and video display monitors providing a display of camera images manually selected from the control keyboard or sequentially selected pictures arranged in a pre-determined sequence.
- d. The system shall have telemetry bi.

4.1.1 EQUIPMENT LOCATION

- a. A Central Equipment Rack - 19" type equipment racks, located in the Telecoms Rack Room (TRR).
- b. Operator Monitoring and Control:
 - i. The Main Control Room (MCR) shall include a 29" colour video display monitor with flat square screen LCD and associated control keyboard units.
 - ii. The Emergency Control Room (ECR) shall include 3 x 29" colour video display monitors with flat square LCD screen and associated control and keyboard Units
 - iii. Each IES shall contain an optical fibre patch panel for CCTV system
- c. External located coloured cameras shall provide coverage of:
 - i. External Process Plant
 - ii. The required number of cameras, monitors, etc. shall studied and proposed for COMPANY approval during the EPC phase to ensure adequate plant coverage.
 - iii. Cameras locations inside the plant to be defined by the FEED Engineer

4.1.2 TRANSMISSION EQUIPMENT

Transmission equipment shall be of modular construction and shall utilize optical fiber cables as defined in the LTG-SPC-5501 LTG Standard Specification for OFC and Conduit. Multimode optical fibre cables shall be provided between the Central Equipment Rack and the field located optical fiber patch panels located in each IES. These optical

Fiber cables shall carry both video and telemetry data control information. Each camera shall be connected via multimode fiber cable that has minimum capacity of four fibers.

4.1.3 CCTV CAMERA MULTIMODE O.F.: TRANSMITTER UNIT

The multimode optical fiber cable from each camera will be terminated via a SC connector to an optical fiber transmitter unit. The bi-phase telemetry data control information shall terminate on a RS-485 data module. One transmitter and data

module is required for each camera unit. The O.F. transmitter and the bi-phase telemetry data unit shall be contained within the camera housing. The optical fiber transmitter shall modulate the analogue video signal and convert it to light, suitable for optical fibre cable transmission. The video signal will then be routed via the optical fibre cable and patch panels to the video matrix within the CCTV Central equipment rack. The telemetry bi-phase data control information will be used to control the pan and tilt unit, auto iris, zooming, focus and other camera parameters.

4.2 CENTRAL RACK EQUIPMENT

The Central Rack Equipment shall house the main electrical, electronic, optical fiber and processing equipment necessary for system distribution and control.

The rack shall be provided with powered fans to enable adequate air flow. The system should be capable to be interfaced with other desired system

4.2.1 CENTRAL RACK UNIT

The CCTV Central Rack Unit with its associated switching and fibre optic equipment, complete with rack mounted 9" monitor shall be provided. This shall enable the CCTV to operate as an independent stand-alone CCTV sub-system should the need arise, i.e. the event of a fault or a break in the optical fibre cable, and or a fault within the main CCTV control and switching system. Hence operation and control of the cameras can still be available directly from a control keyboard / display unit or portable PC.

4.2.2 SWITCHING MATRIX UNIT

Video switching shall be carried out by a microprocessor-based cross point matrix switching units capable of automatically routing video signals from a requested camera position to a specified monitor.

The switching unit shall present a number of output ports for interfacing to monitors and accommodate other integrated VCRs.

An interface port shall be reserved for maintenance/administration purposes. A Laptop PC terminal shall be provided; it shall be loaded with the latest version of diagnostic software according to standard specs.

An interface port shall be reserved for a Real Time Clock GUI port required for the connectivity of central rack unit with LAN of control room is required, to enable authorized workstations to monitor the whole plant from their locations.

4.2.3 VIDEO QUAD PROCESSOR

Selectable quad/full screen coloured processors units shall be provided. The system shall be capable of presenting the selected video images to video monitors and recorders in quad, split or full screen viewing modes, and shall be independent of both record and real time viewing functions.

4.2.4 VIDEO CASSETTE RECORDERS

A number Video Cassette Recorders shall be required. The Vendor shall state within his tender documents the number of video recorders to be provided.

- a. The TV video to be recorded shall be pal colour 625.
- b. Only S-VHS high grade professional tapes shall be provided.
- c. The recorders shall be capable of being fed from and played back through multi plexes.
- d. The equipment shall be suitable for 19" rack mounting and shall be located within the central equipment rack.
- e. All video recorders shall have the facility to be switched on and off remotely.



- f. Time, date and title of cameras shall be recorded on all tapes.
- g. It shall be possible to replay both real time and lapse recordings through the same system, whether in quad, split or full screen mode.
- h. Recorders shall operate in the standard 3 hour mode for real time recording.
- i. A facility for external time synchronization shall be provided.

4.3 OPERATOR CONTROL KEYBOARD UNITS

Control functions of the CCTV cameras from the MCR and ECR keyboards i.e. camera selection, sequence programming, sequence hold commands shall be provided. Alpha numeric/display keyboards shall be provided, suitable for desk mounting. A busy indicator device shall be provided on each monitor to indicate, if a chosen camera is already under control by another operator.

One keyboard / display unit shall be installed in each of the DCS workstations in the MCR, and one keyboard / display unit shall be installed in the ECR and shall have the following functions:

- a. Power on/off control of each camera
- b. Focus and zoom control of each camera
- c. Pan and tilt control of each camera
- d. Sequence control, to program required automatic camera selection
- e. Iris control, to open / close camera iris
- f. Wash/wipe Control - enable the wash / wipe facility to clean camera glass face
- g. Camera selection enabling up to four camera outputs to be displayed on the monitors simultaneously
- h. Access security programmed codes shall be provided, for use of keyboards by authorized operators
- i. Control keyboard/displays shall have a programmable priority hierarchy access level for priority selection of each camera. Company will establish and advise the Vendor at a later date, the priority access level for individual users

4.4 MONITORS

At least 21" diagonal size CCTV monitors shall be supplied. They shall be of the indoor type with a minimum protection of IP-20, c/w with overhead brackets suitable for ceiling mounting and the model has to be the latest at time and to be reviewed and approved by the Company.

CCTV monitor control adjustments shall be via an infra-red or wireless remote control unit, and shall include the following control functions as a minimum:

- a. Brightness control
- b. Contrast control
- c. Colour control
- d. On / Off and standby control

4.4.1 PICTURE QUALITY

- a. To be compatible with pal 625 colour standard or better
- b. The monitors shall be responsive to widely varying lighting conditions from 5 lux reflected light to 100,000 lux as may be associated with bright sunlight and welding arc lights.



- c. Under the worst case lighting conditions specified above the overall signal-to-noise ratio shall be 45 dB
- d. Horizontal resolution as per project requirement
- e. Accept a supply voltage of 240 Volts, 50 Hz

4.4.2 OTHER FACILITIES

- a. Time, date and title 10 information of cameras shall be displayed on all monitors
- b. The monitors shall be capable of supporting 2 or 4 way split screen displays

4.5 CAMERAS

Colour Charge Coupled Device (CCD) cameras shall be provided and installed at strategic locations within the plant / process area to enable efficient monitoring of the plant equipment for safe operation. The main features of the cameras shall meet the following:

- a. The standard shall be pal 625 line colour with 2:1 interlace
- b. The cameras shall generate standard pal 625 line colour video and provide a 1V Peak-to-Peak video signal at the video output
- c. Cameras shall be designed to provide high picture quality under varying light conditions and fitted with automatic light correction facilities
- d. Fitted with automatic iris control, zoom and gain control
- e. Able to operate with a fixed focus lens and motorized zoom lens
- f. All cameras shall be powered from a 240 Volts 50Hz local power source

4.5.1 CAMERA HOUSING

Depending on the location, the cameras shall be housed in an explosion-proof and/or weather-proof case. The explosion proof requirements shall be in accordance with the area classification in which the equipment will be installed.

