

MATERIAL AND EQUIPMENT STANDARD**FOR****GENERAL ELECTRICAL ITEMS****FIRST EDITION****DECEMBER 2007**

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1. SCOPE

1.1 This Standard specification covers the minimum requirements for design, manufacture and quality control of general electrical items (bulk materials) to be used in oil, gas and petrochemical industries in Iran.

1.2 The general requirements are given in this specification; the specific requirements will be given in requisition and / or purchase order.

1.3 The following items are covered under this specification:

- Motor control stations
- Lighting panels
- Lighting fixtures
- Lighting poles
- Welding socket outlets
- Convenience socket outlets
- Junction boxes and terminal boxes
- Conduits and fittings
- Bus ducts
- Cable trays and ladders
- Cable glands
- Cable terminations and joints
- Grounding materials
- Identification tags

Where additional items are required for any project, such items shall be specified in an addendum attached to this specification.

Note: The specification number of the revised version of this standard specification is changed from IPS-M-EL-185(0) and IPS-M-EL-290(0) to IPS-M-EL-161(1).

2. REFERENCES

2.1 The electrical materials under this specification shall be manufactured and tested in accordance with the applicable sections of the latest edition of International Electrotechnical Commission "IEC" standards, in particular the following;

- IEC 60051-2 Special Requirements for Ammeters and Voltmeters
- IEC 60079-0 Explosive Atmospheres, Equipment-General Requirements
- IEC 60079-1 Electrical Apparatus for Explosive Gas Atmospheres, Flameproof Enclosures "d"
- IEC 60079-7 Electrical Apparatus for Explosive Gas Atmospheres, Type of Protection "e"

IEC 60079-10	Electrical Apparatus for Explosive Gas Atmosphere, Classification of Hazardous Areas
IEC 6079-15	Electrical Apparatus for Explosive Gas Atmospheres, Type of Protection “n”
IEC 60309	Plugs Socket-Outlets and Couplers for Industrial Purposes
IEC 60423	Outside Diameters Of Conduits for Electrical Installations and Threads For Conduits and Fittings
IEC 60439-2	Low voltage Switchgear and Controlgear Assemblies, Particular requirements for Bus bar Trunking Systems (Bus ways)
IEC 60502-4	Power Cables Test Requirement on Accessories for Cables 6 kV up to 30 kV
IEC 60529	Degree of Protection Provided by Enclosures
IEC 60598	Luminaires
IEC 62444	Cable Glands for Electrical Installations (or EN 50262)
API RP 505	Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1 and Zone 2

2.2 Any deviation from this specification and the above mentioned references shall be clearly mentioned in vendor's proposal.

3. SERVICE CONDITION

3.1 Materials specified herein will be installed indoor or outdoor which will be specified in requisition and/or purchase order.

3.2 The atmosphere is tropical, dusty and corrosive. The ambient air temperature, relative humidity and elevation of the location in which the materials will be used shall be indicated in requisition and/or purchase order.

3.3 The voltage levels adopted in the Oil, Gas and Petrochemical Industries of Iran are based on the IEC recommendation No. 60038.

3.4 The low voltage system is 400/230 volt. The medium voltage system is 6 Kv and the high voltage system is 10 Kv, 20 Kv and 30 Kv. The voltage variation is plus or minus 10 percent.

3.5 The neutral point of low voltage system is solidly earthed. The neutral point of medium voltage and high voltage systems are earthed through current limiting resistors.

3.6 The utilization voltages are the following:

- Medium voltage power supply: 6 Kv, 3 phase
- Low voltage power supply: 400 V, 3 phase and neutral
- Welding socket outlets: 400 V, 3 phase and neutral plus earth.
- Convenience socket outlets: 230 V, 1 phase and neutral plus earth
- Lighting: 230 V, 1 phase and neutral plus earth
- Contactors, control voltage : 230 V, 1 phase and neutral

- Circuit breakers, control voltage: 110 V dc
- Anti-condensation heaters: 230 V, 1 phase and neutral plus earth wire for heaters up to 3 kW. For heaters 3 kW and above, the supply voltage will be 400 volt, 3 phase, four wire plus earth wire.

