

SECTION -

GENERAL TECHNICAL REQUIREMENTS

TECHNICAL SPECIFICATIONS

Section - GENERAL TECHNICAL REQUIREMENTS

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Section -

GENERAL TECHNICAL REQUIREMENT

1.0 GENERAL

- 1.1 This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification.
- 1.2 The provisions under this section are intended to supplement general requirements for the materials, equipments and services covered under other sections and is not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall hold good.

2.0 INSTRUCTION TO BIDDERS (General requirement)

- 2.1 The bidders shall submit the technical requirements, data and information as per the technical data and information as per the technical data sheets provided in the bid documents.
- 2.2 The bidders shall furnish catalogues, engineering data, technical information design documents, drawings etc., fully in conformity with the technical specification.
- 2.3 It is recognized that the Contractor may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Ultimate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to the Owner. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously. All deviations from the specification shall be clearly brought out in the respective schedules of deviations. Any discrepancy between the specification and the catalogues or the bid, if not clearly brought out in the schedule, will not be considered as valid deviation.
- 2.4 Except for lighting fixtures, wherever a material or article is specified or defined by the name of a particular brand, Manufacturer or Vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition. For lighting fixtures, makes shall be as defined in Section-Lighting System.
- 2.5 Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or needed for erection, completion and safe operation of the equipment as

- required by applicable codes though they may not have been specifically detailed in the Technical Specifications unless included in the list of exclusions. Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the switchyard unless specifically excluded shall be supplied. All similar standard components/ parts of similar standard equipment provided shall be inter-changeable with one another.
- 2.6 Unless brought out clearly in the respective schedule of deviations, it will be considered that, the Bid Proposal scrupulously conforms compliance to the specification. The bidders must bring out all the deviations in the bid proposal.
- 2.7 In case there is a discrepancy between the data of offered equipment and catalogue furnished, and unless the deviation are brought out clearly in the Technical Deviation Schedule, the equipment will be deemed to conform compliance to the specification scrupulously.
- 3.0 **STANDARDS**
- 3.1 The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.
- 3.2 The equipment to be furnished under this specification shall conform to latest issue with all amendments of standard specified under Annexure - C of this section as well as under respective Sections of the specification of respective equipment.
- 3.3 In addition to meeting the specific requirement called for in the respective sections of the Technical Specification, the equipment shall also conform to the general requirement of the relevant standards, which shall form an integral part of the specification.
- 3.1 The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to complement each other.
- 3.5 The Contractor shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC.
- 3.6 When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.
- 3.7 Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards specified under Annexure-C

/Individual section of various equipments shall also be accepted copies of such standards shall be submitted by the bidder.

3.8 In case governing standards for the equipment is different from IS or IEC, the salient points of difference shall be clearly brought out in additional information schedule of Bid documents along with English language version of standard or relevant extract of the same. The equipment conforming to standards other than specified in Annexure-C /Individual section of various equipments shall be subject to Owner's approval.

3.9 The bidder shall clearly indicate in his bid the specific standards in accordance with which the works will be carried out.

4.0 **SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED**

4.1 **VOID**

4.2 All equipments shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the sites of installation.

4.3 All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice, snow, short circuit etc., for equipment.

4.4 The bidder shall design the terminal connectors of the equipment taking into account various forces that the terminal connectors are required to withstand.

4.5 The equipment shall also comply to the following:

- a) All EHV equipments shall be suitable for hot line washing.
- b) To facilitate erection of equipment, all items to be assembled at site shall be "match marked".
- c) All piping, if any between equipment control cabinet/ operating mechanism to marshalling box of the equipment, shall bear proper identification to facilitate the connection at site.
- d) The supplier shall supply type tested equipments, materials. The type test reports shall be furnished by the supplier along with equipment/ material drawings. In the event of any discrepancy i.e., any test report not acceptable due to any design / manufacturing changes or due to non – compliance with the requirement stipulated in the technical specification or IEC/IS, same shall be carried out without any additional cost to owner.

Only in case of repetition of the type test, if required by the owner, these tests shall be payable.

- 4.6 Operating times of circuit breakers, protective relays and PLCC equipment have been specified in respective sections. However bidder is allowed to have minor variations on the individual equipment timings subject to the condition that overall fault clearing time remains within 100ms.

5.0 ENGINEERING DATA

- 5.1 The furnishing of engineering data by the Contractor shall be in accordance with the Schedule for each set of equipment as specified in the Technical Specifications.

- 5.2 The review of these data by the Owner will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect substation layout. This review by the Owner may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the Owner shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

- 5.3 All engineering data submitted by the Contractor after final process including review and approval by the Owner shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the Owner in Writing.

6.0 DOCUMENTS

6.1 List of Documents

1. The bidder must furnish a detailed list of drawing/documents along with the bid proposal which he intends to submit to the owner after award of the contract.
2. The contractor shall necessarily submit all the drawing/documents unless anything is waived.
3. The contractor shall submit 4 (Four) sets of drawing / design documents / test reports as may be required for the approval of the owner.
4. All engineering data submitted by the contractor after final process including review and approval by the owner shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the Owner in Writing.

6.3 Drawings

- 6.3.1 All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, the external connections, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearances and spaces required for installation and interconnections between various portions of equipments and any other information specifically requested in the specifications.
- 6.3.2 Each drawing submitted by the Contractor shall be clearly marked with the name of the Owner, the unit designation, the specifications title, the specification number and the name of the Project. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.
- 6.3.3 Further work by the Contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Owner, if so required.
1. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Contractor's risk. the Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Owner. Approval of Contractor's drawing or work by the Owner shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.
 2. The review of these data by the Owner will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under the specifications, external connections and of the dimensions which might affect substation layout. This review by the Owner may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the Owner shall not be considered by the Contractor as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

6.6 APPROVAL PROCEDURE

The scheduled dates for the submission of these as well as for, any data/ information to be furnished by the Owner would be discussed and finalised at the time of award. The Contractor shall also submit Four (4) copies of all drawings/design documents/test reports for approval of the Owner. The following schedule shall be followed generally for approval.

- | | | |
|------|---|---|
| i) | Approval/ comments/ by
Owner on initial submission
Of receipt | Within 4 (Four) weeks |
| fl) | Resubmission (whenever
Required) | Within 2 (Two) weeks from
Date of comments
including both ways postal
time). |
| iii) | Approval or comments | Within 2 (Two) weeks of
receipt of resubmission. |
| iv) | Furnishing of distribution
Copies | 2 weeks from the date of
final approval |

Notwithstanding the time schedule indicated for approvals, the contractor (successful bidder) shall be responsible for completing the works in stipulated time as per approved PERT Chart.

NOTE: The contractor may please note that all resubmission must incorporate all comments given in the prior submission by the Owner or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.

6.6 The drawings which are required to be referred frequently during execution should be submitted on cloth lined paper.

6.7 Other requirements of Documentation.

1. Three sets of **computer-CD** and 8 sets of all drawings per substation plus one set of **computer-CD** and four sets of all drawings to Chief Engineer Elec., (Tendering & Procurement) KPTCL, Bangalore shall be furnished after approval of drawings.

- 6.7.2 The manufacturer shall also submit one video **CD** per substation and one for Chief Engineer, Electricity, (Tendering & Procurement), KPTCL, Bangalore highlighting installation and maintenance techniques / requirements of Circuit Breaker and isolators.
- 6.7.3 On completion of the entire works, the Contractor shall also furnish **Six** bound sets of all built drawings, duly signed by the site in-charge along with 1 set of **computer CD**. Computer floppies for each substation to Chief Engineer, Electricity, (Tendering & Procurement), KPTCL, Bangalore, containing as built drawings in Auto-cad version **2000** or better shall also be submitted.
1. **6** copies of instruction/operation manuals **and 2 sets of computer CD** per sub-station to Chief Engineer, Elec., Tendering & Procurement, KPTCL, Bangalore shall also be furnished. The instruction manuals shall contain full details of drawings of equipment being supplied under this contract, their exploded diagrams with complete instructions for storage, handling, erection, commissioning, testing, operation, trouble shooting, servicing and over hauling procedures.
 2. After approval of test reports, 6(six) bound sets containing all drawings/manuals, type and routine test reports etc., along with sub-contractor's test reports for all bought out assemblies/ components/ parts including internal wiring diagrams and exploded diagrams of assemblies/components / parts, shall be furnished.
- 6.8 If after the commissioning and initial operation of the substation, the instruction manuals require any modifications/ additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Owner.

The contractor shall furnish to the Owner, spare parts catalogues also.

1. COLOUR SCHEME AND CODES FOR PIPE SERVICE

- 7.1 The contractor shall propose a colour scheme for the those equipments/ items for which the colour scheme has not been specified in the specification for the approval of Owner. The decision, of Owner shall be final. The scheme shall include:

- Finishing colour of indoor equipment.
- Finishing colour of outdoor equipment
- Finish colour of all cubicles.
- Finishing colour of various auxiliary system equipment including piping.
- Finishing colour of various building items.

- 7.2 All steel structures, plates etc., shall be painted with non-corrosive paint on a suitable primer. It may be noted that normally all Owner's electrical equipment in Owner's switchyard are painted with shade 697 of IS-5. All the indoor cubicles shall be of Opaline green conforming to shade 275 of IS-5 and for other miscellaneous items colour scheme will be approved by the Owner.