The camera housing shall be:

- a. Suitable for housing all equipment necessary for camera operation
- b. Cameras shall be housed in a sealed unit, with a heavy duty pan and tilt Unit
- c. Equipped with sun hood, and window wipe facilities
- d. Able to operate with a motorized zoom lens

4.5.2 CAMERA PAN / TILT UNIT

The pan and tilt unit shall meet the following requirements:

Pan rotation	0° to 350°
Tilt rotation	-90° to +90°
Pan speed	4.5° to 6°/Sec
Tilt speed	4.5°/Sec

The pan/tilt unit shall be provided with a motor overload protection facility.

Contractor shall consider that suitable supporting structures shall be required to obtain proper positions for each camera and ensure that the cameras are accessible by a ladder built in the support structure.



4.6 EQUIPMENT ALARMS

The Vendor shall state the alarm indications supplied as standard with the equipment.

These alarms shall include but not limited to the following:

- a. Equipment failure
- b. Mains fuse failure
- c. Common group or individual equipment failure. This shall take the form of an earth-free and volt-free contact rated nominally for 5 amps at 24V DC. This alarm condition shall be interfaced to the DCS for annunciation
- d. Provision in the DCS to be considered by the Contractor and DCS Vendor for CCTV alarm

4.7 CABLES

All required cables including the multimode optical fibre cables between field cameras and optical fiber patch panels shall be provided by Contractor.

4.8 ELECTRICAL PROTECTION

All field mounted electrical equipment shall be of the explosion-proof type EEx(d) or EEx(i) certified to CENELEC / IEC or equivalent for hazardous area classified zone 1,

IIC, T3 or Zone 2, IIC, T3 as required.

4.9 POWER SUPPLIES AND EARTHING

The control system, monitors and all critical components of the CCTV system shall be powered by a 240 Volt, 50 Hertz Uninterruptible Power Supply (UPS). Power to all cameras and associated equipment will be supplied from the plant's 240 volt 50 Hertz vital power distribution panels.

All system components shall be capable of operating at a minimum of $\pm 10\%$ available voltage, $\pm 5\%$ frequency, and interruption time of 10m Seconds and 5% harmonic content.

Vendor shall state the total load requirements for each system, at an agreed date, to permit sizing of the UPS system. This shall include the power requirements for each cabinet and total power for each system. Vendor will include inrush currents and crest factors in supplied information.

4.10 MEAN TIME TO REPAIR (MTTR)

The design and construction of the CCTV system shall ensure high reliability and availability.

The CCTV system shall employ modular constructional techniques in its design, allowing a first line maintenance philosophy of module replacement to be implemented.

The average module replacement time for the system will be less than 1 hour as long as the correct spares holdings are maintained as recommended by the Supplier.

4.11 SYSTEM SOFTWARE

All software shall be supplied fully installed on the equipment and a master copy provided on suitable media, CD-ROM preferred. All manuals shall be included and

Vendor shall ensure that all applicable software licenses are transferred to Company.



5▣ FABRICATION AND PAINTING

Vendor shall obtain approval in writing from the Purchaser before start of fabrication and manufacturing of the system. Vendor shall submit the required specification, drawings & documents for approval. Also Vendor shall refer the relevant codes and standards for manufacturing mentioned herein.

Painting shall be in accordance with Company Painting Specifications.

6▣ INSPECTION AND TESTING

Vendor shall perform all inspection and testing as per job Specification requirements, and as per relevant codes, prior to shipment. The inspection and testing for CCTV

Network System shall be carried out as per approved Inspection and Test Plan. Vendor shall submit the Inspection and Testing Plan for Proprietary items / Special items for approval. Vendor shall submit the test certificates to the Company for the tests conducted during the manufacturing process like Continuity test, enclosure test, hazardous area certification test, and any other before Factory Acceptance Testing (FAT).

6.1▣ FACTORY ACCEPTANCE TESTING (FAT)

Prior to FAT, Vendor shall submit to the Company a detailed FAT procedure, for review and approval, listing all the systems and subsystems for CCTV Network system, complete with the project approved tags, and highlighting the inspection and testing requirements of all such devices. FAT shall be carried out as per approved Inspection and Test Plan. FAT shall be carried out prior to shipment of the system.

FAT procedures shall be submitted at least 4 weeks prior to FAT testing taking place.

FAT shall be carried out at the manufacturing facilities. The tests shall be witnessed by the Company or their approved representative. FAT procedure will be signed off by the Vendor and Company or their approved representative at the successful completion and conclusion of testing.

The FAT shall be consisting of the following as a minimum:

- a. Visual inspection
- b. Earthing isolation and continuity measurements at sample locations
- c. Power up, power distribution verification plus voltage and current measurements
- d. Diagnostics
- e. Power supply test (momentary power loss, voltage fluctuations, etc.)
- f. RFI and EMI testing
- g. Functional test(if possible)
- h. Any other tests defined in FAT Procedures

A certificate to detail the results and records obtained during the FAT shall be made available for ratification by the Vendor on the date of test.

6.2▣ SITE ACCEPTANCE TESTING (SAT)

A SAT shall be carried out on completion of the installation of the equipment at site which shall be witnessed by the Company / Owner's representative. SAT shall be performed on the complete CCTV Network System and Subsystem as per the approved test procedure. A comprehensive test procedure in compliance with the Company specification shall be developed and issued to Company / Owner for review and approval.



The Site Acceptance Test (SAT), in general, shall demonstrate that the entire CCTV Network System functions correctly and properly in accordance with the specified requirements.

7□ MARKING, PACKING AND SHIPMENT

Following FAT completion, Vendor shall ensure that all equipment and associated materials and accessories for the CCTV Network System are designed properly, marked and packed, and secured for transit to site without damage.

Vendor shall provide and submit his standard 'Marking, Packing and Shipping Procedures' for review by Company / Owner.

Vendor shall specify any conditions, normal or special, to be verified in intermediate storage and during transport.

Equipment shall be suitably packed including any dismantling, transit fastening and bracing necessary to prevent distortion or damage during transit.

Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the jobsite. Preparation for shipment and packing will be subject to inspection and rejection by Company's / Contractor's inspectors. All costs occasioned by such rejection shall be to account of the Vendor.

8□ SPARES AND ACCESSORIES

The following spare philosophy shall be followed in case it is not covered in Job Specification.

The Vendor shall include recommended Spare Parts List for start-up, precommissioning and two years operation as per the following;

- a. Itemized recommended spare parts list for start-up and pre-commissioning.
- b. Itemized recommended spare parts list for two years operation.

Vendor shall recommend accessories and special tools required for operation and maintenance of CCTV Network System, for Company review.

All the spare parts furnished by Vendor shall be wrapped and packaged to preserve an original as-new condition under normal conditions of storage. The same parts shall be properly tagged with stainless steel tags and coded so that later identification as to their intended equipment usage shall be clear.

All items supplied shall be packaged separately and clearly marked as "Spare Parts" and shipped with the equipment.

9□ DOCUMENTATION

The following documentation shall be fulfilled by the Vendor, if it is not covered in Job Specification.

9.1□ DOCUMENTATION REQUIRED WITH TECHNICAL BID

During bidding stage Vendor shall submit in his offer the following documents as a minimum:

- a. CCTV system FAT Specification
- b. CCTV system hardware configuration
- c. Bill of Materials including Vendor list, details for third party items



- d. Catalogues and Manuals
- e. Quality Assurance Plan
- f. Any other documents (Job specific)

9.2 □ DOCUMENTATION REQUIRED FOR APPROVAL

Upon placement of Purchase Order, Vendor shall submit as a minimum the following drawings, documents and specifications for the Company's approval:

- a. CCTV System hardware configuration and termination details
- b. System software design specification
- c. Procedures for FAT & SAT
- d. Recommended spare parts list with part numbers
- e. Connection drawings and wiring details
- f. Installation, operation, maintenance and fault finding manuals
- g. Functional design specification (FDS) for CCTV
- h. Quality Assurance Plan
- i. Any other documents (Job specific)

9.3 □ GUARANTEE / WARRANTY

Vendor shall guarantee that the complete scope of supply shall be safely and reliably meet all of the requirements of this Company specification.