3.7 The frequency of the electrical system is 50 Hz and the frequency variation is plus or minus 5 percent.

4. HAZARDOUS AREA REQUIREMENTS

4.1 The industrial areas in the Iranian Petroleum Industry are classified as zone 0, zone 1, zone 2 and safe area as defined in IEC 60079-10. The areas classified as zone 0, zone 1 and zone 2 are generally referred to as hazardous areas.

4.2 The extent of each hazardous area zone is according to the guidelines and demonstrated examples outlined in API RP505.

4.3 General electrical items shall be suitable for the appropriate hazardous area zone as specified in this standard specification and shall be in accordance with the recommendations of IEC publications group 60079 (electrical apparatus for explosive gas atmosphere).

4.4 Unless otherwise specified in requisition and/or purchase order the gas group requirement of the general electrical items shall be group IIB and the temperature class shall be T3. In areas where hydrogen is present in sufficient qualities so that they are classified as IIC, the gas group requirement of the general electrical items shall be IIC.

4.5 The general electrical items for use in hazardous areas shall be certified by recognized international or national certifying authorities which are among the following: Underwriters Laboratories Inc. (UL) of USA, the Ex Certification Bodies of IEC or the Notified Bodies for ATEX certification. Certificate of conformity indicating the certifying authority shall be supplied by the vendors at quotation stage.

5. TECHNICAL SPECIFICATIONS

5.1 Motor Control Stations

5.1.1 Motor control stations include pushbuttons and necessary components which will be used generally for start and stop of motors. They can also be used for controlling other electrical consumers such as lighting, heating etc. In some technical documents they may be referred to as start-stop pushbuttons.

5.1.2 The types of motor control stations which will be shown on drawings or requisition are the following:

- Type A1 includes start and stop pushbuttons
- Type A2 includes start and stop pushbuttons and an ammeter
- Type B1 includes start and stop pushbuttons plus a three position selector switch
- Type B2 includes start and stop pushbuttons plus a three position selector switch and an ammeter
- Type C1 includes one start pushbutton with normally open contact/s.
- Type C2 includes one stop pushbutton with normally closed contact/s (for emergency stop).

The function of the selector switch included in type B1 and B2 can be either Hand-Off-Auto or Local-Off-Remote which shall be marked on the motor control station as indicated on drawings or requisition.

5.1.3 Indicating light/s may be required to show Run, Stop or Fault condition on the motor control station. Such requirement will be shown on drawing/s, or requisition, when necessary.

5.1.4 Motor control stations will be generally located near the motors which they control.

5.1.5 The enclosure of the motor control stations shall be made of cast iron or copper free aluminum complete with earth terminals inside and outside of the enclosure. Vendor shall specify the metal and the thickness of the metal in his proposal. For indoor applications, enclosures made of Glass Reinforced Plastic (GRP) can be acceptable upon the approval of the Engineer.

5.1.6 Metallic enclosures shall be painted as per manufacturer's standard. Electrostatic powder coating is preferable. Vendor shall specify the type of painting and the color of enclosures in his proposal.

5.1.7 The enclosures of motor control stations for use in areas classified as zone 1 and zone 2 shall be Exd type with a degree of protection of IP65. Unless otherwise specified in requisitions the gas group classification shall be group IIB and the temperature class shall be T3. In areas where hydrogen is present the gas group classification shall be IIC with temperature class of T3. For ease of interchangeability similar motor control stations shall be used in safe areas of industrial plants (Exd IIBT3, Exd IICT3).

5.1.8 Pushbuttons and selector switches shall be suitable for operation on 230 V ac and 110 V dc. The contacts shall be rated for at least 5 amps.

5.1.9 Pushbuttons shall be spring return type.

5.1.10 Stop pushbuttons shall be fitted with suitable means to prevent accidental operation. Stop pushbuttons, except emergency stop buttons, shall be padlockable at depressed (Off) position.

5.1.11 Pushbuttons shall be colored. Green for start button and Red for stop button.

5.1.12 Pushbuttons, selector switch and ammeter shall be wired to terminal blocks within the enclosure of the motor control station.