1. MATERIAL/WORKMANSHIP

8.1 General Requirement

- 8.1.1 Where the specification does not contain characteristics with reference to workmanship, equipment, materials and components of the covered Equipment, it is understood that the same must be new, of highest grade and of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended.
- 8.1.2 In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard, the Owner shall decide upon the question of similarity. When required by the specification or when required by the Owner the Contractor shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it being understood that the cost as well as the time delay associated with the rejection shall be borne by the Contractor.
- 8.1.3 The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements and shall be used throughout the design. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Owner.
- 8.1.4 Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall be interchangeable with, and shall be made of the same materials, and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different piece of equipment in order to minimize spare part stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.
1. All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first class work in accordance with the best modern practices will be accepted. Installation shall be considered as

being the erection of equipment at its permanent location. This unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, aligning, coupling of or bolting down to previously installed equipment bases/ foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances and instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits suitable guards shall be provided for the protection of personnel on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purposes. The spare equipment(s) shall be Installed at designated locations and tested for healthiness.

2. The Contractor shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The contractor shall apply all operational lubricants to the equipment installed by him.
3. All oil, grease and other consumables used in the works/ equipment shall be purchased in India unless the contractor has any special requirement for the specific application of a type of oil or grease not available in India. If such is the case he shall declare in the proposal, where such oil or grease is available. He shall help Owner in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.
4. A cast iron or welded steel base plate shall be provided for all rotating equipment which are to be installed on a concrete base unless otherwise agreed to by the Owner. Each base plate shall support the unit and its drive assembly, shall be of design with pads for anchoring the units and shall have a raised up all around and shall have threaded in air connections, if so required.

2. Provisions for exposure to Hot and-Humid climate

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favorable to the growth of fungi and mildew. The indoor equipments located in non-air-conditioned areas shall also be of same type.

8.2.1 Space Heaters

The heaters shall be suitable for continuous operation at 240V as supply voltage. On-off switch and fuse shall be provided.

- 8.2.1.2 One or more adequately rated thermostatically controlled heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.
- 8.2.1.3 The heaters shall be suitably designed to prevent any contact between the -heater wire and the air and shall consist of coiled resistance wire centered in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conducting and electrical insulation properties, or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air. Alternatively, they shall consist of a resistance wire mounted into a tubular ceramic body built into an envelop of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in vitreous glaze. The surface temperature of the heaters shall be restricted to a value which will not shorten the life. Of the heater sheaths . of the heater sheaths or that of insulated wire or other component in the compartments.

8.2.2 FUNGI STATIC VARNISH

Besides the space heaters, special and fungus resistant varnish shall be applied on parts which may be subjected or predisposed to the formation of fungi due to the presence of deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

8.2.3 Ventilation opening

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds and suitable provision shall be made so as to avoid any communication of air/dust with any part in the enclosure of the Control cabinet, Junction boxes and Marshalling boxes, Panels, etc.

8.2.4 Degree of protection

The enclosure of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc., to be installed shall provide degree of protection as detailed here under:

a)	Installed out door	:	IP	-55
b)	Installed indoor	:	IP	in 31
	air-conditioned area	:	IP	- 31

c)	Installed in covered area	:	IP	-	52
d)	Installed non-air-conditioned where possibility of water is limited	:	IP	-	41
e)	For LT (AC & DC distribution Boards)	:	IP	-	52

The degree of protection shall be in accordance with IS : 13947 (Part-I) / IEC 947 (Part-I)/IS 12063/IEC 529. Type test report for degree of protection test, on each type of the box shall be submitted for approval.

9.0 RATING PLATES, NAME PLATES AND LABELS

9.1 Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plates of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the owner. The rating plate of each equipment shall be according to IEC requirement.

9.2 All such Nameplates, instruction plates, rating plates shall be with English inscription.

10.0 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, soldering/ brazing material for a copper piping of circuit breakers and essential chemicals etc., which will be required to put the equipment covered under the scope of the specifications, into successful Operation, shall be furnished by the Contractor unless specifically excluded under the exclusions in these specifications and documents.

11.0 DESIGN IMPROVEMENTS

11.1 The bidder shall note that the equipment offered by him in the bid only shall be accepted for supply. However, the owner or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes, the specification shall be modified accordingly.

11.2 If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change In. the price and/or schedule of completion before the Contractor proceeds with the

Following such agreement, the provision there-of, shall be deemed to have been amended accordingly.

12.1 To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the Contractor's Works or at his Sub-Contractor's premises or at the Owner's site or at any other place of Work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be outlined by the Contractor and shall be finally accepted by the Owner after discussions before the award of Contract. A quality assurance program of the contractor shall generally cover the following:

- 1. System for handling storage and delivery; and**

2. A quality plan detailing out the specific quality control measures and procedures adopted for controlling the quality audit surveillance of the system and procedure of the contractor/ his vendor's quality management and control activities.

The Owner or his duly authorized representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Contractor/his vendor's quality management and control activities.

12.2 **Quality assurance Document**

The Contractor shall be required to- submit the following Quality Assurance Documents within three weeks after dispatch of the equipment.

- a) All Non-Destructive Examination procedures stress relief and weld repair procedure actually used during fabrication and reports including radiography interpretation reports.
- b) Welder and welding operator qualification certificates.
- c) Welder's identification list, listing welders and welding operator's qualification procedure and welding identification symbols.
- d), Raw material test reports oil components as specified by the specification and/or agreed to in the quality plan.
- e) Stress relief time temperature charts/oil impregnation time temperature charts.
- f) Factory test results for testing required as per applicable codes/mutually agreed quality plan standards refereed in the technical specification.
- g) The quality plan with verification of various customer inspection points (CIP) as mutually agreed and methods used to verify the inspection and testing points in the quality plan were performed satisfactorily.

13.0 **INSPECTION, TESTING & INSPECTION CERTIFICATE**

- 13.1 The owner, his duly authorized representative and/or outside inspection agency acting on behalf of the owner shall have at all reasonable times free access to the contractor's / supplier's/ Subvendor premises or works and shall have the power at all reasonable times to inspect and examine the materials and workmanship at the works during its manufacture or erection. If part of the works is being manufactured or assembled at other premises or works, the contractor shall obtain from the owner or his duly authorized representative permission to inspect as if the works were manufactured or assembled on the

contractors own premises or works inspection may be made at any stage of manufacture, dispatch or at site at the option of the owner and the, equipment if found unsatisfactory due to bad workmanship or quality, Material is liable to be rejected.

- 13.2 All equipments /materials being supplied shall conform to type tests including additional type test and shall be subject to routine tests in accordance with requirements stipulated under respective sections. The contractor shall intimate the owner the detailed programme about the test at least 3 weeks in advance in case of domestic supplies & 6 weeks in advance in case of foreign.

13.3 **TYPETESTS:**

Type tested equipments shall be offered. Refer respective clauses for validity period of various equipments. The type test reports shall not be older than the validity period of respective equipment as on the last date of submission of bid.

13.4 **a) For Equipments manufactured in India:**

- i. The type tests on indigenous equipment for which testing facility is available in India, should have been conducted in any independent laboratories approved by the Government or the laboratories accredited by the National accreditation body of the country like Central Power Research Institute (CPRI), Electrical Research and Development Association (ERDA), etc.
- ii. The type tests on indigenous equipment, for which testing facility is not available in India, should have been conducted in a laboratory of foreign country accredited by National accreditation body of that country.
- iii. The type tests conducted in-house by a manufacturer shall also be acceptable provided the laboratory is accredited by National accreditation body of the country and the tests has been conducted in the presence of a representative of NABL accredited laboratory or any of the purchasing utilities or CEA in that order. Such type test reports shall record the details of such witness including the signature/authentication in the type test report.

b) For Equipments manufactured Abroad:

- i. Type tests on imported equipment should have been conducted in an Indian Laboratory or foreign laboratory accredited by National accreditation body of the country where the Type test has been conducted.

- ii. The type tests conducted in-house by a manufacturer shall also be acceptable provided the laboratory is accredited by National accreditation body of the country and the tests has been conducted in the presence of a representative of accredited laboratory or any of the purchasing utilities or CEA in that order. Such type test reports shall record the details of such witness including the signature/authentication in the type test report.

In case of in-house type tested imported equipment of foreign OEM, the term “Purchasing Utility” covers the foreign Utility who has purchased that equipment

- 13.5 The contractor shall give the owner/ inspector thirty (30) days written notice of any material being ready for joint testing. Such tests shall be to the contractor's account except for the expenses of the Inspector. The owner/ inspector, unless witnessing of the tests is virtually waived, will attend such tests within thirty (30) days of the date of which the equipment is notified as being ready for test/ inspection, falling which the contractor may proceed with the test which shall be deemed to have been made in the owner's/ inspector's presence and he shall forthwith onward to the owner/ inspector duly certified copies of tests in triplicate. The owner of inspector shall, within fifteen(15) days from the date of inspection as defined herein give notice in writing to the contractor, of any objection to any drawings and all or any equipment an workmanship which in his opinion is not in accordance with the contract. The contractor shall give due consideration to such objections and shall either made the modifications that may be necessary to meet the said objections or shall coalman writing to the owner/ inspector giving reasons therein, that no modifications are necessary to comply with the contract.
- 13.7 When the factory tests have been completed at the Contractor's or Sub-Contractor's works, the, owner/ inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the owner/ inspector, the certificate shall be issued within fifteen (125) days of receipt of contractor's test certificate by the Engineer/ inspector. Failure of the owner/ inspector to issue such a certificate shall not prevent the contractor from proceeding with the works. The completion of these tests or the issue of the certificate shall not bind the owner to accept the equipment should, it, on further tests after erection, be found riot to comply with tile contract. The equipment shall be dispatched to site only after approval of test reports and issuance of delivery advise by the owner.
- 13.8 In all cases where the contract provides for tests whether at the premises or at the works of the contractor or of any sub-contractor, the contractor except where

otherwise specified shall provide free of charge such items as labor, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the owner/inspector or his authorized representative to carry out effectively such tests of the equipment in accordance with the contract and shall give facilities to the owner/ inspector or to his authorized representative to accomplish testing.