Generally Vendor shall provide warranty support for a period of 12 months from the date of supply or 18 months from the date of manufacturing. Warranty shall apply to defective material workmanship and facility design. Warranty work shall be done at Owner's local facilities. The cost of correction / replacement of any warranty items shall be borne by the Vendor.

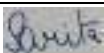
The Job specifications / Data sheets shall be referred for any specific warranty / guarantee.



VCS Quality Services Pvt. Ltd.

STANDARD SPECIFICATION FOR INSTRUMENTATION CABLES

VCS-SS-IN-5801_02

					
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**STANDARD SPECIFICATION
FOR
INSTRUMENTATION CABLES**

**DOCNO: VCS-SS-IN-5801
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02	11.05.2022					VCS QMS Integration
		Sarita Verma	Kedar Nath Chakraborty	Hashim khan	GV Walimbe	

□



ABBREVIATION

ASTM	American Society of Testing and Materials
AWG	American Wire Gauge
BS	British Standards
DC	Direct Current
DIN	Deutsches Institute for numbering
EPR	Ethylene Propylene Rubber
F&G	Fire and Gas
IEC	International Electro-technical Commission
IS	Indian Standards
PVC	Polyvinyl Chloride



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1 □ SCOPE

This Standard Specification, together with the Data Sheets attached herewith, establishes the minimum technical and functional requirements for design, engineering, materials, fabrication, painting, inspection and testing, documentation, marking, packing and shipping of Cables along with its spares and accessories.

2 □ DEFINITIONS

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

Owner/ Purchaser/ Company	Owner of the particular Project (Project Specific).
Consultant	The party which comes out all or part of the engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
Bidder/ Manufacturer / Supplier / Vendor	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.
Works/ Shop	The place where the ITEM / UNIT is fabricated and tested and transported to Purchaser.
Datasheet	Technical data provided by the Purchaser / Owner / Company.
Standard Specification	Specifications Developed as Standard by the Company.
Job Specification	Specifications Developed pertaining to particular project / Job in regard.
Material Requisition	Requisition as raised to Supplier for Quotation of the item
Purchase Requisition	Requisition as raised to Supplier for Procurement of the item
Purchase Order	Legal Order supplied to Supplier for procurement of the Engineered Item
Site	The work place where the equipment is installed and commissioned.

3. REFERENCE DOCUMENTS

3.1 Codes & Standards

The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the Purchaser's enquiry.

IEC-332-3 Part 3	Tests on bunched wires and cables
IEC 584-3 Part	Extension and compensating cables – Tolerances identification system
IEC-60332 Part 3	Tests on electric and optical fibre cables under fire conditions - Test for vertical flame spread of vertically mounted bunched wires or cables
IEC-60331	Fire-Resisting Characteristics of Electric Cables
ASTM D 2863	Test method for measuring the minimum oxygen concentration to support candle like combustion of plastics (Oxygen index)
BS-5308 Part 1	Specification for Polyethylene insulated cables
BS-5308 Part 2	Specification for PVC insulated cables
DIN-50049	Document on Material Testing
IS-1554 Part 1	PVC insulated (heavy duty) electric cables-working voltage up to and including 110 V
IS-2633	Method for testing uniformity of coating on zinc coated articles
IS-3975	Mild steel wires, formed wires and tapes for armouring cables
IS-5831	PVC insulation and sheath of electric cables
IS-8784	Thermocouple compensating cables

3.2 Order of Precedence

In the event of conflict between Specifications, Data sheets, related standards, codes etc., the order of precedence shall be as follows:

- a. Data sheets
- b. Job Specifications
- c. Standard Specifications
- d. Codes and Standards

Vendor shall refer the matter to the Purchaser for clarification and only after obtaining the approval in writing, the same should proceed with the manufacture of the items in question.



4 MATERIALS

Materials selected shall be in accordance with the Data Sheets and Company's Standard Specifications. Type and material of extension Cable shall be as per IS-5831 and IEC 584-3 where applicable.

Cable cores shall be of annealed electrolytic tinned copper conductor with PVC jackets conform to IS-5831. Insulation shall be Mica-glass / EPR or silicon rubber for F&G. signal/control Cables. Armouring shall be of galvanized steel wire / strip armour conforming to IS-1554. Screening / shielding shall be of black Aluminium backed Mylar / Polyester foil.

5 DESIGN

The following design requirement covers the general requirements of Instrument Cables and accessories etc., but for the exact requirements and applications, the relevant, specific job Specifications and design basis shall be referred and complied.

5.1 Signal and Control Cables

5.1.1 Type – I (Single Pair / Triad Shielded Cable)

Each core shall be 1.5 mm², made of 7 stranded annealed electrolytic copper conductor. Each strand shall be 0.53 mm dia.

Primary insulation shall be 85°C polyvinyl chloride (PVC) as per IS-5831 Type-C. Thickness shall be 0.5 mm minimum.

A pair or triad shall have twisted cores and number of twists shall be not less than 10 per meter. Colour of core insulation shall be black-blue in pair and black-blue-brown in a triad.

Individual pair and triad shall be shielded. Shield shall be Aluminium backed by Mylar / polyester tape with the metallic side down helically applied with either side 25 % overlap or 100% coverage. Minimum shield thickness shall be 0.05 mm. Drain wire shall be 0.5 mm² multistrand bare tinned annealed copper conductor. The drain wire shall be in continuous contact with Aluminium side of the shield.

Inner and outer jacket shall be made of extruded flame retardant 90°C 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.

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.

Armour over inner jacket shall be of galvanized steel wire / flat as per IS-1554 Part-1.

Tolerance in overall diameter of cable shall be within ± 2 mm over offered value.

5.1.2 Type – II (Multipair / Multitriad Cable with Individual Pair Shield and Overall Shield)

a. 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.

b. Overall shield shall be of Aluminium backed up by Mylar / polyester tape helically applied with the metallic side down with either side 25% overlap or 100% coverage. Minimum shield thickness shall be 0.075 mm. Drain wire shall be similar to individual pair drain wire and shall be of the overall shield.

c. Overall twist of all pair / triads shall be as per Vendor's standard.

- d. A pair of communication wire shall be provided for multipair / multitriad cables. Each wire shall be 0.5 mm² of plain annealed single or multistrand copper conductor with 0.4 mm thick 85°C PVC insulation. Insulation shall be green and red colour coded.
 - e. Pair identification shall be with numbers at interval of not more than 250 mm as per vendor's standards.
- 5.1.3 Type – III (Multipair / Multitriad Cable with Only Overall Shield)
- a. These Cables shall be same as type-II cables except that the individual pair / triad shall not have shielding.
- 5.1.4 Type - IV (Multipair / Multitriad Cable with Individual Pair Shield and Overall Shield)
- a. The Cable shall be same as Type II except conductor size shall be 1.5 mm² made of 7 stranded annealed electrolytic copper conductor. Each strand shall be of 0.53 mm dia.
- 5.1.5 Type – V (Multipair / Multitriad Cable with Overall Shield only)
- a. The Cable shall be same as type IV except that the individual pair / triad shall not have the shielding.
- 5.2 Fire and Gas Cables shall be fire resistant and shall meet all the Specifications mentioned above and:
- a. Insulation shall be Mica-Glass / EPR or silicon rubber.
 - b. The inner sheath shall be applied with a low smoke fire resisting compound.
 - c. Suitable filler material (if necessary) shall be filled.
 - d. Outer sheath shall be made up of low smoke, heat and oil resistant and flame retardant material.
 - e. Circuit integrity of the Cable shall be maintained for a minimum period of 3 hours as per IEC-60331.
 - f. The outer jacket colour shall be orange.
- 5.3 □ Thermocouple Extension Cables**
- Type and material of extension cable shall be as per IS-5831 and IEC-584-3 where applicable.
- 5.3.1 Type – I (Single Pair Shielded Cable)
- a. Each core shall be made of 16 AWG solid conductors.
 - b. Primary insulation shall be 85°C polyvinyl chloride (PVC) as per IS 5831 Type C. Thickness shall be 0.5 mm minimum. Colour coding shall be as per IS-8784 Table-5.
 - c. The cores of the pair shall be twisted and number of twists shall be not less than 10 per meter. The pair shall be shielded. Shield shall be Aluminium backed by Mylar / polyester tape bonded together 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 0.5 mm² multistrand bare tinned annealed copper conductor. The drain wire shall be continuous contact with Aluminium side of the shield.
 - d. Inner and outer jacket shall be made of extruded flame retardant 90°C 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. Inner jacket and outer jacket colour shall be as per IS-8784. A rip cord shall be provided for inner jacket.