5.1.13 Two cable or conduit entries shall be provided at the bottom of the enclosure. One of the entries shall be equipped with Exd stopper plug. The cable or conduit entries to the enclosure shall be with metric threads of ISO form according to IEC 60423.

5.1.14 Ammeter shall be incorporated in the motor control station. Ammeter installed in separate enclosure adjacent to motor control station can be acceptable upon prior approval of the Engineer.

5.1.15 Ammeters shall be in accordance with the requirements of IEC 60051. The accuracy class shall be 1.5 minimum.

5.1.16 Ammeters in motor control stations will operate from a CT with 1 amp secondary current.

5.1.17 Ammeters for motor duty shall withstand the motor starting current and shall have a compressed overload scale of at least 6 times the full load current of the motor. The full load current of the motor shall be indicated by a red line on the ammeter scale.

5.1.18 Motor control stations shall be provided with labels indicating the tag number of the motor or equipment it controls and the operating function of pushbuttons and selector switch. Labels shall be according to clause 5.14 of this specification and shall be fixed to the enclosure by screws or rivets and not to be pasted.

5.2 Lighting Panels

5.2.1 Lighting panel is an enclosure in which switches, fuses, miniature circuit breakers and other auxiliary components such as contactors, relays, timers etc. are installed. The lighting circuits, socket outlets and small power consumers are fed from such panel.

5.2.2 Components installed in the lighting panel/s will be specified in requisition and/or drawing/s. The panel/s shall be supplied complete with all components, wired to suitable terminals. Vendor shall indicate the type, size and manufacturer of the components in his proposal.

5.2.3 In case where, the purchaser requires empty enclosure/s, to be installed in safe areas, this will be clearly indicated in requisition and/or purchase order. Such panels may not be installed in hazardous areas.

5.2.4 The enclosure of lighting panel shall be metallic, made of Aluminum alloy, cast iron or similar. Glass Reinforced Plastic (GRP) can be acceptable for indoor use upon prior approval of the Engineer.

5.2.5 The enclosure of lighting panels for use in classified areas of zone 1 and zone 2 shall be Exd type with a degree of protection IP65. The gas group classification shall be IIB or IIC as indicated in requisition with temperature class of at least T3 (Exd IIBT3, Exd IICT3).

5.2.6 For standardization purpose, similar type of lighting panels selected for zone 2 areas shall be used in safe areas of industrial plants.

5.2.7 For safe areas, indoor application, enclosures with degree of protection IP 54 is acceptable.

5.2.8 Lighting panels with hinged cover door or removable cover door is acceptable. Hinged cover door is preferable. The cover bolts shall be stainless steel.

5.2.9 Lighting panels shall have the required numbers of entries indicated in requisition or drawing/s. The size of the entries shall be suitable for the cables or conduits specified in requisition or drawing/s.

5.2.10 All entries to lighting panels shall be with ISO metric threads according to IEC 60423. Unused entries of Exd enclosures shall be closed with Exd stopper plugs.

5.2.11 Suitably sized earthing studs shall be provided inside and outside of the lighting panels.

5.2.12 Metallic enclosures of lighting panels shall be painted according to manufacturer's standard. Electrostatic powder coating is preferable. Vendor shall specify the type of painting and the color of the panels in his proposal.

5.2.13 Identification label according to article 5.14 of this specification inscribed with the lighting panel identification number shall be fixed on each panel. The labels shall be fixed on the panels by screws or rivets and not to be pasted.

5.3 Lighting Fixtures

5.3.1 The lighting fixtures in the process plants shall be fluorescent type in white color as far as practical. Flood lights with mercury vapor lamps can be used where applicable.

5.3.2 The lighting fixtures for street lighting and high industrial buildings such as generator buildings, compressor buildings, workshops and similar, shall be with mercury vapor lamps.

5.3.3 For buildings such as control rooms, substations and similar, fluorescent fixtures can be used. Incandescent fixtures can be used as decorative lighting.

5.3.4 For fence lighting, the fixtures with high pressure mercury vapor lamps or high pressure sodium vapor lamps can be used, as selected by the Engineer. Sodium vapor lamps shall not be used in areas where fire hazard is envisaged.