- 13.9 The inspection by owner and issue of inspection certificate thereon shall in no way limit the liabilities and responsibilities of the contractor in respect of the agreed quality assurance program forming a part of the contract.
- 13.10 The owner will have the right of having at his own expenses any other test(s) of reasonable nature carried out at contractor's premises or at site or in any other place in addition of aforesaid type and routine tests, to satisfy that the material comply with the specification.
- 13.11 The owner reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipments for these tests shall be provided by the Owner.

14.0 TESTS

14.1 Charging

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Owner and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The list of pre-commissioning tests to be performed are given in respective chapters and shall be included In the Contractor's quality assurance program.

14.2 Commissioning Tests

- 14.2.1 The available Instrumentation and control equipment will be used during such tests and the Owner will calibrate, all such measuring equipment and devices as far as practicable. However, immeasurable parameters shall be take into account in a reasonable manner by the Owner for the requirement of these tests. The tests will be conducted at the specified load points and as near the specified cycle condition as practicable. The owner will apply proper corrections in calculation, to take into account conditions which do not correspond to the specified conditions.
- 14.2.2 Any special equipment, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.

14.2.3 The specific test to be conducted on equipment have been brought out in the respective chapters of the technical specification.

14.3 The contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning the equipment and the switchyard. However necessary fee shall be reimbursed by Owner on production of requisite documents.

15.0 PACKAGING

15.1 All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the Owner, the Contractor shall also submit packing details/ associated drawing for any equipment/material under his scope of supply, to facilitate the Owner to repack any equipment/ material at a later date, in case the need arises. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken account of. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharf age and other such charges claimed by the transporters, railways etc., shall be to the account of the Contractor. Owner takes no responsibility of the availability of the wagons.

16.0 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discolouration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable device to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

17.0 FINISHING OF METAL SURFACES

17.1 GENERAL

All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. High tensile steel nuts & bolts and spring washers shall be electro, galvanized to service condition 4. All steel conductors including those used for earthing/ grounding (above ground level) shall also be galvanized according to IS: 2629.

17.2 HOT DIP GALVANISING

The minimum weight of the zinc coating shall be 610 gm / sq. mm and minimum thickness of coating shall be 85 microns for all items thicker than 6mm. For items lower than 6mm thickness shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq. mm minimum.

1. The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discolored patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

17.2.3 After galvanizing, no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

17.2.4 The galvanized steel shall be subjected to six one-minute dips in copper sulphate solution as per IS : 2633.

17.2.5 Sharp edges with radii less than 2.5mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as relevant Indian Standard.

- | | | |
|---|----------------------|-----------|
| - | Coating | thickness |
| - | Uniformity | of zinc |
| - | Adhesion | test |
| - | Mass of zinc coating | |

1. Galvanized material must be transported properly to ensure that galvanized surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

17.3 PAINTING

All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS - 6005 "Code of practice for phosphating iron and sheet". All surfaces which will not be easily accessible after shop assembly shall before hand be treated and protected for the life of the equipment. The surfaces which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with atleast two coats of primer. Oil, grease, dirt and swarf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

- 1.

- 17.3.2 After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, stoving type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.
- 17.3.3 After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting.
- 17.3.4 The exterior colour of the paint shall be as per shade No. 697 of IS-5 and 275 of IS-5 and inside shall be glossy white. Each coat of primer and finishing paint shall be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments.
1. In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc.) the procedure shall be submitted along with the Bids for Owner's review & approval.

18.0 HANDLING, STORING AND INSTALLATION

- 18.1 In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the owner or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, and square and properly aligned and oriented. Commercial use of switchyard equipment means completion of all site tests specified and energisation at rated voltage.
- 18.2 Contractor may engage manufacturer's Engineers to supervise the unloading, transportation to site, storing, testing and commissioning of the various equipment being procured by them separately. Contractor shall unload, transport, store, erect, test and commission the equipment as per instructions of the manufacturer's supervisory Engineer(s) and shall extend full cooperation to them.
- 18.3 In case of any doubt/ misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the Owner. Contractor shall be held responsible for any damage to the equipment consequent to not following manufacturer's drawings/ instructions correctly.
- 18.4 Where assemblies are supplied in more than one section, Contractor shall make all necessary mechanical and electrical connections between sections including the connection between buses. Contractor shall also do necessary adjustment/

alignment necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the contractor at his own expense.

- 18.5 Contractor shall be responsible for examining all the shipments and notify the owner immediately of any damage, shortage, discrepancy etc., for the purpose of Owner's information only. The Contractor shall submit to the Owner every week a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, whatage mid other such charges claimed by the transporters, railways etc., shall be to the, account of the Contractor.
- 18.6 The Contractor shall be fully responsible for the equipment/ material until the same is handed over to the Owner in an operating condition after commissioning, Contractor shall be responsible :for the maintenance of the equipment/material while in storage as well. as after erection until taken over by Owner, as well as protection of the same against theft, element of nature, corrosion, damages etc.
- 18.7 Where material/ equipment is- unloaded by Owner before the contractor arrives at site or even when he is at site, Owner by right can hand over the same to Contractor and there upon it will be the responsibility of Contractor to store the material in an orderly and proper manner.
- 18.8 The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment, which require indoor storage.
- 18.9 The word 'erection' and 'installation' used in the specification are synonymous.
- 18.10 All outdoor equipment except Marshalling kiosk shall be suitable for hot line washing.
- 18.11 Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.
- 18.12 The minimum. phase to earth, phase to phase and section clearance for the various 220KV, 66KV, 11KV sections of the switchyard are given below:

	220 KV	66KV	11KV
Phase to earth (mm)	2100	630	200
Phase to phase (mm)	2100	630	200
Section clearance (mm)	4300	3000	

However, the clearance as shown in the layout drawing shall be maintained.

In case of GIS Switchgear, the minimum phase to earth clearance (live part clearance)

shall be accordance with the relevant IEC/ IS for insulation co-ordination.

The design and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance throughout the service life. If at any stage during the execution of the Contract, it is observed that the erected equipment(s) do not meet the above minimum clearances, the Contractor shall immediately proceed to correct the discrepancy at his risks and cost.

19.0 PROTECTIVE GUARDS

19.1 Suitable guards shall be provided for protection of personnel on all exposed, rotating and/or moving machine parts. An such guards with necessary spares and accessories shall be designed for easy installation and immoral for maintenance purpose.

20.0 DESIGN CO-ORDINATION

20.1 The Contactor will be responsible for the selection and design of appropriate equipments to provide the best co-ordinate performance of the entire system. The basic design requirements are detailed out in this specification. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

20.2 The Contractor has to co-ordinate designs and terminations with the agencies (if any) who are consultants/ Contractor for the Owner. The names of agencies shall be intimated to the successful bidders-.

21.0 DESIGN CO-ORDINATION MEETING

The Contractor will be called upon to attend design co-ordination meetings with the Engineer, other Contractors and the Consultants of the Owner (if any) during the period of Contract. The contractor shall attend such meetings at his own cost at Bangalore or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during those discussions.

22.0 TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, disassembly and maintenance of the equipment. However, these tools and tackles shall be separately, packed and brought on to site.

23.0 EQUIPMENT BASES

A cast iron or welded steel base plate shall be provided for all rotating equipment, which is to be installed on a concrete base unless otherwise agreed to by the

Owner. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.

24.0 AUXILIARY

SUPPLY

24.1 The auxiliary power for station supply, including the equipment drive, cooling system of any equipment, lighting etc., shall be designed for the specified parameters as under. **The** DC supply for the instrumentation and PLCC system shall also **confirm to** the parameters as indicated in the following.

Normal voltage	Variation in voltage	Frequency in Hz	Phase / wire	Neutral connection
415 V	+10% -10 %	50±5%	¾ wire	Solidly earthed
240 V	+10% -10 %	50± 5 %	½ wire	Solidly earthed
220 V	+10 % -10%	DC		Isolated 2 wire system
48 V	+10% -20%	DC		2 wire system (+) earthed

25.0 SUPPORT

STRUCTURE:

25.1 Typical drawings of support structures are enclosed to the bid documents. Based on the equipments to be supplied, height of center line of live point indicated the layout / cross section drawings the successful bidder has to furnish the drawing for owners approval only after approval of the drawing the fabrication of structures are to be taken up. Any substructure or adopter plate required to meet the above bus termination height other than the standard structure will also have to be supplied by the Contractor as part of the equipment. All brackets, angles, stool or other members necessary for attaching the operating mechanism to the supporting structure shall be engineered and supplied as integral part of the equipment. The support structures for all equipments shall be supplied by the Contractor.

25.2 The, support structures should be hot dip galvanized with minimum 610 gram / m² net of zinc.

25.3 In case of any deviation in this regard the bid is liable to be considered technically non-responsive and shall be liable to be rejected.

25.4 Support structure shall meet the following mandatory requirements:

25.4.1 The minimum vertical clearance from any energized metal part of the equipment / post insulator from Ground level shall be 5.75 & 4.25 meters for 245 KV & 72.5 KV equipments respectively.

25.4.2 The minimum vertical distance from the bottom of the lowest porcelain part of the bushing, porcelain enclosures or supporting insulators to the bottom of the equipment base, where it rests on the foundation pad shall be 2.50 metres.