- e. Armour over inner jacket shall be of galvanized steel wire/flat as per IS-1554 Part-I.
- f. Tolerance in overall diameter of cable shall be within ± 2 mm over offered value.

5.3.2 Type – II (Multipair Cable with Individual Shield and Overall Shield)

- a. The Cable shall be same as single pair shielded cable except for following;
 - i. Each core shall be 20 AWG solid conductor.
 - ii. In addition to individual pair shield overall shield shall be provided. Overall shield shall be of Aluminium backed up by Mylar / polyester tape helically applied with metallic side down either side 25% overlap or 100% coverage. Minimum shield thickness shall be 0.075 mm. Drain wire shall be similar to individual pair drain wire and shall be in continuous contact with the aluminium side of the overall shield.
 - iii. Overall twist of all pair shall be as per Vendor's standard.
 - iv. A pair of communication wire shall be provided for multipair cables. Each wire shall be 0.5 mm² of plain annealed single or multistrand copper conductor with 0.4 mm thick 85°C PVC insulation. Insulation shall be green and red colour coded.
 - v. Pair identification shall be with numbers at interval of not more than 250 mm as per Vendor's standard.

5.3.3 Type – III (Multipair Cable with Individual Pair Shield and Overall Shield)

- a. The Cable shall be same as type II except conductor size shall be 16 AWG.

5.4 ☐ Electrical Characteristics

5.4.1 Cable parameters L/R ratio, capacitance shall conform to intrinsic safety requirements for IS cables. Limitations for cable parameter shall be as follows:

- a. 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 mm² conductors and 39.7 Ω /km at 20°C for cables with 0.5 mm² conductors.
- b. Mutual capacitance between any core and screen shall not exceed 250 pF/m at 1 KHz. Capacitance between any cores or screen shall not exceed 400 pF/m at 1 KHz.
- c. L/R ratio of adjacent core shall not exceed 40 μ H/ Ω for cables with 1.5 mm² conductors and 25 μ H/ Ω for cables with 0.5 mm² conductors.
- d. Electrostatic noise rejection ratio shall be minimum 76 dBA.
- e. Drain wire resistance including screen shall not exceed 30 Ω /km.
- f. Core inductance shall not exceed 4 mH/Km.
- g. Values shall be derived under the fault condition in the cable which produces the worst case parameters for intrinsic safe cables.

All Cables shall have insulation voltage rating of 600 / 1100 V.



5.5□ Name Plate

All Instrument Cable shall be marked as per Manufacturer's standard and shall have a permanently attached stainless steel plate with the following, as a minimum detail:

- a. Tag number as per Data Sheet;
- b. Manufacturer's name;
- c. Details of the Cable;
- d. Length of the Cable in meters contained in the drum;
- e. Gross weight;
- f. Direction of rotation of drum for unwinding by means of an arrow;
- g. Purchase Order number.

6□ FABRICATION AND PAINTING

Vendor shall obtain approval in writing from the Purchaser before start of fabrication of Cables. Vendor shall submit the required Specification, drawings & documents for approval. Also Vendor shall refer the relevant codes and standards for manufacturing herein.

7□ INSPECTION AND TESTING

Vendor shall perform all inspection and testing as per Job Specification requirements, and as per relevant codes, prior to shipment. The inspection and testing for Instrument Cables shall be carried out as per approved Inspection and Test Plan. Vendor shall submit the Inspection and Testing for Approval. Vendor shall submit the test certificates to the Company for the tests conducted during the manufacturing process like hydro test, material test, hazardous area certification test, and any other before Factory Acceptance Testing (FAT).

7.1□ Factory Acceptance Testing (FAT)

Prior to FAT, Vendor shall submit to the Company a detailed FAT procedure, for review and approval, listing all the Instrument Cables, complete with the project approved tags, and highlighting the inspection and testing requirements of all such devices. FAT shall be carried out as per approved Inspection and Test Plan. FAT shall be carried out prior to shipment of the Instrument Cables.

FAT procedures shall be submitted at least 4 weeks prior to FAT testing taking place. FAT shall be carried out at the manufacturing facilities. The tests shall be witnessed by the Company or their approved representative. FAT procedure will be signed off by the Vendor and Company or their approved representative at the successful completion and conclusion of testing.

The FAT shall be consisting of the following as a minimum:

7.1.1 Standard Type Test certificate shall be furnished for Cables similar to those being offered,

- a. Cable shall be flame retardant to IEC-60332 part-III category A.
- b. Cables required for F&G applications shall be as per IEC-60331.



- 7.1.2 Standard Routing Test (to be carried out by the manufacturer during various stages of manufacturing, test certificates shall be furnished)
- a. Insulation resistance, voltage test and spark test as per 8S-5308 part-II and sheath test as per IS-5831;
 - b. Armor test as per IS-3975;
 - c. Cable capacitance, L/R ratio and inductance test;
 - d. Conductor resistance test in Ohms/km;
 - e. Thermo emf tests for thermocouple extension cables.
- 7.1.3 Standard Acceptance Test shall be carried out in the presence of Purchaser or his authorized representatives,
- a. Continuity test;
 - b. Voltage test as per 8S-5308 part-II;
 - c. L/R ratio and capacitance values test;
 - d. Oxygen index test as per ASTM D 2863 latest edition;
 - e. Conductor resistance and drain wire resistance;
 - f. Dimensional check for overall diameter and under armor outer armor diameter;
 - g. Fire resistant test / certificate review (when specified);
 - h. Tests for uniformity of galvanization of armor as per IS-2633;
 - i. Check for drum length and overall length tolerances.

7.2 □ Site Acceptance Testing (SAT)

A SAT shall be carried out on completion of the installation of the Cables at site which shall be witnessed by the company / owner's representative. SAT shall be performed as per the approved test procedure. A comprehensive test procedure in compliance with the company specification shall be developed and issued to company / owner for review and approval.

The Site Acceptance Test (SAT), in general, shall demonstrate that the Cables functions correctly and properly in accordance with the specified requirements. SAT mainly consists of the following inspections:

- a. Continuity test
- b. Conductor resistance and drain wire resistance
- c. Drum length and overall length tolerances
- d. Any other test, if required.

8 □ MARKING, PACKING AND SHIPMENT

Following FAT completion, Vendor ensure that all Cables, associated materials and accessories are designed properly, marked and packed, and secured for transit to site without damage.

Vendor shall provide and submit his standard "Marking, Packing and Shipping Procedures" for review by Company / Owner.

Vendor shall specify any conditions, normal or special, to be verified in intermediate storage and during transport.



Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the jobsite.

Cables shall be dispatched in wooden drums, securely battened with take-off end fully protected against damage

The ends of the Cable shall be sealed with suitable PVC / Rubber caps to prevent ingress of moisture.