5.3.5 Flood lights with mercury vapor lamps installed on towers or poles of adequate length can be used for general area lighting such as storage tank areas, loading and unloading areas, parking areas and similar.

5.3.6 Specially designed aircraft warning lights shall be installed on stacks and tall structures according to the recommendations of the Convention on International Civil Aviation.

5.3.7 All lighting fixtures except portable lamps shall be suitable for 230 volt single phase and neutral, 50 Hz power supply.

5.3.8 Portable lamps shall be suitable for 50 volt ac and shall be fed through double wound transformers fully isolated from earth.

5.3.9 Lighting circuits will be fed from lighting panels by means of miniature circuit breakers.

5.3.10 In hazardous areas classified as zone 0 according to article 4 of this standard specification, no lighting fixtures shall be installed.

5.3.11 In hazardous areas classified as zone 1, the lighting fixtures shall be flameproof Exd type with a degree of protection IP65. The gas group classification of Exd fixtures shall be at least group IIB. Where hydrogen is present, the gas group classification shall be group IIC. The maximum surface temperature of Exd fixtures shall be suitable for the appropriate gas in the subject area and shall in no case be more than 200°C which corresponds to T3 according to IEC 60079-0 (Exd IIBT3 or Exd IICT3).

5.3.12 In hazardous areas classified as zone 2 the lighting fixtures shall be increased safety Exe according to IEC 60079-7. Lighting fixtures suitable for zone 1 as specified in 5.3.11 can also be used in zone 2 areas. The lighting fixtures with explosion protection of ExnA or ExnC in accordance with IEC 60079-15 can be used in zone 2 areas with prior approval of the Engineer. The maximum surface temperature of Exe and Exn fixtures shall be suitable for the appropriate gas in the subject area and shall in no case be more than 200°C which corresponds to T3 according to IEC 60079-0 (Exe IIT3, ExnA IIT3 or ExnC IIT3).

5.3.13 For standardization purpose, the same type of lighting fixtures selected for zone 2 areas shall be used in safe areas of industrial plants.

5.3.14 Cable or conduit entries to the lighting fixtures shall be with ISO metric threads according to IEC 60423.

5.3.15 Internal terminals of the lighting fixtures shall be suitable for the size of the power supply cable as indicated in requisition or drawing/s and shall not be less than 2.5 mm².

5.3.16 All lighting fixtures shall have looping facility.

5.3.17 Necessary mounting accessories for all fixtures shall be supplied by the vendor.

5.3.18 The vendor of lighting fixtures shall submit a separate proposal for the supply of lamps and other optional accessories on unit price basis.

5.4 Lighting Poles

5.4.1 Lighting poles shall be made of steel, complete with base plate and anchor bolts. Anchor bolts with nuts and washers shall be supplied by the vendor.

5.4.2 Lighting poles can be hot dipped galvanized or painted steel. The painting shall be according to manufacturer's standard. The color and the painting method shall be indicated in the vendor proposal.

5.4.3 The height of the lighting poles shall be as indicated in requisition or drawing/s. The height and the metal thickness of the lighting poles shall be indicated in the vendor proposal.

5.4.4 Lighting poles for use in zone 1 and zone 2 areas shall have a junction box welded to the pole which includes suitable terminals to be connected to the incoming cable. An opening shall be provided in the pole to carry the branch cable from the junction box to the lighting fixture. The junction box shall be according to article 5.7 of this standard specification. Looping facility shall be provided in the junction box.

5.4.5 Lighting poles for use in safe areas may be fitted with a wiring compartment in their lower part with a small door for access to terminals and fuses. The access door shall be rain tight and shall be easily removable. The dimension of access doors shall be indicated in vendor proposal.

5.4.6 Earthing studs shall be provided on the pole frame and inside the junction box or wiring compartment.

5.5 Welding Socket Outlets

5.5.1 The welding socket outlets and the corresponding plugs shall be 400 volt, 3 phase, 63 amps 4 pins (3 phase and neutral) complete with means for earthing connection. The earthing connection (e.g. pin) shall be made before the plug is fully inserted and shall be disconnected after the plug is withdrawn.