26.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS:

26.1 All power clamps and connectors shall conform to IS : 5561 & NEMA CC1 and shall be made of materials listed below:

a)	For connecting ACSR conductors shall be of C wedge type	Aluminum alloy casting, conforming to designation A6 of IS:617 and shall be tested for all test as per IS:617
b)	For connecting equipment terminals made of copper with ACSR conductors	Bimetallic connectors made from aluminum alloy casting, conforming to designation A6 of IS:617 with 2 mm thick bimetallic liner and shall be tested as per IS:617
c)	For connecting G.I. wire	Galvanized mild steel shield wire
d)	<ol style="list-style-type: none">1. Bolts, nuts & plain, washers2. Spring washers for items 'a' to 'c'	<ol style="list-style-type: none">1. Electro-galvanized for sizes below M12, for others hot dip galvanized.2. Electro-galvanized mild steel suitable for at least service condition-3 as per IS:1573

26.2 Each equipment shall be supplied with the necessary terminals and connectors, as required by the ultimate design for the particular installation. The conductor terminations of equipment shall be either expansion, sliding or rigid type.

The requirement regarding external corona and RIV as specified for any equipment shall include its terminal fittings and the equipment shall be factory tested with the connectors in position. If corona rings are required to meet these requirements they shall be considered as part of that equipment and included in the scope of work.

26.3 Where copper to aluminum connections are required, bi-metallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current carrying or subjected to stress.

- 26.4 Low voltage connectors, grounding connectors and accessories for grounding all equipment as specified in each particular case, are also included in the scope of Work.
- 26.5 No current carrying part of any clamp shall be less than 10mm thick. All ferrous parts shall be hot dip galvanized. Copper alloy liner of minimum 2mm thickness shall be cast integral with aluminum body for Bi-metallic clamps.
- 26.6 Lateral load deflection test shall be carried out as an acceptance test. The test procedure and accepted norms shall be mutually discussed and agreed to.
- 26.7 All casting shall be free from blow holes, Surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
- 26.8 Flexible connectors, braids or laminated straps made for the terminal clamps for bus posts shall be suitable for both expansion or through (flexed/sliding) type connection as required. In all the cases the clamp height (top of the mounting pad to centre line of the tube) should be same.
- 26.9 Clamp shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified ambient temperature. The rated current for which the clamp/connector is designed with respect to the specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/ connector, except on the hardware.
- 26.10 All current carrying parts shall be designed and manufactured to have minimum contact resistance.
- 26.11 **VOID**
- 26.12 **TESTS**
- 26.12.1 Clamps and connectors should be type tested as per IS: 5561 and shall also be subject to routine tests as per IS: 5561. Following type test reports on three samples of similar type shall be submitted for approval.
- 1) Temperature rise test (maximum temperature rise allowed is 35 deg C over 50 deg ambient temperature)
 - 2) Short time current test
 - 3) Resistance test and tensile test
 - 4) Corona (dry) and RIV (dry) test for 220 KV class clamps
- 27.0 **CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES MARSHALLING BOXES FOR OUTDOOR EQUIPMENT**

- 27.1 All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS : 5039 / IS : 8623, IEC-439, as applicable, and the clauses given below:
- 27.2 Control cabinets junction. boxes, Marshalling boxes & terminal boxes shall be made of sheet steel or aluminum enclosure and shall be dust, water and vermin proof. Sheet steel used shall be at least, 2.0 mm thick cold rolled or 2.5 mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminum enclosed box the thickness of aluminum shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness
- 27.3 The enclosures of the control cabinets, junction boxes, terminal boxes & marshalling boxes shall provide a degree of protection of not less than (IP:53). After protection degree. test of marshalling kiosk, 2.5 KV rms for 1(one) minute, insulation resistance and functional test should have been conducted. In case these tests have not been carried out during IP : 55 test, then the contractor shall carry out the IP-55 test along with. these tests, at his cost.
- 27.4 Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements.
- 27.5 Cabinet/ boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of the gasket shall be such that it does not get damaged/cracked during the operation of the equipment.
- 27.6 All doors removable covers and plates shall be gasketed all around with suitably profiled **Neoprene** gaskets. The gasket shall be tested in accordance with approved quality plan. The quality of gasket shall be such that it does not get damaged/ cracked during the ten years of operation of the equipment or its major overhaul whichever is earlier. All gasket surfaces shall be smooth, straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating louvers, if provided, shall have screen and fillers. The screen shall be fine wire mesh made of brass.
- 27.7 All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet.

Suitable cable gland plate projecting at least 150mm above the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on

this gland plate. The gland shall project at least 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required. The Nickel-plated glands shall be dust proof; screw on & double compression type and made of brass. The gland shall have provision for securing armour of the cable separately and shall be provided with earthing tag. The glands shall conform to BS: 6121.

27.8 A 240V, single phase, 50Hz, 15 amp AC plug and socket shall be provided in the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of industrial grade.

27.9 For illumination of Control cabinet a 15 Watts CFL shall be provided.

27.10 All control switches shall be of rotary switch type and Toggle/piano switches shall not be accepted.

27.11 Earthing

Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire shall be terminated on to the earthing pad and secured by the use of star of self-etching washer. Earthing of hinged door shall be done by using a separate earth wire.

27.12 Tests

a) The marshalling kiosks shall be subject to routine tests as per IS:5039.

b) The following routine tests shall also be conducted.

i) Check for wiring

ii) Visual and dimension check

Marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/ connection/ ferruling by pasting the same on the inside of the door.

28.0 Auxiliary

Switches

The auxiliary switch shall conform to the following type tests:

a) Electrical endurance test - A minimum of 2000 operation for 2A DC with a time constant greater than or equal to 20 millisecond with a subsequent examination of mV drop/visual; defects/ temperature rise test.

b) Mechanical endurance test. A minimum of 1,00,000 operations with a subsequent checking of contact pressure test/visual examination.

- c) Heat run test on contacts.
- d) IR/HV test etc.

29.0 **TERMINAL BLOCKS AND WIRING**

- 29.1 Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All inter-phase and external connections to equipment or to control cubicles will be made through terminal blocks.
- 29.2 Terminal blocks shall be 1100V grade and have continuous rating to carry the maximum expected current on the terminals. Those shall be of moulded piece, complete with insulated barriers stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be non-disconnecting stud type equivalent to Elmex type, CATM4, Phoenix cage clamp type of Wage or equivalent. The insulating material of terminal block shall be Nylon 6.6, which shall be free of halogens, fluorocarbons etc.
- 29.3 Terminal blocks for current transformers and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short-circuiting and earthing facilities.
- 29.4 The terminal shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally.
- 29.5 The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable.
- 29.6 The terminal blocks shall be of extendable design.
- 29.7 The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.
- 29.8 The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.
- 29.9 Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.
 - a) All circuits except CT circuits : Minimum of two of 2.5 Sq. mm copper flexible.

- b) All CT circuits: Minimum of 4 Nos. of 6 Sq. mm copper flexible
- 29.10 The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinets is live.
- 29.11 At least 20% spare terminals shall be provided on each panel/ cubicle/ box and these spare terminals shall be uniformly distributed on all terminal rows.
- 29.12 There shall be minimum clearance of 250mm between the First/bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be minimum of 150mm.
- 29.13 The Contractor shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets.
- 29.14 All input and output, terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The Contractor shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

30.0 **LAMPS** **AND** **SOCKETS**

30.1 **Lamps:**

All incandescent lamps shall use a socket base as per IS1258, except in the case of signal lamps.

30.2 **Sockets**

All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

30.3 **Hand** **Lamp:**

A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF switch for connection of hand lamps.

30.4 **Interior** **lighting:**

Each panel shall be provided with a **15 watts CFL** lighting fixture of Standard Indian type or 15watts compact fluorescent tube rated for 240 Volts, single Phase, 50 Hz supply for the, interior illumination of the panel during maintained. The

Fittings shall be complete with switch fuse unit and switching of fittings shall be controlled by the respective panel door switch.

30.5 Switches and Fuses:

30.5.1 Each control panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with switch fuse units. Selection of the main and Sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

30.5.2 All fuses shall be of HRC cartridge type conforming to IS:9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately Shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage.

30.5.3 All control switches shall be of rotary type and toggle/piano switches shall not be accepted.

31.0 Bushings, hollow Column Insulators, Support Insulators:

31.1 Bushings shall be manufactured and tested in accordance with IS:2099 & IEC: 137. While hollow column insulators shall be manufactured and tested in accordance with IEC 233/IS:5621. The support insulators shall be manufactured and tested as per IS-254-4./IEC 168 and IEC 273. The insulators shall also conform to IEC 815 as applicable.

The Bidder may also offer Silicone Composite Insulator conforming to IEC 62231:2006.

31.2 Bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used shall be homogeneous, free from land nations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.

Support insulators shall be Porcelain/ Silicone Composite Insulator

31.3 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.

31.4 Support insulators/ bushings/ hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions Under

which they will be used.

- 31.5 When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators/bushing-, when operating at the normal rated voltage.
- 31.6 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The, design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.
- 31.7 All iron parts shall be hot dip galvanized and all joints shall be airtight. Surface of joints shall be trued up porcelain parts by grinding and metal parts by matching. Insulators/bushing design shall. be such as to ensure a uniform compressive pressure on the joints.
- 31.8 **Tests:**

In accordance with the requirements stipulated under Clause No.13.0 of this Section bushing, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS : 2009 & IS : 2544 and IS 5601 and for Silicon composite Support Insulator conforming to IEC 62231:2006.