Preparation for shipment and packing will be subject to inspection and rejection by Company's inspectors. All costs occasioned by such rejection shall be to account of the Vendor.

9 □ SPARES AND ACCESSORIES

The following spare philosophy shall be followed in case it is not covered in Job Specification.

The Vendor shall include recommended Spare Parts List for start-up, pre-commissioning and two years operation as per the following;

- a. Itemized recommended spare parts list for start-up and pre-commissioning.
- b. Itemized recommended spare parts list for two years operation.

Vendor shall recommend accessories and special tools required for operation and maintenance of Instrument Cables for Company review.

All the spare parts furnished by Vendor shall be wrapped and packaged to preserve an original as-new condition under normal conditions of storage. The same parts shall be properly tagged with stainless steel tags and coded so that later identification as to their intended equipment usage shall be clear.

All items supplied shall be packaged separately and clearly marked as "Spare Parts" and shipped with the equipment.

10 □ DOCUMENTATION

The following documentation shall be fulfilled by the Vendor, if it is not covered in Job Specification.

10.1 □ Documentation Required with Technical Bid

During bidding stage Vendor shall submit in his offer the following documents as a minimum:

- a. Standard Specification, Data Sheets;
- b. Bill of Materials including Vendor list, details of third party items;
- c. Catalogues and Manuals;
- d. Quality Assurance Plan;
- e. Any other documents.

10.2 □ Documentation Required for Approval

Upon placement of Purchase Order, Vendor shall submit as a minimum the following drawings, documents and specifications for the Company's approval:

- a. Specifications, Data Sheets;
- b. Bill of materials including Vendor list, details for third party items;



- c. Catalogues, Manuals and relevant drawings and documents;
- d. Dimensional drawings;
- e. Material test certificates;
- f. Procedures for FAT;
- g. Quality Assurance Plan;
- h. List for spare parts for start-up and for 2 years of operation.

10.3 □ Guarantee & Warranty

Vendor shall guarantee that the complete scope of supply shall be safely and reliably meet all of the requirements of this Company Specification.

Vendor shall provide warranty support for a period of 12 months from the date of supply or 18 months from the date of manufacturing. Warranty shall apply to defective material workmanship and facility design .The cost of correction / replacement of any warranty items shall be borne by the Vendor, as per the purchase conditions of the Material / Purchase Requisition.

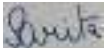
The Job specifications / Data sheets shall be referred for any specific warranty / guarantee.



VCS Quality Services Pvt. Ltd.

STANDARD SPECIFICATION FOR JUNCTION BOXES AND CABLE GLANDS

VCS-SS-IN-5802_02

					
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**STANDARD SPECIFICATION
FOR
JUNCTION BOXES AND CABLE GLANDS**

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01	18.01.2020					Format change and document numbering is revised.
		Rakesh Bhardwaj	Vinod Babu	Kedarnath Chakraborty	Anupam Das	
02	11.05.2022					VCS QMS Integration
		Sarita Verma	Kedar Nath Chakraborty	Hashim khan	GV Walimbe	



**STANDARD SPECIFICATION
FOR
JUNCTION BOXES AND CABLE GLANDS**

**DOCNO: VCS-SS-IN-5802
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ABBREVIATION

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
FAT	Factory Acceptance Test
IEC	International Electro-technical Commission
IP	Ingress Protection
IS	Indian Standards
ISO	International Organization for Standardization
NACE	National Association of Corrosion Engineers
SAT	Site Acceptance Test



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1 □ SCOPE

This Standard Specification, together with the Data Sheets attached herewith, establishes the minimum technical and functional requirements for design, engineering, materials, fabrication, painting, inspection and testing, documentation, marking, packing and shipping of Junction Boxes and Cable Glands along with its accessories which include the following types:

- a. Electrical junction boxes
- b. Pneumatic junction boxes
- c. Cable glands.

2 □ DEFINITIONS

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

Owner/ Purchaser/ Company	Owner of the particular Project (Project Specific).
Consultant	The party which comes out all or part of the engineering, procurement, construction, pre-commissioning and assistance for commissioning, monitors and controls the overall project management.
Bidder/ Manufacturer / Supplier / Vendor	The party(s) which manufactures and / or supplies material, equipment, technical documents / drawings and services to perform the duties specified by Contractor.
Works/ Shop	The place where the ITEM / UNIT is fabricated and tested and transported to Purchaser.
Datasheet	Technical data provided by the Purchaser / Owner / Company.
Standard Specification	Specifications Developed as Standard by the Company.
Job Specification	Specifications Developed pertaining to particular project / Job in regard.
Material Requisition	Requisition as raised to Supplier for Quotation of the item
Purchase Requisition	Requisition as raised to Supplier for Procurement of the item
Purchase Order	Legal Order supplied to Supplier for procurement of the Engineered Item
Site	The work place where the equipment is installed and commissioned.



3 ☐ **REFERENCE DOCUMENTS**

3.1 **Codes & Standards**

The related standards referred to herein and mentioned below shall be of the latest editions prior to the date of the Purchaser's enquiry.

ASME B1.20.1	Pipe Threads
DIN 50049	Document on Material Testing
IS 5	Colours for ready mixed paints and enamels.
IS 2147	Degree of Protection provided for Enclosures
IS 2148	Flame proof Enclosure of Electrical Apparatus.
IEC 529	Degree of Protection by providing Enclosures
IEC 79	Electrical Apparatus for Explosive Gas Atmosphere
EN 837	Pressure Gauges Part-t: Bourdon Type Pressure Gauges, Dimensions, Metrology, Requirements and Testing

3.2 **Order of Precedence**

In the event of conflict between Specifications, Data sheets, related standards, codes etc., the order of precedence shall be as follows:

- a. Data sheets
- b. Job Specifications
- c. Standard Specifications
- d. Codes and Standards

Vendor shall refer the matter to the Purchaser for clarification and only after obtaining the approval in writing, the same should proceed with the manufacture of the items in question.

4 ☐ **MATERIALS**

Materials selected of the Junction Boxes and Cable Glands shall be in accordance with the Data Sheets and Standard Specifications. For corrosion service the material selected shall be in compliance with the requirements of NACE MR-0175 / ISO-15156 latest editions.

5 ☐ **DESIGN**

5.1 **Junction Boxes**

Junction Boxes shall be either of the following type as specified in Data Sheets.

- a. Weather proof Junction Boxes.
- b. Weather proof and flameproof Junction Boxes.



The enclosure shall be as per IS-2147 and IP-65 for weather proof Junction Boxes and for flameproof it shall be as per IS-2148 suitable for the area classification specified.

Number of entries and locations shall be as per Data Sheets and all the cable entries shall be bottom entries.

Junction Boxes shall be provided with telephone sockets and plugs for connection of hand powered telephone set.

5.1.1 Electrical Junction Boxes

Material shall be die-cast aluminium of minimum 5 mm thick (LM-6 alloy)

Flame proof Junction Boxes shall have detachable cover which is fixed to the box by means of cadmium plated triangular head /hexagonal head screws.

Weatherproof Junction Boxes shall have doors which shall be hinged type and these shall be fixed by plated countersunk screws.

Flameproof Junction Boxes shall have a warning engraved/integrally cast on the cover as given below;

"Isolate power supply elsewhere before opening."

Terminals shall be spring loaded, vibration proof, clip- on type, mounted on nickel plated steel rails complete with end cover and clamps for each row.

All terminals shall be suitable for accepting minimum 2.5 sq. mm copper conductor, in general. However, for power supply distribution boxes, terminal detail shall be as per job specification/data sheets.

The Junction Box shall be sized for termination of all cores and screens including spares without the need for more than 1 core per terminal. In addition a minimum of 10 % spare terminals shall be provided, unless specified otherwise in Data Sheet.