5.5.2 Installation of socket outlets in zone 1 areas is not recommended unless absolutely necessary and approved by the Engineer. The welding socket outlets and plugs for use in zone 2 areas shall be Exd type with a degree of protection IP 65. Unless otherwise specified in requisition the gas group classification and the temperature class shall be group IIBT3. In areas where hydrogen is present the gas group classification and the temperature class shall be IICT3. For ease of interchangeability, similar socket outlets shall be used in safe areas of industrial plants (Exd IIBT3, Exd IICT3).

5.5.3 The enclosure of welding socket outlets shall be metallic and corrosion resistant. The metal shall be specified in vendor proposal.

5.5.4 In addition to the earthing connection inside the socket, an earthing stud shall be provided outside the metallic enclosure.

5.5.5 The welding socket outlets shall be equipped with a 4 pole ON-OFF switch .It shall not be possible to insert or withdraw a plug when the switch is in ON position. Socket outlet can only be energized when the plug is fully inserted. Means shall be provided to padlock the switch in OFF position.

5.5.6 A cap, connected to the welding socket outlet by means of a chain, shall be provided to close the entrance of the socket when no plug is inserted.

5.5.7 Power entry to the welding socket outlet will be either via 4 core 16 mm² cable or by means of 16mm² wires (4 wires plus an earth wire) in metallic conduit. The cable will be copper conductor, PVC insulated, lead covered, with single wire armour. The armour will be used as earth conductor. The wires will be copper conductor with PVC insulation. Internal terminals of the socket outlets shall have looping facility.

5.5.8 Cable or conduit entries to the welding socket outlets shall be with metric threads of ISO form according to IEC 60423.

5.6 Convenience Socket Outlets

5.6.1 The convenience socket outlets and the corresponding plugs shall be 230V single phase and neutral, 16 amps 3 pins (phase, neutral and earth). The earthing pin of the plug shall be made before the plug is fully inserted, and shall be disconnected after the plug is withdrawn.

5.6.2 Installation of socket outlets in zone 1 areas is not recommended unless absolutely necessary and approved by the Engineer. The convenience socket outlets and plugs for use in zone 2 areas shall be Exd type with a degree of protection IP 65. Unless otherwise specified in requisitions the gas group classification and the temperature class shall be group IIBT3. In areas where hydrogen is present the gas group classification and the temperature class shall be IICT3. For ease of interchangeability, similar socket outlets shall be used in safe areas of industrial plants (Exd IIBT3, Exd IICT3).

5.6.3 The enclosure of convenience socket outlets shall be metallic and corrosion resistant. The metal shall be specified in vendor proposal. Glass Reinforced Plastic (GRP) is acceptable for installation in safe indoor areas.

5.6.4 In addition to the earthing connection inside the socket, an earthing stud shall be provided outside the metallic enclosure.

5.6.5 The convenience socket outlets shall be equipped with a 2 pole ON-OFF switch. It shall not be possible to insert or withdraw a plug when the switch is in ON position. Socket outlet can only be energized when the plug is fully inserted. Means shall be provided to padlock the switch in OFF position.

5.6.6 A cap, connected to the convenience socket outlet by means of a chain, shall be provided to close the entrance of the socket when no plug is inserted.

5.6.7 Power entry to the convenience socket outlet will be either via 2 core 4 mm² cable or by means of 4 mm² wires plus an earth wire in metallic conduit. The cable will be copper conductor, PVC insulated, lead covered, with single wire armour. The armour will be used as earth conductor. The wires will be copper conductor with PVC insulation. Internal terminals of the socket shall have looping facility.

5.6.8 Cable or conduit entries to the convenience socket outlets shall be with metric threads of ISO form according to IEC 60423.

5.7 Junction Boxes and Terminal Boxes

5.7.1 Junction box or terminal box is an enclosure in which electrical connections are made. Such boxes can be circular or rectangular, which are used for connection of power cables and/or wires or control cables and/or wires.

5.7.2 Junction boxes and terminal boxes shall be made of copper free Aluminum or cast iron. Glass Reinforced Plastic (GRP) will be acceptable for installation in safe indoor areas.

5.7.3 The boxes for use in classified areas zone 1 shall be Exd type with a degree of protection IP65. The gas group classification and the temperature class shall be IIBT3 or IICT3 as specified in requisition or drawing/s (Exd IIBT3, Exd IICT3).