- 31.9 Technical parameters of bushing/hollow column insulators/support insulators:

Sl. No	Particulars	For 245 KV system	For 72.5 KV system	For 12.5 KV system
1	Rated volatage (KV)	245	72.5	36
2	Impulse withstand	±1050	±325	±170
3	Switching surge with stand voltage (dry and wet) (KVP)	-	-	-
4	Power frequency withstand voltage (dry and wet)KV rms	450	140	70
5	Total creepage distance (mm)	6125	1813	900
6	Pollution class-iii heavy (as per IEC 71) and as	-	-	-

	specified in section-2 for all class of equipment.			
7	Insulator shall also meet requirement of relevant standards for 245KV, 110 KV, 66 KV & 33KV system, as applicable having alternate long & short sheds	-	-	-

32.0 MOTORS

Motors shall be "Squirrel Cage" three, phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required to the driven equipment and shall conform to type tests and shall be subjected to routine test as per applicable standards. The motors shall be of approved make

32.1 Enclosures

- a) Motors to be installed outdoors without enclosure shall have hose proof enclosure equivalent to IP 55 as Per IS:4691. For motors to be installed indoor i.e. inside a box, the motor enclosures, shall be dust proof equivalent. to IP 44 as per IS:4691.
1. Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.
2. Motors shall have drain plugs so located that they will drain water resulting from condensation or other causes from all pockets in the motor casting.
3. Motors weighing more than 25Kg. shall be provided with eyebolts, lugs or other means to facilitate lifting.

32.2 Operational

Features

- a) Continuous motor rating (name plate rating) shall be at least ten (10) percent. above the maximum load demand of the driven equipment at design duty point and the motor shall not be over loaded at any operating point of driven equipment that will rise in service.
- b) Motor shall be capable at giving rated output without reduction in the expected life span when operated continuously in the system having the particulars, as given in Clause 21.4.0 of this section.

32.3 Starting

Requirements:

- a) All induction motors shall be suitable for full voltage direct-on-line starting. These shall be capable of starting and accelerating to the rated speed alongwith

- the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 80% of the rated voltage.
- b) Motors shall be capable of withstanding the electrodynamics stresses and heating imposed if it is started at a voltage of 110% of the rated value.
 - c) the locked rotor current. shall not exceed six (six) times the rated full load current for all motors, subject to tolerance as, give in IS325
 - d) Motors when started with the driven equipment imposing full starting torque under the supply voltage conditions specified under Clause 24.0 shall be capable of withstanding atleast two successive starts from cold condition at room temperature and one start from hot condition without injurious heating and winding. The motors shall also be suitable for three equally spread starts per hour under the above referred supply condition,
 - e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than starting time with the driven equipment of minimum permissible voltage by at least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement, the Bidder shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speed lower than 20% and open for speeds above 20% of the rated. speed. The speed switch shall be capable of withstanding 120% of the rated speed in either direction of rotation.

32.4 Running

Requirements:

- a) The maximum permissible temperature rise over the ambient temperature of 50 degree C shall be within the limits specified in IS:325 (for 3 - phase induction motors) after adjustment due to increased ambient temperature specified. The limits specified in IS:325 (for 3- phase induction motors)after adjustment due to increase ambient temperature specified
- b) The double amplitude of motor vibration shall be with in the limits specified in IS 4729. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.
- c) All the induction motors shall be capable of running at. 80% of rated voltage for a period or 5 minutes with rated load commencing from hot condition.

33.0 TESTING

AND

COMMISSIONING

An indicatives list of tests is given below. Contractor shall perform any additional test based on specialties of the items as per the field Q.P / instructions of the equipment contractor or Owner without any extra cost to the Owner. The Contractor Shall arrange all instruments required for

Conducting these tests along with calibration certificates and shall furnish the list, of instruments to the Owner for approval.

1. Insulation resistance.
2. Phase sequence and proper direction of rotation
3. Any motor operating incorrectly shall be checked to determine the cause and condition corrected.

34.0 MAJOR TECHNICAL PARAMETERS

For 245 KV and 72.5 KV Circuit Breaker and Isolator :
Refer respective equipment Technical specifications.

ANNEXURE - A CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1.0 General:

Unless otherwise stipulated. All equipment **except power transformer** together with its associated connectors, where applicable, shall be tested for external corona both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and by measurement of radio interference voltage (RIV).

2.0 Test levels:

The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.

3.0 Test methods for RIV:

3.1 RIV tests shall be made according to measuring circuit as per International Special-Committee on Radio Interference (CISPR) publication 16-1 (1993) Part - 1. The measuring circuit shall preferably be tuned to frequency with 10% 0.5 MHz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts,

3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107-1964, except otherwise noted herein.

3.3 In measurement of RIV, temporary additional external corona. shielding may be provided. In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, 115% and 130% of the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage. is listed in the detailed specification together with maximizing permissible RIV level in microvolts.

3.5 The metering instruments shall be as per CISPR recommendation of equivalent device so long as it has been used by other testing authorities.

3.6 The RIV measurement may be made with a noises meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltages at the high voltage terminal to voltage read by noise meter.

4.0 Test methods for visible Corona

The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise value. The test voltage shall be raised to 130% of RIV test voltage and maintained there for five minutes. The voltage will then be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltage steps i.e. 85%, 100%, 115% W-id 130%. Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using Panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f/5.6 or equivalent. The photographic process shall be such that prints are available for inspection and comparison with conditions as determined from direct observation. Photographs shall be taken from above and below the level of connector so as to show corona on bushing, insulators and all parts of energized connectors. The photographs shall be framed such that, test-object, essentially, fills the frame with no cut-off.

- 4.1 The test shall be recorded on each photograph. Additional photographs shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location from the photographic evidence.
- 4.2 In addition to photographs of the test object at least four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects'. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by Owner's inspector, after determining the best camera locations by trial energisation of test object at a voltage which results in corona.
- 4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.
- 4.4 However, both test shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction Voltage testing may be permitted at the discretion of Owner's inspector if, in his opinion, it will not prejudice other test.

5.0 Test

Records:

In addition to the information previously mentioned and these requirements specified as per CISPR or NEMA 1.07 -1961 the following data shall be included in test report:

- a) Background noise before and after test.
- b) Detailed procedure of application of test voltage.
- c) Measurement's of RIV levels expressed in micro volts at each level.
- d) Results and observations with regard to location and type of interference sources detected at each step.
- e) Test voltage shall be recorded when measured RIV passes through 100 microvolts iii each direction.

Onset and extinction of visual corona for each of the four tests required shall be recorded.

ANNEXURE- B

SEISMIC WITHSTAND TEST PROCEDURE

The seismic withstanding test on the complete equipment (except Power Transformer) shall be carried out alongwith supporting structure.

The Bidder shall arrange to transport the structure from his Supplier's premises/KPTCL sites for the purpose of seismic withstand test only.

The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the Terminal Pad of the equipment and any other point as agreed by the Owner. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the Owner.

ANNEXURE-C

LIST	OF	SPECIFICATIONS
GENERAL	STANDARDS	AND CODES

Indian Electricity Grind code (IEGC)
Indian Electricity Act 2003
Indian Factories Act

IS-5 1994	Colours and	for Ready Mixed	Paints Enamels.
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IS-335	New	insulating	Oils.
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IS-617		Aluminum Ingots Engineering	and	and Castings	Aluminum for	Alloy General Purposes
IS-13-1448 (P1 to P145)		Methods and	of	Test its	For	Petroleum Products.
IS-2071 (PI to P3)		Methods	of	High	Voltage	Testing.
IS- 1.2063		Classification protection of electrical equipment		of provided	degrees by	of enclosures
IS-2165						
P 1: 1997		Insulation				Coordination.
P2: IS-2362		Determination fisher	of	Water	by	1983 Karl Method.
IS-3043		Code	of	Practice	for	Earthing
IS-3637		Gas		Operated		Relays
IS-6103		Method Resistance Electrical	of	Test (Resistivity) Insulating	for	Specific of Liquids.
IS-6104		Method Tension the	of of	Test Oil Ring	for against	Interfacial Water by Method
IS-6262		Method Dielectric Insulating	of	test Constant	for of	power factor Electrical Liquids.
IS-6792	-	Method Electric oils.	for strength	determination of		of insulating
IS-5578	-	Guide conductors.	for	making	of	insulated

IS- 11353:1985	Guide for uniform system of marking & Identification of conductors terminals.	of apparatus
IS-8263	Method Test on for High Radio voltage Interference Insulators.	
IS-9224 (Part 1, 2 & 4)	- Low Voltage Fuses	
IEC-60060 (Part I to P,-1)	- High Voltage test Techniques	
IEC-60068	- Environmental Test	
IEC- 60117	- Graphical Symbols	
IEC- 60156	- Method for the the Electrical Insulation Determination of Strength of Oils.	
IEC-60270	- Partial Discharge Measurements.	
IEC-60296	- Specification for Insulating Oils and Unused Mineral Transformers Switchgear.	
IEC-60376	Specification and New Sulphur Hex Acceptance of fluoride.	
IEC-60437	Radio Interference Test on High Voltage Insulators.	
IEC-60506	Switching Impulse Test on High Voltage Insulators.	
IEC-60507	Artificial Pollution Tests on High Voltage Insulators to be used on AC systems.	
1EC-60694	Common Voltage Standards. Specification for Switchgear & Control High gear	
IEC-60815	Guide for Insulators in the respect Selection of Polluted	