The Junction Boxes shall have sufficient space to ensure ease of termination. Sizing shall be done with due consideration for accessibility and maintenance in accordance with the following guidelines;

- a. 50 to 60 mm between terminals and sides of box parallel to terminal strip for upto 50 terminals and additional 25 mm for each additional 25 terminals.
- b. 100 to 120 mm between terminals for up to 50 terminals and additional 25 mm for each additional 25 terminals.
- c. Bottom/top of terminal shall not be less than 100mm from bottom/top of the Junction Box.

Terminals shall be marked as per various types indicated in Data Sheets.

Shall be provided with external earthing lugs.

5.1.2 Pneumatic Junction Boxes

Pneumatic Junction Boxes shall be made of 3 mm thick hot rolled steel. They shall have necessary neoprene gasket between door and body. Door shall be flush with the box and shall be hinged type and provided with wing nuts.

Single tube entries shall be suitable for 6 mm 0.0 copper tube with bulk head fittings. Multi tube bundle entry shall be suitable for the data furnished in Data Sheets.

5.2 Cable Glands, Plugs and Reducers / Adaptors

Cable Glands shall be supplied by Vendor whenever specified.

Cable Glands shall be double compression type for use with armoured cables.



The Cable Glands shall be of nickel plated brass material unless specified otherwise in Data Sheet.

The Cable Glands shall be weather proof. Whenever specified they shall also be flameproof and certificate from statutory body shall be furnished.

Cable Glands shall be supplied to suit the Cable dimensions indicated along with tolerance indicated in Data Sheets. Various components like rubber ring, metallic ring, metallic cone and the outer/inner nuts etc. shall be capable of adjusting to the above tolerances of Cable dimensions.

Each Cable Gland shall be supplied as a kit complete with locknut, shroud, and earth tag and sealing washer with proper identification of Gland size. Shrouds provided for additional protection to the Cable Gland termination. Earth tag shall be of nickel plated brass material.

Reducers/Adaptors shall be supplied as per details indicated in Data Sheets. They shall be nickel plated brass. These shall be weather proof in general. These shall also be flame proof wherever specified and certificate from statutory body for flame proofness shall be furnished.

Stopper plugs to seal spare cable entries in the Instrument Junction Boxes shall be provided wherever specified in Data Sheet. They shall be of nickel plated brass for metallic Junction Boxes and glass fibre reinforced polyamide for non-metallic junction boxes.

Plugs shall be certified flameproof when used with Flameproof Junction Boxes.

All Cable Glands and accessories such as reducers, adaptors, stopper plugs shall be stamped with type and size of Cable Glands, type and size of entry thread and the relevant approval details.

5.3 Name Plate

All Junction Boxes shall be marked as per Manufacturer's standard and shall have a permanently attached stainless steel plate with the following, as a minimum detail:

- a. Tag number as per Purchaser's Data Sheets.
- b. Type of enclosure such as terminal capacity, size, IP rating, serial no etc.
- c. Name of Manufacturer.
- d. Type of explosion protection (as applicable)
- e. Name of certifying agency and certificate number

The Tag no shall be generally white character on red background for fire & gas, white character on blue background for intrinsically safe circuits and black character on white background for all other applications.

6 FABRICATION AND PAINTING

Vendor shall obtain approval in writing from the Purchaser before start of fabrication of Junction Boxes and Cable Glands. Vendor shall submit the required Specification, drawings & documents for approval. Also Vendor shall refer the relevant codes and standards for manufacturing herein. Painting of Junction Box shall be in accordance with Standard Painting Specifications.

Surface shall be prepared for painting. It shall be smooth and devoid of rust and scale

Two coats of lead - free base primer and two final coats of lead free epoxy based paint shall be applied both for interior and exterior surfaces.



The colour shall be as specified in Data Sheets.

7 ☐ INSPECTION AND TESTING

Vendor shall perform all inspection and testing as per Job Specification requirements, and as per relevant codes, prior to shipment. The inspection and testing for Junction Box and Cable Glands shall be carried out as per approved Inspection and Test Plan. Vendor shall submit the Inspection and Testing for Approval. Vendor shall submit the test certificates to the Company for the tests conducted during the manufacturing process like Certificate from statutory body for suitability to install in specified area classification, dimensional test report, material test, calibration test and any other before Factory Acceptance Testing (FAT).

7.1 ☐ Factory Acceptance Testing (FAT)

Prior to FAT, Vendor shall submit to the Company a detailed FAT procedure, for review and approval, listing all the Junction Box and Cable Glands complete with the project approved tags, and highlighting the inspection and testing requirements of all such devices. FAT shall be carried out as per approved Inspection and Test Plan. FAT shall be carried out prior to shipment of the Junction Box and Cable Glands.

FAT procedures shall be submitted at least 4 weeks prior to FAT testing taking place. FAT shall be carried out at the manufacturing facilities. The tests shall be witnessed by the Company or their approved representative. FAT procedure will be signed off by the Vendor and Company or their approved representative at the successful completion and conclusion of testing.

The FAT shall be consisting of the following as a minimum:

- a. Visual inspection
- b. Calibration
- c. Functional test

A certificate to detail the results and records obtained during the FAT shall be made available for ratification by the Vendor on the date of test.

7.2 ☐ Site Acceptance Testing (SAT)

A SAT shall be carried out on completion of the installation of the equipment at site which shall be witnessed by the company / owner's representative. SAT shall be performed on the Junction Box and Cable Glands as per the approved test procedure. A comprehensive test procedure in compliance with the company specification shall be developed and issued to company / owner for review and approval.

The Site Acceptance Test (SAT), in general, shall demonstrate that the Junction Box and Cable Glands functions correctly and properly in accordance with the specified requirements.

8 ☐ MARKING, PACKING AND SHIPMENT

Following FAT completion, Vendor responsible for the Junction Box and Cable Glands shall ensure that all equipment and associated materials and accessories are designed properly, marked and packed, and secured for transit to site without damage.

Vendor shall provide and submit his standard "Marking, Packing and Shipping Procedures" for review by Company / Owner.

Vendor shall specify any conditions, normal or special, to be verified in intermediate storage and during transport.



Equipment shall be suitably packed including any dismantling, transit fastening and bracing necessary to prevent distortion or damage during transit.

Adequate protection shall be provided to prevent mechanical damage and atmospheric corrosion in transit and at the jobsite.

Each packing shall have its weight clearly marked on it and shall be identified with the contents, purchase order no and item number.

All entries shall be installed with plastic plugs to prevent unwanted material and insects entering the instrument junction boxes.

Preparation for shipment and packing will be subject to inspection and rejection by Company's inspectors. All costs occasioned by such rejection shall be to account of the Vendor.

9 □ SPARES AND ACCESSORIES

The following spare philosophy shall be followed in case it is not covered in Job Specification.

The Vendor shall include recommended Spare Parts List for start-up, pre-commissioning and two years operation as per the following;

- a. Itemized recommended spare parts list for start-up and pre-commissioning.
- b. Itemized recommended spare parts list for two years operation.

Vendor shall recommend accessories and special tools required for operation and maintenance of Junction Box and Cable Glands, for Company review.

All the spare parts furnished by Vendor shall be wrapped and packaged to preserve an original as-new condition under normal conditions of storage. The same parts shall be properly tagged with stainless steel tags and coded so that later identification as to their intended equipment usage shall be clear.

All items supplied shall be packaged separately and clearly marked as "Spare Parts" and shipped with the equipment.

10 □ DOCUMENTATION

The following documentation shall be fulfilled by the Vendor, if it is not covered in Job Specification.