5.7.4 The boxes for use in zone 2 areas shall be Exe IIT3. The boxes specified in 5.7.3 can also be used in zone 2 areas (Exe IIT3).

5.7.5 For ease of interchangeability, similar boxes selected for zone 2 areas shall be used in safe areas of industrial plants.

5.7.6 The boxes shall have the required numbers of entries indicated in requisition or drawing/s. The size of the entries shall be suitable for the cables or conduits specified in requisition or drawing/s.

5.7.7 All entries to the boxes shall be threaded with metric threads of ISO form according to IEC 60423.

5.7.8 Internal and external earth studs shall be provided in all junction boxes and terminal boxes.

5.7.9 The boxes shall be painted according to manufacturer's standard. Electrostatic powder coating is preferable. Vendor shall specify the type of painting and the color of the boxes in his proposal.

5.7.10 Necessary mounting accessories including bolts, nuts and washers shall be supplied for installation of the boxes on walls or steel structures as specified in requisition or purchase order.

5.7.11 Identification labels according to article 5.14 of this specification shall be fixed on the boxes to be used by the purchaser. The labels shall be fixed on the boxes by screws or rivets and not to be pasted. The boxes which may not require identification labels will be indicated in requisition or purchase order.

5.8 Conduits and Fittings

5.8.1 Conduits for use in zone 1 areas shall be rigid steel, hot dipped galvanized heavy gauge, solid drawn (seamless) with metric threads of ISO form according to IEC 60423.

5.8.2 Welded type conduits with the same specification as 5.8.1 can be used in zone 2 areas.

5.8.3 Conduit fittings shall be Exd type for zone 1 and zone 2 areas.

5.8.4 Minimum size of exposed conduits (surface mounted) shall be 20 mm.

5.8.5 In cooling towers area aluminium conduits shall be used. Copper free aluminium fittings shall be used with aluminium conduits.

5.8.6 Concealed conduits for use in offices, buildings etc. can be rigid steel black enameled (or galvanized). PG thread for black enameled conduits in accordance with DIN 40430 is acceptable.

5.8.7 Where flexible conduits are to be used to connect vibrating equipment to instruments or conduit fittings, they shall be suitable for the hazardous areas where they are to be installed.

5.8.8 Sealing fittings shall be supplied, to be installed where conduits run between safe and hazardous areas and also as close as possible to the equipment or components to which the conduits will enter. The required numbers of such fittings will be specified in requisition or purchase order.

5.8.9 The supplier of conduit system shall quote for all necessary conduit accessories including couplings, caps, U bolts, clamps etc.

5.9 Bus Ducts

5.9.1 Bus ducts or busways can be used to connect the secondary side of power transformers or the output of power generators to the corresponding switchgears.

5.9.2 Where a transformer or a generator is installed outdoor, bus ducts shall pass through the wall of the switchgear building.

5.9.3 Bus ducts shall be made of galvanized steel with minimum degree of protection IP54. Vendor shall indicate the metal thickness in his proposal. Painted steel will also be considered.

5.9.4 Necessary numbers of openings with removable covers shall be provided on the bus ducts for inspection purposes.

5.9.5 Bus ducts shall be totally enclosed non-ventilated and shall include conductors and insulating supports.

5.9.6 The rated phase to phase voltage between conductors and the rated current of conductors will be specified in requisition and/or purchase order.

5.9.7 Conductors in bus ducts shall be copper, covered with insulating material. The vendor shall specify the insulating covering in his proposal.

5.9.8 The insulating covering of the conductors shall be done at the manufacturer's shop. Unless otherwise specified in requisition the color of the insulating covering shall be red, yellow, blue for phase conductors and black for neutral conductor.

5.9.9 The size of copper conductors, if not specified in requisition or drawing/s, shall be calculated based on 110 percent of the rated current of the upstream transformer or generator, taking into account the appropriate derating factors.

5.9.10 The size of the neutral conductor can be half of the size of phase conductors.

5.9.11 Conductor joints shall be tin plated. Vendor shall supply necessary bolts, nuts, washers and insulating material for jointing the conductors.