	Conditions.
IEC-60865 (1994)(P1 8& P2)	Short Circuit Current Calculation of effects.
ANSI-C. 1./NFPA.70	National Electrical Code
ANSI-C37.90A	Guide for Surge Withstand Capability (SWC) tests
ANSI-C63-2 1, C63.3	Specification for Electromagnetic Noise and Field Strength Instrumentation 10 KHz to 1 GHz
C36.4 ANSI-C68. 1	Technique for Dielectric Tests
ANSI-C76. 1/IEEE21	Standard General Requirements and Test procedure for Outdoor Apparatus Bushings.
ANSI-SI 4	Specification for Sound Level Meters
ANSI-Y32-2/C337.2-	Drawing Symbols
ANSI-Z55. 1.1 -	Gray Finishes for Industrial Apparatus and Equipment No.61. Light Gray
NEMA- 1071 -	Methods of Measurements of RIV of High Voltage Apparatus
NEMA-ICS-11 -	General Standards for Industrial Control and Systems Part ICSI-109
CISPR- I	Specification for CISPR Radio Interference Measuring Apparatus for the frequency range 0. 15 MHz to 30 MHz
CSA-Z299.1-1978h -	Quality Assurance Program Requirements
CSA-Z299.2-1979h -	Quality Control Program Requirements
CSA-Z299.3-1979h -	Quality Verification Program Requirements

CSA-Z299.4-1979h	-	Inspection Requirements	Program
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BS- 148		Insulating oil for Transformers switchgear.	
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TRANSFORMERS

IS- 10028 (Part 2 8& 3)		Code of practice for selection, installation & maintenance of Transformers (P1: 1993), (P3:199 1)	
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IS-2026 (Pl. to P4)		Power Transformers	
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IS-3347 (Part1 to Part8)		Dimensions for Porcelain transformer Bushings for use in lightly polluted atmospheres.	
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IS-3639		Fittings and Accessories for Power Transformers	
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IS-6600	-	Guide for Loading of Oil immersed Transformers.	
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IEC-60076 (Part1 to Part5)		Power Transformers	
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IEC-60214		On Load Tap-Chargers.	
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IEC-60354		Loading Guide for Oil - Immersed power transformers	
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IEC-60076		Determination of Transformer & Reactor sound levels	
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ANSI-C571280	-	General Requirements for Distribution, Power and Regulation Transformers	
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ANSI-C571,290	-	Test code for Distribution, Power and Regulation Transformers	
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ANSI-C5792		Guide for Loading Oil-Immersed lower Transformers upto and including 100MVA with 55 ⁰ C or 65 ⁰ C Winding Rise	
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ANSI-CG, IEEE-4		Standard Techniques for High	
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Voltage Testing

NEMA-TR- 1

Transformers, Regulators and
Reactors

CIRCUIT BREAKERS

IEC-62271-100

High Voltage Alternating Current
Circuit Breakers

IEC-60427

Synthetic Testing of High Voltage
alternating Current Circuit Breakers.

IEC-61624

Pressurised hollow Column Insulator

CURRENT TRANSFORMER, VOLTAGE TRANSFORMERS AND COUPLING CAPACITOR VOLTAGE TRANSFORMERS

IS-2705 (PI to P4) - Current Transformers.

IS-3156 (PI to P4) - Voltage Transformers

IS-4379 identification of the content of
Industrial Gas Cylinders

IEC- 61869-2/1 Current Transformers.

IEC- 61869-3/1 Voltage Transformers.

IE C-60358 Coupling capacitors and capacitor dividers.

IEC-61869-4 Instrument Transformers
Measurement of Partial
Discharges

IEC-60481 (1974) - Coupling devices for Power Line
Carrier Systems.

ANSI-C5713 - Requirements for Instrument
Transformers

ANSI-C92.2 - Power Line Coupling Voltage
Transformers

ANSI-C93.1 - Requirements for Power Line Carrier

		Coupling		Capacitor
BUSHING				

IS- 2099	-	Bushings above	for	Alternating	Voltages 1000V
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IEC- 60137	-	Insulated Alternating		Bushings Voltages	for above 1000V
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SURGE		ARRESTERS
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IS-3070 (Part2) (1993)	Lightning arrestors for alternating current systems Metal oxide lightening arrestors without gaps.
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IEC-60099-4 IEC-60099-5	Metal oxide Surge Arrestors without gaps. Selection and application recommendation
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ANSI-C62.1	IEE Standards for Surge Arrestors for AC Power Circuits
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NEMA-LA 1	Surge	Arrestors
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CUBICLES AND PANELS & OTHER RELATED EQUIPMENTS

IS-722, IS-1248, IS-3231,3231(P-3)	Electrical relays for power System protection
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ISAA;5039	Distributed pillars for Voltages not Exceeding 1000 Volts.
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IEC-60068.2.2	Basic environmental testing Procedures Part 2: Test B: Dry heat.
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IEC-60529	Degree of Protection provided by enclosures.
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IEC- 60947-4-1	Low voltage Switchgear and Controlgear
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IEC- 158 (upto P3-1985)	Low Voltage Control Gear Contractors.
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IEC-60439 (P 1 8& 2)	Low Voltage Switchgear and control gear assemblies
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IEC-61095	Electromechanical Contactor for household
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and similar purpose

ANSI-C37.20	Switchgear assemblies, including metal enclosed bus.
ANSI-C37.50	Test Procedures for Low Voltage Alternating Current Power Circuit Breakers
ANSI-C39	Electric Measuring instrument
ANSI-C83	Components for Electric Equipment
IS:8623: (Part I to 3)	Specification for Switchgear Control Assemblies.
NEMA-AB	Moulded Case Circuit and Systems
NEMA-CS	Industrial Controls and Systems
NEMA-PB- I	Panel boards
NEMA-SG-5	Low voltage Power Circuit Breakers
NEMA-SG-3	Power Switchgear Assemblies
NEMA-SG-6	Power Switching Equipment
NEMA-5E-3	Motor Control Centers
1248 (PI to P9)	Direct acting indicating analogue electrical measuring instruments & their accessories.

DISCONNECTING

SWITCHES

IEC- 60129	Alternating Disconnections and Earthing (Isolators) Current and switches
IEC-60265 (Part 1 and part 2)	High Voltage Switches

ANSI-C37.32		Schedule of preferred Ratings, Manufacturing Specifications and Application Guide for high Voltage Air Switches, Bus supports and switch accessories.
ANSI-C37.34		Test Code for high voltage air Switches
NEMA-SG6		Power switching equipment
TELECOMMUNICATIONS		AND LINE TRAP
		Indian Electricity Rules as amended up-to-date
IS-8792	-	Line traps for AC power system.
IS-8793	-	Methods of tests for line traps.
IS-8997	-	Coupling devices for PLC systems
IS-8998	-	Methods of test for coupling devices for PLC Systems.
IEC-60353		Line traps for AC power systems.
IEC-60481		Coupling Devices for power line carrier systems.
IEC-60495		Single sideboard power line carrier terminals
IEC-60683		Planning of (single side-band) power line carrier systems.
CIGRE		Teleportation report by Committee 34 & 35.
CIGRE		Guide, on Power line, carrier 1979.
CCIR		International Radio Consultative Committee
EIA		Electric Industries Association
PROTECTION	AND	CONTROL EQUIPMENT

IEC-60051 : (P1 to P9)		Recommendations for Direct Acting, indicating analogue electrical measuring instruments and their accessories.
IEC-60255 (Part 1 to part 23)		Electric relays.
IEC-60297 (P1 to P4)		Dimensions of mechanical structures of the 482.6mm (19 inches) series.
IEC-60359		Expression of the performance of electrical & electronic measuring equipment.
IEC-60387	-	Symbols for Alternating- Current Electricity meters.
IEC-60447	-	Man machine interface (MMI) - Actuating principles.
IEC-60521	-	Class 0.5, 1 and 2 alternating current watt hour meters
IEC-60547	-	Modular plug-in Unit and standard 19-inch rack mounting unit based on NIM standard (for electronic nuclear instruments)
ANSI-81		Screw threads
ANSI-B 18		Bolts and Nuts
ANSI-C37.1		Relays, Station Controls etc.
ANSI-C37.2		Manual control, and automatic station control, supervisory and associated telemetering equipment
ANSIA-37-2		Relays and relay system associated with electric power apparatus
ANSI-C39. I		Requirement for electrical analog indicating instatements

MOTORS

IS-325 (199 1)	Three-phase	induction	motors.
IS-4691	Degree of enclosure machinery.	protection for rotating	provided by electrical
IECI-60034 (P1 to P19)	Rotating	Electrical	Machines
IEC-Document (Central Office)	Three	phase induction	2 motors
NEMA-MGI	Motors	and	Generators
Electronic	equipment	and	components
MIL-21b MIL-833 MIL-2750			
IEC-60068 (P1 to P5)	to	Environmental	testing
IEC-60326 (P1 to P2)	to	: Printed	boards.