10.1 Documentation Required with Technical Bid

During bidding stage Vendor shall submit in his offer the following documents as a minimum:

- a. Standard Specification, Data Sheets;
- b. Bill of Materials including Vendor list, details of third party items;
- c. Catalogues and Manuals;
- d. Quality Assurance Plan;

10.2 Documentation Required for Approval

Upon placement of Purchase Order, Vendor shall submit as a minimum the following drawings, documents and specifications for the Company's approval:

- a. Specifications, Data Sheets;



- b. Bill of materials including Vendor list, details for third party items;
- c. Catalogues, Manuals and relevant drawings and documents;
- d. Dimensional drawings;
- e. Calibration certificates;
- f. Material test certificates;
- g. Procedures for FAT;
- h. Quality Assurance Plan;

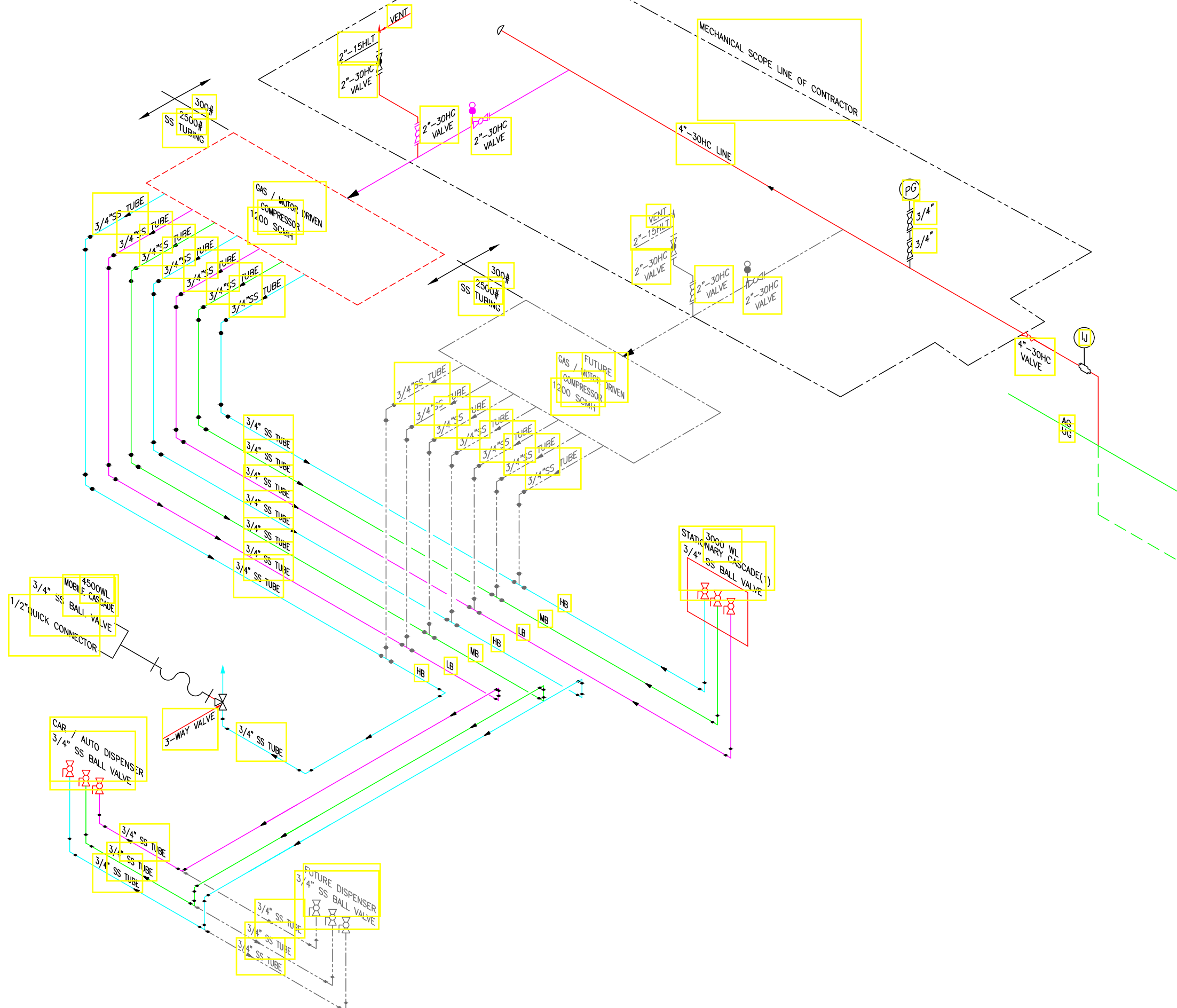
10.5 Guarantee & Warranty

Vendor shall guarantee that the complete scope of supply shall be safely and reliably meet all of the requirements of this Company Specification.

Vendor shall provide warranty support for a period of 12 months from the date of supply or 18 months from the date of manufacturing. Warranty shall apply to defective material workmanship and facility design .The cost of correction / replacement of any warranty items shall be borne by the Vendor, as per the purchase conditions of the Material / Purchase Requisition.

The Job specifications / Data sheets shall be referred for any specific warranty / guarantee.

CGS MOTHER STATION AT KOWARPARA



CGS MOTHER STATION ONE COMPRESSOR, ONE FUTURE COMPRESSOR, ONE STATIONARY CASCADE, ONE CAR / AUTO DISPENSER, ONE FUTURE DISPENSER, AND ONE MOBILE CASCADE

[illegible]



Energising Quality

PROJECT NUMBER: C241131



**INSTRUMENTATION INSPECTION AND TEST PLAN
FOR MOTHER STATIONS.**

Total Sheets

3

Document No

C241131

00

IN

ITP

5003

**NORTH EAST GAS DISTRIBUTION COMPANY LIMITED
(NEGDC)**

**COMPOSITE WORK OF MOTHER STATION AT
MANGALDOI FOR CITY GAS DISTRIBUTION PROJECT OF
NEGDC**

C1	15.06.2026	For Client Review	MK	S.K.M	S.K.M
REV	DATE	DESCRIPTION	PREP	CHKD	APPR

COMPOSITE WORK OF MOTHER STATION AT MANGALDOI FOR CITY GAS DISTRIBUTION PROJECT OF NEGDCCL.

INSTRUCTIONS FOR FILLING UP:

1. QAP shall be submitted for each equipment separately with breakup of assembly / sub-assembly & part/component or for group of equipment having same specification.
2. Use numerical codes as indicated for extent of inspection & tests and submission of test certificates & documents. Additional codes & description for extent of inspection & test may be added as applicable for the plant and equipments.
3. Separate identification number with quantity for equipment shall be indicated wherever equipment having same specifications belonging to different facilities are grouped together.
4. Weight in kilogram must be indicated under column 5 for each item. Estimated weights may be indicated wherever actual weights are not available.

ABBREVIATION USED:

CONTR: CONTRACTOR

MFR: MANUFACTURER

TPI: THRID PARTY INSPECTION AGENCY

*: Vendor / Bidder to provide

P / W/ R: P: Performer, R: Review; W: Witness

EN 10204, Type 3.2 certificates shall be provided for bought out items. Those shall be inspected by TPI appointed by Vendor

CODES FOR EXTENT OF INSPECTION, TESTS, TEST CERTIFICATES & DOCUMENTS:

CODE DESCRIPTION	CODE DESCRIPTION	CODE DESCRIPTION	CODE DESCRIPTION
1. Visual 2. Dimensional 3. fitment & alignment 4. Physical Test (Sample) 5. Chemical test (Sample) 6. Ultrasonic test 7. Magnetic particle test (MPT) 8. Radiography test 9. Dye Penetrant test 10. Measurement of IR value a) Before HV test b) After HV test 11. High voltage test/Dielectric Test	12. Routine test as per relevant IS other standard 13. Type test as per relevant IS/ other standard 14. Impulse Test 15. Partial Discharge Test 16. Heat run risc test/temper 17. Enclosure protection test 18. Calibration 19. Noise & Vibration 20. Test certificate of bought out components 21. Tank pressure test 22. Paint shed vibration	23. Short time rating 24. Operational & functional test 25. Over speed test 26. Flame proof Test 27. Clearance and creepage distance 28. Acceptance test 29 Honing Test 30 Hydrotest/ Shell leak test 31 Pneumatic Seat leak test 32 Impact test	D1. Approved GA drawing. D2. Approved single line/ schematic diagram D3. Test certificates D4. Approved Bill of materials D5. Un-priced P.O. copy D6. Calibration certificates of all measuring instrument and gauges.