5.9.12 Insulated conductors shall be braced and supported to withstand the thermal and mechanical effects of the worst case of short circuit current for a duration of 1 second.

5.9.13 At least two earthing bolts shall be provided on each bus duct to be connected to earthing conductors. The size of earthing conductors can be assumed 70 mm² unless otherwise specified. Different sections of a bus duct shall be electrically connected.

5.9.14 The construction of the bus duct and the copper conductors shall be such as to suit the terminals of the equipment at both ends. Suitable flanges shall be provided for both ends.

5.9.15 Vendor shall supply expansion units, flexible conductors etc. when necessary.

5.10 Cable Trays and Ladders

5.10.1 Cable trays and ladders shall be made of hot dipped galvanized steel. Cable trays and ladders made of Glass Reinforced Plastic (GRP) are acceptable upon approval of the Engineer.

5.10.2 Cable trays shall be supplied with covers made from the same material as the cable tray. Clips or screws shall be provided to fix the cover after the installation of cables.

5.10.3 Accessories for cable trays and cable ladders such as bends, tees, risers, couplers, crosses, reducers etc. shall be made from the same material as the cable tray or ladder.

5.10.4 The metal thickness of trays, ladders and accessories shall be indicated in vendor's proposal.

5.10.5 Fixing materials such as clamps, straps, fasteners, bolts and nuts etc. shall be made of hot dipped galvanizes steel, or stainless steel, and shall be supplied by the vendor.

5.10.6 All materials shall be suitable for the environmental condition specified, and shall be ready for assembling at site without any modification. Additional coating or painting shall not be required at site.

5.10.7 Supports for trays and ladders shall be provided by the vendor. Unless otherwise specified in the requisition the spacing between two supports shall not be more the 1.2 meter for trays and not more than 2.5 meter for ladders.

5.10.8 Metallic trays and ladders shall be earthed by means of a 10 mm² earthing conductor. Bonding straps shall be provided to connect electrically all sections of metallic trays or ladders and accessories.

5.10.9 Unless otherwise indicated in requisition or drawing/s, maximum two layers of cables will be installed on trays or ladders.

5.11 Cable Glands

5.11.1 Cable glands shall be manufactured and tested in accordance with IEC 62444 or EN 50262.

5.11.2 Cable glands shall be suitable for the type and size of the cables and the type of the enclosures to which the cable entry will be made.

5.11.3 Unless otherwise specified, the cables are lead sheathed, single wire armoured with PVC over sheath.

5.11.4 Cable glands shall provide sealing of inner sheath, outer sheath and the lead sheath of the cable, and shall provide clamping of the single wire armour.

5.11.5 Cable glands shall be made of Nickel Plated Brass. Stainless steel cable glands will be used for special applications. The material of cable glands will be indicated in requisition or purchase order.

5.11.6 Glands for single core cables shall be made of Nickel Plated Brass.

5.11.7 Cable glands for use in zone 1 and zone 2 areas shall be certified Exd IIB or IIC type as indicated in requisition with a degree of protection IP65. For ease of interchangeability similar cable glands shall be used in safe areas of industrial plants.

5.11.8 The threads of cable glands shall be metric threads of ISO form according to IEC 60423.

5.11.9 Cable glands shall be supplied complete with manufacturer's standard shroud or sleeve.

5.12 Cable Termination and Joints

5.12.1 Cable termination and joints shall be supplied in kit form and shall include all insulating and setting material, conductor fittings and all required consumables.

5.12.2 The straight cable joint kits shall be suitable for jointing underground buried cables. The cables are with lead sheath and single wire armour. The size of conductors will be indicated in requisition and/or purchase order. Unless otherwise indicated in requisition and/or purchase order, the insulation of 400 volt low voltage cables is PVC and the insulation of medium voltage and high voltage cables is XLPE.

5.12.3 Cable accessories for medium and high voltage cables (6 Kv to 30 Kv) shall fulfill the test requirements of IEC 60502-4.

5.13 Grounding Materials

5.13.1 Grounding system in industrial areas shall consist of a grounding loop with radial taps to equipments, structures and to lightning protection air rods when necessary.