MATERIAL AND WORKMANSHIP STANDARDS

IS- 1363 (P I to P3)	Hexagon nuts of	headbolts, product	screws and grade C.
IS- 1364 (P1 to P5)	Hexagon nuts of	head bolts, products grades	screws and A and B.
IS-3138 (199 1)	Hexagonal to	Bolts and M	Nuts (M42 150)
ISO-898	Fasteners: studs	Bolts,	screws and
ASTM	Specification Materials	and	tests for

CLAMPS & CONNECTORS

IS-5561	Electric	power	connectors.
NEMA-CCI	Electric	Power	connectors

	for	sub	station
NEMA-CC3	Connectors aluminium Overhead Conductors	for or	Use aluminium- copper

BUS	HARDWARE	AND	INSULATORS
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IS: 2121	Fittings cored overhead	for aluminum	aluminium conductors power	and steel for lines.
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IS-731	Porcelains power lines with voltage 1000	insulators a	for	overhead nominal V.
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IS-2486 (P1 to P4)	Insulator power lines voltage greater than	fittings with	for a	overhead nominal 1000V.
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IEC- 60120	Dimensions Couplings	of of	Ball string	and insulator	Socket Unit
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IEC- 60137	Insulated alternating	bushings volt-ages	for above	1000V.
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IEC- 60168	Tests on insulators glass for Voltages	indoor and of ceramic Systems Greater	outdoor post material or with Nominal 100OV.
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IEC-60233	Tests use	on in	Hollow electrical	insulators equipment.
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IEC-60273	Characteristics outdoor systems greater	of post with than	indoor insulators nominal 1000V.	and for Voltages
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IEC-60305	Insulators nominal ceramic for AC String	for voltage or glass systems Insulator	overhead above insulator Characteristics units of the cap	lines with 1000V unit's of
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		and	pin	type.
IEC-372		Locking devices for ball and socket couplings of string insulator units : dimensions and tests.		
IEC-60383 (PI & P2)		Insulators for overhead lines with a nominal voltage above 1000V.		
IEC-60433	-	characteristics of string insulator units of the long rod type.		
IEC-60471	-	Dimensions of Clevis and tongue couplings of string insulator units.		
ANSI-C29	-	Wet process porcelain insulators		
ANSI-C29. I	-	Test methods for electrical power Insulators		
ANSI-C92.2		For insulators, wet-process porcelains and toughened glass suspension type		
ANSI-C29.8		For wet-process porcelain insulators apparatus, post-type		
ANSI-0.8		Iron and steel hardware		
CISPR-7B		Recommendations of the CISPR tolerances of form and of Position, Part 1.)		
ASTM A-1 53		Zinc, coating hot dip on iron and steel hardware		

STRAIN AND RIGID BUS-CONDUCTOR

IS-2678		Dimensions &, tolerance for Wrought. Aluminium and Aluminium Alloys drawn round type.		
IS-5082		Wrought Aluminium and Aluminium Alloy Bars, Rods, Tubes and Sections for Electrical		

purposes.

ASTM-B 230-82	Aluminium electrical	1350	H	19	Wire for purpose
ASTM-B 231-81	Concentric aluminium	-	lay 1350	-	stranded, conductors
ASTM-B 221	Aluminium rod,	-	Alloy wire,	extruded	bar, shape
ASTM-B 236-83	Aluminium purpose	bar-,	for (bus	electrical bars)	
ASTM-B 317-83	Aluminium - Alloy extruded bar, rod, pipe and structural shapes for electrical purposes (Bus Conductors)				

BATTERIES AND BATTERIES CHARGER

BATTERY

IS 1652	Stationary Cells & Batteries, Lead-acid type (with Plante positive plates)
IS 1146	Rubber & Plastic containers for Lead-acid storage Batteries
IS 6071	Synthetic separators for Lead-Acid Batteries
IS 266	Specification for Sulphuric acid
IS 1069	Specifications for Water for Storage Batteries
IS 3116	Specification for Sealing compound for Lead-Acid Batteries
IS 1248	Indicating Instruments

Battery Charger

IS 3895	Mono-crystalline Semiconductor Rectifier Cells and Stacks
IS 4540	Mono-crystalline Semiconductor Rectifier Assemblies and Equipment.

IS 6619	Safety code for Semiconductor Rectifier Equipment
IS 2026	Power Transformers
IS 2959	AC Contactors for Voltages not exceeding 1000 V
IS 1248	Indicating Instruments
IS 2208	HRC Fuses
IS 13947 (Part –3)	Air Break Switches, air break disconnectors & fuse combination units for voltage not exceeding 1000 V AC or 1200 V DC.
IS 2147	Degree of protection provided by enclosures for low voltage switchgear and controlgear
IS 6005	Code of practice for phosphating of Iron and Steel
IS 3231	Electrical relays for power system protection
IS 3842	Electrical relay for AC system
IS 5	Colours for ready mix paint
IEEE 484	Recommended design for installation design and installation of large lead storage batteries for generating stations and substations.
IEEE 485	Sizing large lead storage batteries for generating stations and substations.

WIRES

AND

CABLES

ASTMD-2863	Measuring the minimum oxygen concentration to support candle like combustion of plastics (oxygen index)
IS-694	PVC Insulated cables for working voltages upto and inclding 1100 Volts
IS 1255	Code of practice for installation and maintenance

of Power cables upto and including 33KV

IS-1554 (P1 and P2)	PVC insulated (heavy duty) electric cables part working voltage upto and including 1100V. Part (2) for working voltage from 3.3 KV upto and including 11KV.
IS-3975	Mild steel wires, formed wires and tapes for armouring of cables.
IS 1753	Aluminium conductor for insulated cable
IS 2982	Copper conductor in insulated cables
IS 3961 (P1 to P5)	Recommended current rating of cables
IS-5831	PVC insulating and sheath of electric cables.
IS-6380	Elastometric insulating and sheath of electric cables.
IS-7098	Cross linked polyethylene insulated PVC sheathed cables for working voltage from 3.3KV upto, and including 33 KV
IS-8130	conductors for insulated electrical cables and flexible cords.
IS-10418	Specification for drums for electric cables
IEC-60096 (Part 0 to Part P4)	Radio Frequency cables.
IEC- 60183	Guide to the Selection of High voltage Cables.
IFC- 60189 (P1 to P7)	Low frequency cables and wires, with PVC insulation and PVC sheath.
IEC-60227 (PI to P7)	Polyvinyl Chloride insulated of rated voltages

		tip to mid in-including 450/750 V.
IEC-60228		Conductors of insulated cables
IEC-60230		impulse tests on cables and their accessories.
IEC-60287 (P1 to P3)		Calculation of the continuous current rating of cables (100% load factor).
IEC-60304	-	Standard colours for insulation for low-frequency cables and wires.
IEC-60331	-	Fire resisting characteristics of Electrical cables.
IEC-60332 (P1 to P3)	-	Tests on electric cables under fire conditions.
IEC-60502	-	Extruded solid dielectric insulated power cables for rated voltages from 1KV up to 30KV.
IEC-754 (P1 and P2)	-	Tests oil gases evolved during Combustion of electric cables.
NEMA-WC1 -		Asbestos and Asbestos -Varnished cloth and asbestos-Thermoplastic insulated wire and cable
NEMA-WC2 -		Steel Armour and associated covering for impregnated - paper -insulated cables
NEMA-WC3		Rubber insulated wire and cable for transmission and distribution of electrical energy.
NEMA-WC5		Thermoplastic insulated wire and cables for the transmission and distribution of electrical energy
NEMA-WC7		Cross-linked thermo setting polyethylene insulated wire and cable for the transmission and distribution of electric energy
NEMA-WC8		Ethylene-propylene-rubber-

	insulated wire and cable for the and distribution of electrical energy
NEMA-W67	Cross-linked-thermo setting Polyethylene
(IPCEA, S-66-52,M)	Insulated wire and cable for the transmission and distribution of electrical energy
IPCEA S-61-402	Thermoplastic-insulated wire and cable for the transmission and distribution of electrical energy
ASTMD-2843	Standard test methods for density of smoke from burning or decomposition of plastics.
IEEE-48	Pot heads
IEEE-383	Standards for type tests of 1E class of electrical cables, field splicers and connection for nuclear power generating stations.

GALVANIZING

IS-209	Zinc Ingot
IS-2629	Recommended Practice for Hot- Dip galvanizing on iron and steel.
IS-2633	Methods for testing uniformity of coating of zinc coated articles.
ASTM-A- 123	Specification for zinc (Hot Galvanizing) Coatings, on products Fabricated from rolled, pressed and forged steel shapes, plates, bars and strips.
ASTM-A- 153	Specification for Zinc Coating (Hot Dip) on iron and steel hardware.

ASTM-A- 121-77 Zinc-coated (Galvanized) steel barbed wire

IS-6005 (199 1) Code of practice for phosphating of iron and steel

SSPEC Steel structure painting council

NFPA National Fire Protection Association

IS 636 Non percolating flexible fire fighting delivery note

IS-638 (1993) Sheet rubber jointing and rubber insertion jointing.

IS-780 (1990) Sluice valves for water-works
purposes (50 to 300 mm size)

IS- 1538 (1993) Cast iron fittings for pressure pipes for water gas and sewage.

