

SECTION: 2.9

MEDIUM VOLTAGE CABLING

1.0 **Scope**

1.1 The scope of work shall cover supply, laying, connecting, testing and commissioning of low and medium voltage power and control cabling.

2.0 **Standards**

2.1 The following standards and rules shall be applicable:

- 1) IS: 1554 Parts I & II PVC Insulated Heavy duty cable
- 2) IS: 3961 Recommended current Rating of cable
- 3) IS: 7098 XLPE Insulated cables

All codes and standards mean the latest.

3.0 **Cables**

3.1 All cables shall be 1100 Volt grade PVC insulated, sheathed with or without steel armouring as specified and with an outer PVC protective sheath. All cables shall have Flame Retardant, Low Smoke Sheath (FRLS) and meet, ASTM norms for the smoke density and Oxygen Index norms. Cables shall have high conductivity stranded aluminium or copper conductors and cores colour coded to the Indian Standards.

3.2 XLPE cables shall be same as PVC with an FRLS outer sheath.

3.3 All cables shall be new without any kinks or visible damage. The manufacturers name, insulating material, conductor size and voltage class shall be marked on the surface of the cable at every 600mm spacing.

4.0 **Installation**

4.1 Cables shall be laid in the routes marked in the drawings. Contractor shall install all conduits/Pipes required for the cable work as per drawings. Where the route is not marked, the contractor shall mark it out on the drawings and also on the site and obtain the approval of the Architect/Consultant before laying the cable. Procurement of cables shall be on the basis of actual site measurements and the quantities shown in the schedule of work shall be regarded as a guide only.

- 4.2 Cables shall be bent to a radius not less than 12 (twelve) times the overall diameter of the cable or in accordance with the manufacturer's recommendations whichever is higher.
- 4.3 In the case of cables buried directly in ground, the cable route shall be parallel or perpendicular to roadways, walls etc. Cables shall be laid on an excavated, graded trench, over a sand or soft earth cushion to provide protection against abrasion. Cables shall be protected with brick or cement tiles as shown on drgs. Width of excavated trenches shall be as per drawings. Backfill over buried cables shall be with a minimum earth cover of 600mm. The cables shall be provided with cable markers at every 35 meters and at all loop points.
- 4.4 The general arrangement of cable laying is shown on drawings. All cables shall be full runs from panel to panel without any joints or splices. Cables shall be identified at end terminations indicating the feeder number and the Panel/Distribution board from where it is being laid, on aluminium tag. All cable terminations for conductors upto 4 sqmm may be insertion type and all higher sizes shall have tinned copper compression lugs. Cable terminations shall have necessary brass glands and all lugs shall be double compression type whether so specified or not. The end terminations shall be insulated with a minimum of six half-lapped layers of PVC tape. Cable armouring shall be earthed at both ends.
- 4.5 Each cable shall be tagged with number that appears in cable schedule & Panel/Distribution board from where it is being laid., tag shall be of aluminium.

4.6 Cable Tray & Ladder Specification

All cable tray shall be complied with the following:-

- a) cable tray compliance to IEC 61537
- b) Safe Working Load certificate should be provided by the vendor
- c) Salt test certificate should be provided by the vendor
- d) Hot dipped galvanisation should be according to DIN EN ISO 1461
- e) Electrical continuity certificate should be provided by the vendor

4.6.1 General Requirement:-

Cable Tray and Cable Ladder systems are intended for the support and accommodation of cables and possibly other Electrical equipment in Electrical/Instrumentation/Communication systems.

Design and Fabrication of Cable Trays / Ladders:-

The cable trays / ladders shall be fabricated according to the design specified by IEC 61537 and should be tested for Safe Working Load (SWL). The relevant details of SWL and the load chart with respect to SWL, supporting distance and the deflection should be according to the following chart.