5.13.2 The grounding loop shall be connected to grounding rods or grounding plates. Sufficient grounding rods or grounding plates shall be installed so that the resistance between the grounding loop at any point of the loop and the ground shall be limited to one ohm.

5.13.3 The selection of the grounding system which can consist of grounding rods or grounding plates will depend on the nature of the soil and will be shown on drawing/s.

5.13.4 Grounding rods can be directly driven into ground (by hand or by power hammer) or will be installed in ground wells with suitable depth and back filled with suitable material. The depth of ground wells will be shown on drawing/s.

5.13.5 Grounding plates will be installed in ground wells with suitable depth as indicated in requisition or drawing/s, and will be backfilled with suitable material.

5.13.6 Grounding rods shall be made of solid hard drawn copper with minimum diameter of 16mm and minimum length of 1.2 meter. Driving caps and driving tips shall be made of high strength steel.

5.13.7 Together with grounding rods, sufficient screws (coupling studs) shall be provided to connect the required numbers of grounding rods together in order to drive them into ground or install them into ground wells as one piece. Also, sufficient numbers of clamps shall be provided to connect two stranded copper conductor to the upper grounding rods. The clamps shall accommodate conductors up to 95 mm².

5.13.8 Grounding plates which will be installed in ground wells shall be made of copper of at least 60×60×5cm. The plates shall be welded or brazed to a lead wire of 95mm² copper conductor, with a length to suit the depth of the wells.

5.13.9 Air rods for lightning protection which will be installed on tall buildings and structures shall be made of nickel chrome coated copper with a diameter of not less than 16 mm. the supplier shall propose the suitable length of the air rods in his proposal which shall not be less than 50 cm.

5.13.10 Air rods shall be supplied complete with base plate and required accessories suitable for connection to down conductors. The type and size of down conductors which can be copper tape or copper wire will be indicated in requisition or drawing/s.

5.13.11 The lead wires from grounding rods and grounding plates, also the copper tape or copper wire from the air rods shall be welded or brazed to the grounding loop.

5.13.12 The supplier of grounding material shall quote for all necessary accessories for the complete grounding system including clamps, connectors, tools and brazing or welding equipment.

5.14 Identification Tags

5.14.1 Identification tags or labels shall be inscribed with identification number of the equipment or cable.

5.14.2 Tags or labels shall be made of stainless steel and shall be permanently fixed to the equipment or to the cables.

6. TEST AND INSPECTION

6.1 The materials under this specification shall be factory tested. Certified copies of test reports and/or certificates where applicable, shall be submitted to the purchaser. The numbers of certified copies required will be specified by the purchaser in the purchase order.

6.2 Routine tests and type tests shall be performed according to the requirements of relevant IEC recommendation/s.

6.3 The purchaser's inspectors shall be granted the right for inspection at any stage of manufacture and testing.

6.4 Purchaser will require the presence of his nominated representative to witness the final inspection and tests. The supplier shall inform the date of such tests at least four weeks in advance.

7. DOCUMENTATION

7.1 The vendor shall supply the necessary information with the quotation to enable evaluation of the submitted proposal.

The documents to be supplied with the quotation shall at least include the following:

- a) Brochures and catalogues containing description of typical materials.
- b) Specific technical data for the material.
- c) Summary of exceptions/deviations to this standard specification.
- d) Type of packaging and approximate shipping weights.

8. SHIPMENT

8.1 The supplier of the general electrical items (or bulk materials) is responsible for packaging and preparation for shipment.

8.2 The packaging and preparation for shipment shall be adequate to eliminate damage during loading, transport and off-loading.

8.3 Necessary corrosion protection means shall be provided to inhibit corrosion during storage of general electrical items at site.

8.4 Each shipping package shall be provided with permanently attached identification tag containing necessary information such as name and quantity of each item.

8.5 Shipping documents with exact description of material for custom clearance shall be supplied.

9. GUARANTEE

9.1 The supplier of material under this specification shall guarantee the subject material and shall replace any material/part damaged as a result of poor workmanship and/or faulty design.

9.2 The guarantee period shall be 12 months after the subject material is placed in service which shall not exceed 18 months from date of dispatch from the manufacturer works.