IS-1703 (1989)	Copper alloy bar valves (horizontal plunge r type) for supply fittings.
IS-2379 (1990)	Colour code for identification of pipe lines.
10-26-13 (111 to 113:1990)	Dismiss ions for pipe thread3 for fastening purpose.
IS-2685 (1992)	Code of practice for selection, installation and maintenance of sluice valves.
IS-2906 (1990)	Specification for sluice valves for water works purposes (350 to 1200 mm size).
IS-3389 (199 1)	Seamless or electrically welded steel pipes for water, gas and sewage(168.3 to 2032 mm diameter).
IS-4038 (1990)	Foot valves for water works purposes.
IS-4927 (1992)	Unlined flax canvas hose for fire fighting.
IS-5312 (P1 and P2 : 1991)	Swing check type reflux (non-return) valves
IS- 3095 (1991)	Butterfly valves for general purpose

STEEL

STRUCTURES

IS-228	Method of chemical analysis of pig iron, cast iron and plain carbon and low alloy steels.
IS-802 (P 1 to 3)	Code of practice for use. of structural steel in overhead transmission line towers.
IS-806	Code of practice for use of steel tubes in general building construction
IS-808	Dimensions for hot rolled steel

		beam, column channel and angle sections.
IS-814		Covered electrodes for manual are welding of carbon of carbon manganese steel.
IS-816		Code of Practice for use of metal arc welding for general construction in Mild steel
IS-817		Code of practice for training and testing of metal arc-welder, Part 1: Manual Metal arc welding
IS-875 (PI to P4)		Code of practice for. design loads (other than earthquake) for buildings and structures.
IS- 116 1		Steel tubes for structural purposes.
IS- 1182		Recommended practice for radiographic examination of fusion welded butt joints in steel plates.
IS-1363 (PI to P3)		Hexagonal head-bolts, screws 7 nuts of products grade C.
IS 1364		Hexagonal head bolts, screws and nuts of product grade C
IS-1367 (P I to P18)		Technical supply condition for threaded fasteners
IS- 1599	-	Methods for bend test.
IS- 1608	-	Method for tensile testing of steel products.
IS- 1893	-	Criteria for earthquake resistant design of structures.
IS- 1978		Line pipe.
IS-2062		Steel for general structural

	purposes.
IS-2595	Codes of practice for Radiographic testing
IS-3063	Single coil rectangular section spring washers for bolts, nuts and screws.
IS-9-3664	Code of practice for ultrasonic pulse echo testing by contact and immersion methods.
IS-7205	Safety code for erection of structural steel work.
IS-9595	Recommendations for Metal arc welding of carbon and carbon manganese steels.
ANSI-B 18.2.1	Inch series square and Hexagonal bolts and screws
ANSI-B 18.2.2	Square and hexagonal nuts
ANSI-G8.14	Round head bolts
ASTM-A6	Specification for General Requirements for rolled steel plates, shapes sheet piling and bars of structural use
ASTM-A36	Specification of structural steel
ASTM-A17	Specification for malleable iron castings
ASTM-A143	Practice for safeguarding against embalmment of Hot Galvanized structural steel products and embrilement procedure for detecting
ASTM-A242	Specification for high Strength low alloy structural steel
ASTM-A283	Specification for low and

		intermediate tensile strength carbon steel plates of structural quality
ASTM-A394		Specification for Galvanized steel transmission tower bolts and nuts
ASTM-441		Specification for High strength low alloy structural manganese vanadium steel.
ASTM-A572		Specification for High strength low alloy Columbium-Vanadium
AWS DI-O		Code for welding in building construction welding inspection
AWS DI-1		Structural welding code
AISC		American institute of steel Construction
NEMA-CG 1		Manufactured graphite electrodes
PIPING	AND	PRESSURE VESSELS
IS-1239 (Part 1 8& 2) -		Mild steel tubes, tubular and other wrought steel fittings
IS-3589	-	Seamless Electrically welded steel pipes for water, gas and sewage. Steel pipe flanges
IS-6392	-	
ASME		Boiler and pressure vessel code
ASTM-AI-20		Specification for pipe steel, brick and hot dipped, zinc-coated welded and seamless
ASTM-A53		Specification for pipe, steel, black and hot dipped, zinc-coated welded and seamless
ASTM-AI06		Seamless carbon steel pipe for high temperature service

ASTM-A284	Low strength and intermediate tensile plates for carbon-silicon steel general machine parts and construction.
ASTM-A234	Pipe fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures
ASTM-A181	Specification for forgings, carbon steel for general purpose piping
ASTM-A105	Forgings, carbon steel for piping Components
ASTM-A307	Carbon steel externally threaded standard fasteners
ASTM-A193	Alloy steel and stainless steel bolting materials for high temperature service
ASTM-A345	Flat rolled electrical steel for magnetic applications
ASTM-A197	Cupola malleable iron
ANSI-B2. 1	Pipe threads (Except dry seal-)
ANSI-B 16. 1	Cast iron pipe flanges and glanged fitting class 25,125, 250 and 800
ANSI-B 16. 1	Malieable iron threaded fittings, class 150 and 300
ANSI-B 16.5	Pipe flanges and flanged fittings, steel nickel alloy and other special alloys
ANSI-B 16.9	Factory-made wrought steel butt welding fittings
ANSI-B 16. 11	Forged steel fittings, welding and socket threaded
ANSI-B 16.14	Ferrous pipe plug, bushings and

		locknuts	with	pipe	'threads
ANSI-B 16.2 5		Butt		welding	ends
ANSI-B 18.1.1		Fire	hose	couplings	screw thread.
ANSI-B 18.2.1		Inch bolts	series	square and	and. hexagonal screws
ANSI-B 18-2.2		Square	and	hexagonal	nuts
ANSI-B 18.2 1. 1		Lock			washers
ANSI-B 18-21.2		Plain			washers
ANSI-B3 1. 1		Power			piping
ANSI-B36. 10	Welded steel		and	seamless	wrought pipe
ANSI-B36.9		Stainless		steel	pipe

OTHER CIVIL WORKS STANDARDS

IS-26 9		33	grade	ordinary	Portland
		Cement.			
IS-2721	-	Galvanized fabric	steel	chain	link fence
IS-278	-	Galvanized	steel	barbed	wire for
		fencing.			
IS-383		Coarse natural	and	fine sources	aggregates from concrete.
IS-432 (PI and P2)		Mild steel wire	steel bars for	and concrete	medium hard-dawn steel reinforcement.
IS -456		Code of reinforced	of	practice for	plain and concrete.
IS-516	-	Method of Concrete	of	test for	strength of
IS-800	-	Code.	of	practice	for

	construction in steel.
IS-806	Steel tubes for structural Purposes:
IS- 1172	Basic requirements for water supply, drainage and sanitation.
IS-1199	Methods of sampling and analysis of concrete.
IS- 1566	Hard-drawn steel wire fabric for concrete reinforcement.
IS- 1742	Code of Practice for Building drainage.
IS- 1785	Plain hard-drawn steel wire for pre-stressed concrete
IS- 1786	High strength deformed Steel Bars and wires for concrete reinforcement.
IS-1811	Methods of sampling Foundry sands.
IS- 1893	Criteria for- earthquake resistant design of structures.
IS-2062	Steel for general structural purposes.
IS-2064	Selection, installation and maintenance of sanitary appliances-code of practices.
IS-2065	Code of practice for water supply in buildings.
IS-2090	High tension steel bars used in pre stressed concrete.
IS-2140	Standard galvanized steel wire for fencing.

8S-2470 (P1 8& P2 1990)	Code of practice for installation of septic tanks.
IS-2514	Concrete vibrating tables.
IS-2645	Integral cement waterproofing compounds.
IS-3025 (Part 1 Part 48)	(Part 1 Methods of sampling and test (Physical and chemical) for water mid waste water.
IS-4091	Code of practice for design and construction of foundations for transmission line towers and poles.
IS-4111 (Part I to P5)	Code of practice for ancillary structures in sewerage system.
IS-4990	Plywood for concrete shuttering work.
IS-5600	Sewage and drainage pumps.
National building code of India 1970	
USBR E12	Earth Manual by United States department of the interior
ASTM-A392-81	Bureau of Reclamation Zinc/coated steel chain link fence fabric.
ASTM-D 1557-80	test for Moisture-density relation of soils using 10-1b (4.5kg rame land 18-in.(457mm)Drop
ASTM-D 1.586	Penetration Test and Split-Barrel. Sampling of Soils
ASTM-D2040-69	Test Method for Relative Density of Cohesion less Soils
ASTM-D2435	Undrained Strengths of Cohesive Soils in Triaxial compression.

BS-5075	Specification for accelerating Part I admixtures, retarding Admixtures and Water Reducing Admixtures.
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ACSR	CONDUCTOR
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Indian Standard	Title	International	standard
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IS:6745 (1990)	Methods for Determination of mass of Zinc coated Iron and Steel Articles	BS:443-1969 coating on zinc	
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IS:8263 (1990)	Methods for Radio Interference Test on High Voltages Insulators	IEC:437-1973 ASTM: 107-1964 CISPR	
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IS:209 (1992) Zinc Ingot		BS:3436-1961	
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IS:398 (1992) Aluminium Conductors fo r Part - V (1992) overhead Transmission purposes Aluminum Conductors galvanized steel reinforced extra high voltage (400KV and above)		IEC:209-1966 BS:215 (Part-11) 1970 JEC:209-1966 BS:215 (Part-11) 1970	
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IS: 1778-1980 Reels and Drums for Bare Conductors		ISO/R89-1959	
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IS: 152 1 (199 1)	Method for Tensile Testing of steel	ISO/R89-1959	wire
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IS:2629 (1990)	Recommended practice dip Galvanizing on steel	for Iron	Hot and
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IS:2633 (1992)	Method for Testing coating of zinc Coated Articles.	Uniformity	of
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IS:4826 (1992)	Hot dip galvanized coatings on round steel	ASTMA-472-729	wires
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GALVANIZED	STEEL	EARTHWIRE
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IS: 1521 (199 1)	Method for Tensile Testing of Steel Wire	ISOIR:	1959
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IS: 1778 (1980)	Reels and Drums for More Conductors	
IS:2629 (1990)	Recommended practice for Hot Dip Galvanizing on Iron and steel.	
IS:2633 (1992)	Methods for testing Uniformity of coating of Zinc Coated Articles.	
IS:4826 (1992)	Hot dip Galvanized Coatings on Round Steel	ASTM:A 475-72a BS-443-1969

Indian Standard	Title	International standard
IS:6745 (1990)	Method for Determination of mass of Zinc coated Steel Articles.	BS:443-1969 Iron and
IS:209 (1992)	Zinc ingot	BS:3436-1961
IS:398 (11) to P5 1992)	Aluminum conductors for overhead transmission purposes.	BS:215 (Pfu,t-I1)