Safe Working Load (SWL) with a span length up to 5 meters									
Description	Side Height (in mm)	Width (in mm)	Span length (in meters)						
			1.5m	2m	2.5m	3m	4m	5m	
			Permitted Load (in kg/meter)						
Perforated tray	60	100-500	150	100	50	-	-	-	
	85	100-500	175	110	50	-	-	-	
	100	150-500	185	130	75	60	-	-	
Cable Ladder	60	200 - 600		225	150	110	45	-	
	110	200 - 600		310	-	140	65	50	
Safe Working Load (SWL) with a span length up to 10 meters									
Description	Side Height (in mm)	Width (in mm)	Span length (in meters)						
			4m	5m	6m	7m	8m	9m	10m
			Permitted Load (in kg/meter)						
Perforated Cable Tray for long span distance	110	200 - 300	160	110	75	-	20	-	-
		400 - 600	200	150	100	-	40	-	-
	160	200 - 300	230	180	140	100	70	-	-
		400 - 600	250	200	160	130	100	-	-
Cable Ladder for long span distance	110	200 - 300	160	110	80	40	-	-	-
		400 - 600	210	150	100	70	-	-	-
	160	200 - 300	230	180	140	100	70	-	-
		400 - 600	250	200	160	130	100	-	-
	200	200 - 600	-	-	300	250	200	140	100

Fabrication of Tray / Ladder and accessories at site and welding is not permitted. In unavoidable circumstances, If any cut or holes are made in the trays/Ladder/accessories, zinc spray need to be applied over the surface. The metal edge has to be protected by edge protection sleeves to avoid cable damage. Edge of the supports has to be protected with plastic END caps. Screwed connections and internal fixing Devices should not create any damage to the cable when correctly fixed. Sudden or jerky motions shall not be used to tighten reusable screw connections.

Cables shall run in cable tray/ladder mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures using mounting accessories

4.6.2 Cable Tray:-

The cable tray and all accessories shall be fabricated from sheet steel and has to be galvanized against corrosion confirming to EN10346 / ISO1461-1999 for installations in indoor and outdoor applications respectively. The cable trays shall be supplied in standard lengths of 3000 mm and the width of the tray shall be as follows.

Width: 100, 150, 200, 300, 400, 500.

All the cable tray accessories like Bend's, TEES's, Cross over's etc should be designed in accordance with IEC 61537 and shall be factory fabricated. The accessories shall be from the same material as of the tray and modular type, it should be connected with the trays by using fasteners. Typical details of trays, fittings and accessories.etc are shown in the enclosed drawings.

For Cable trays designed, tested and confirming to IEC 61537, thickness of cable tray should be according to the manufacturer's catalogue. For locally fabricated and non tested tray, thickness should be 2 mm up to span length of 1.5 meter, 2.5 mm for span length between 2 to 3 meter and 3 to 4 mm for span length between 4 and 10 meter

4.7.3 Cable ladder:-

The cable Ladder and all accessories shall be fabricated from sheet steel and has to be galvanized against corrosion confirming to EN10346 / ISO 1461-1999 for installations in indoor and outdoor applications respectively. The cable ladders shall be supplied in standard lengths of 3000 mm and the width of the ladder shall be as follows.

Width: 200 to 600 mm in multiples of 100 mm

Maximum rung spacing in the ladder shall be 300mm. The rung's should be made of C profiles suitable to fix cables by special metal clamps according to the
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drawing. The ladder shall be of riveted and foldable type for easy transportation and to avoid damage during transportation and storage. All the ladder accessories like Bend's , TEES's, Cross over's etc should be designed in accordance with IEC 61537 and shall be factory fabricated . The accessories shall be made from the same material as of the ladder and modular type, it should be connected with the ladder by using fasteners. The details of ladders, fittings and accessories..etc. are shown in the enclosed drawing.

For Cable Ladders designed, tested and confirming to IEC 61537, thickness of cable Ladder should be according to the manufacturer's catalogue. For locally fabricated and non tested Ladder, thickness should be 2.5 mm up to span length of 1.5 to 2 meter, 3 mm for span length between 2.5 to 4 meter and 3 to 4 mm for span length between 5 and 10 meter

4.7.4 Cover for Cable Trays / Ladders:-

Cover for trays/ladders to protect the cable insulation from falling objects, water droplets, harmful effects of ultraviolet rays and accumulation of dust. The cover shall be Galvanized sheet steel. The cover for the cable trays shall be of snap fit type.