Equipment Details

Inspection & Test



INSTRUMENTATION INSPECTION AND TEST PLAN FOR MOTHER STATIONS.

Document No.

C241131-00-IN-ITP-5003

Rev

C1

COMPOSITE WORK OF MOTHER STATION AT MANGALDOI FOR CITY GAS DISTRIBUTION PROJECT OF NEGDC.

S No.	Item	Identification Number	Qty	Weight Kg	Exp Date of Inspection	MFR Name & Address	In-Process Stage			Final Inspection			Test certificate & Document to be submitted to Client	Acceptance Criteria standards/ IS/BS/ASM E/ Norms and documents	Remark /Sampling Plan
							MFR	CONTR & TPI	Client	MFR	CONTR & TPI	Client			
1.	Pressure Gauges	Refer P&ID	*	*	*	Client Approved	1,2,3,4,5 P	-	-	1,2,3,18,20 P	1,2,3,18,20 -R,24 - W	1,2,3,18,20 R	1,2,3,4,5,18,20,24, D3, D6	D3,D6, Tech. spec	100%
2.	Temperature Gauges	Refer P&ID	*	*	*	Client Approved	1,2,3,4,5 P	-	-	1,2,3,18,20 P	1,2,3,18,20 -R,24 - W	1,2,3,18,20 R	1,2,3,4,5,18,20,24, D3, D6	D3,D6, Tech. spec	100%
3.	Gas Detectors	As per P&ID	*	*	*	Client Approved	1,2,3,4,5 P	-	-	1,2,3,18,20 P	1,2,3,18,20 -R,24 - W	1,2,3,18,20 R	1,2,3,4,5,18,20,24, D3, D6	D3,D6, Tech. spec	100%
4.	FAT Procedure	-	-	-	-	Client Approval	-	-	-	P	R	R	FAT Procedure	Test Record	100%
5.	SAT Procedure	-	-	-	-	Client Approval	-	-	-	P	R	R	SAT Procedure	Test Record	100%



CHECKLIST - TECHNICAL

VCS-SD-CK-001

CHECKLIST – TECHNICAL

Bidder confirms following, as a minimum, has been enclosed in the offer.

S.NO.	Requirements	Compiled by Bidder(Tick)
1	Reference List of previous supply of Procured item	☐
2	Filled – up Data Sheets, duly signed and stamped by bidder enclosed.	☐
3	List of recommended commissioning spares and accessories for Procured item.	☐
4	List of recommended spares and accessories for two year normal operation for procured item.	☐
5	Compliance statement duly filled and stamped enclosed.	☐
6	GA & assembly drawings, cross section drawings including part list & material list enclosed.	☐
7	Other technical details & vendor's product catalogues enclosed.	☐

0	25.05.2017	ISSUED AS STANDARD	AS	GS	AD
REV	DATE	DESCRIPTION	PREP	CHK	APPR



COMPLIANCE STATEMENT

VCS-SD-CS-001

COMPLIANCE STATEMENT

S.No	Requirement	Bidder's Confirmation
1	Bidder confirms that all materials proposed by the bidder are same/ superior to those specified in specification/ data sheets enclosed.	
2	Bidder confirms that the offer is in total compliance with the Technical requirements of the Material Requisition. Bidder confirms that deviation expressed or implied anywhere else in the offer shall not be considered valid.	
3	Bidder confirms that all spares and accessories required for two years of normal operation have been quoted separately.	
4	Bidder confirms that prices for start-up/commissioning spares and accessories have been included in the quoted items.	
5	Bidder confirms that in the event of securing order for the requisitioned item(s), good for manufacturing drawings of ordered item(s) shall have complete details with dimensions, part list and material list including back-up calculations in the first submission, failing which the vendor shall be solely responsible for any likely delay in delivery of item(s).	

Bidder's Signature with Stamp

0	25.05.2017	ISSUED AS STANDARD	AS	GS	AD
REV	DATE	DESCRIPTION	PREP	CHK	APPR



DEVIATION SHEET

VCS-SD-DS-001

DEVIATION/ EXCEPTION/ CLARIFICATION SHEET

Sr. No.	Contractor's Inquiry Reference	Contractor's Requirement	Proposed Deviation by Supplier, with Technical Justification	Cost Impact, if any	Contractor's Conclusions

NOTES

- 1- Bidder confirms that apart of from the deviations/exceptions/clarifications listed above, the bid is in full compliance with Inquiry requisition.
- 2- Bidder shall submit this sheet duly filled up and signed by him along with his bid. In case there is no deviation, then also supplier shall submit this sheet along with his bid indicating NIL deviation.

(Contractor's Name and Signature with Seal)

0	25.05.2017	ISSUED AS STANDARDS	AS	GS	AD
REV	DATE	DESCRIPTION	PREP	CHK	APPR



DRAWINGS & DOCUMENTS

VCS-SD-DD-001

INFORMATION/ DOCUMENTS / DRAWINGS TO BE SUBMITTED BY SUCCESSFUL BIDDER

Successful Bidder shall submit four copies unless noted otherwise, each of the following:

1. Inspection & test reports for all mandatory tests as per the applicable code as well as test reports for any supplementary tests, in nicely bound volumes.
2. Filled in Quality Assurance Plan (QAP) for Purchaser's/ Consultant's approval. These QAPs shall be submitted in two copies within 15 days from LOI/ FOI.
3. Detailed completion schedule activity wise (Bar Chart), within one week of placement of order.

Note : All drawings, instructions, catalogues, etc., shall be in English language and all dimensions shall be metric units.

0	25.05.2017	ISSUED AS STANDARDS	AS	GS	AD
REV	DATE	DESCRIPTION	PREP	CHK	APPR



INSTRUCTION TO BIDDER

VCS-SD-ITB-001

INSTRUCTION TO BIDDERS

1. Bidder to note that no correspondence shall be entered into or entertained after the bid submission.
2. Bidder shall furnish quotation only in case he can supply material strictly as per this Material Requisition and specification/data sheet forming part of Material Requisition.
3. If the offer contains any technical deviations or clarifications or stipulates any technical specifications (even if in line with MR requirements) and does not include complete scope & technical / performance data required to be submitted with the offer, the offer shall be liable for rejection.
4. Bidder must submit all documents as listed in checklist with his offer.
5. Supplier must note that stage wise inspection for complete fabrication, testing including the raw material inspected to be carried out.
6. Vendors for bought out items to be restricted to the approved vendor list attached with bid document. Approval of additional vendor if required, for all critical bought out items shall be obtained by the supplier from the purchaser before placement of order. Credentials/PTR of the additional vendor proposed to be submitted by supplier for review and approval of Purchaser/ Purchaser's representative

0	25.05.2017	ISSUED AS STANDARDS	AS	GS	AD
REV	DATE	DESCRIPTION	PREP	CHK	APPR



LIST OF SPARES

VCS-SD-LS-001

LIST OF SPARES

S.No.	Part No.	Description	Quantity(Minimum)
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

0	25.05.2017	ISSUED AS STANDARD	AS	GS	AD
REV	DATE	DESCRIPTION	PREP	CHK	APPR



REFERENCE LIST

VCS-SD-RL-001

REFERENCE LIST

SI No.	Project	Year of Supply	Client , Address and Contact No.	Email	Size and Rating / thk	Service

|| Bidder's Signature with stamp

0	25.05.2017	ISSUED AS STANDARDS	AS	GS	AD
REV	DATE	DESCRIPTION	PREP	CHK	APPR