4.7.5 Mounting Accessories (supports and Brackets):-

The mounting accessories shall be fabricated from steel and has to be hot dip galvanized against corrosion confirming to ISO 1461-1999 for installations in both indoor and outdoor applications and should be of completely modular type.

All supports and Brackets should be factory made, hot dip galvanized after completing welding, cutting, drilling, other machining operations and tested according to IEC 61537 according to the arrangements in the enclosed drawing. The system shall be designed such that it allows easy assembly at site by using Bolts and Nuts. The main support and brackets shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hard ware etc to form various arrangements required to support the cable trays. Welding of the components at the site shall not be allowed.

4.7.6 Corrosion Protection:-

The cable tray / ladder/accessories shall be Galvanized according to EN10346 / ISO 1461-1999 for installations indoor and corrosive outdoor applications respectively. Sample tray / ladder / accessories / mounting accessories and supports should be salt spray tested according to ISO 9227 for > 150 hours & 500 hours. (*155 hours according to class 3 for pre-galvanized surface and 550 hours according to class 6 for Hot dip Galvanized surface as per ISO)

4.7.7 Testing and Certification:-

Cable tray / Ladder, bend, T Bend, cross, and all supports are to be tested for Safe Working Load (SWL), deflections, Impact resistance, Salt Spray & Electrical continuity test according to IEC 61537. The cable tray/ladder should not deflect more than $1/100^{\text{th}}$ of the span length at SWL in Mid span and the transverse deflection of all mounting accessories at SWL shall not exceed $1/20^{\text{th}}$ of the length. The cable tray / cable ladder should be tested up to 1.7 times SWL at minimum and maximum room temperature. The temperature classification of cable tray system should be - 5 to + 150°C.

4.7.8 Marking, Documentation, Compliance and Inspection:-

Each system component shall be durably and legibly marked with:

- the manufacturer's or responsible vendor's name or trade mark or identification mark;
- a product identification mark which may be, for example, a catalogue number, a symbol, or the like.

When system components other than cable tray lengths and cable ladder lengths are supplied in a package, the product identification mark may be, as an alternative, marked on the smallest package unit.

Marking shall be applied, by moulding, pressing, engraving, printing, adhesive labels, or water slide transfers. Compliance is checked by inspection and, for marking on the product, by rubbing by hand for 15 s with a piece of cotton cloth soaked with water and again for 15 s with a piece of cotton cloth soaked with petroleum spirit. Marking made by moulding, pressing, or engraving is not subjected to the rubbing test. After the test, the marking shall be legible.

If a system component is stored and transported at a temperature outside the declared minimum and maximum temperatures, the manufacturer or responsible vendor shall declare the precautions and the alternative temperature limits. Compliance is checked by inspection.

The manufacturer or responsible vendor shall provide in his literature all information necessary for the proper and safe installation and use of the cable tray system and cable ladder system. The SWL and impact resistance is valid for the whole temperature classification declared. The information shall include

- a. Instructions for the assembly and installation of system components and for the precautions required to avoid excessive transverse deflection, which could cause damage to the cables.
- b. Thermal Expansion properties and precautions to be taken, if necessary,
- c. Material, Surface Treatment and Salt Spray Test certificate
- d. Relative humidity if it affects the material and Surface Treatment

- d. Information on holes or devices provided for equipotential bonding or to run Earth Bonding Bar
- e. Precautions for transport and storage outside the declared temperature classification, where applicable
- f. Product dimensions
- g. Torque setting in Nm for screwed connections and internal fixing Devices. These devices should not create any damage to the cable when correctly fixed. Sudden or jerky motions shall not be used to tighten reusable screw connections. To test the screwed connections, it shall be tightened and removed.
- h. End Span Distance
- i. Position and type of coupling along the span
- j. SWL in kg/m for the fittings when not directly supported
- k. Fixing method for installing cable tray or cable ladder to the supports
- l. SWL in kg/m for the cable tray lengths or the cable ladder lengths including joints for various Span Distances. SWL information can be given in the form of a diagram, table or similar. Compliance is checked by inspection
- m. SWL in kg for cantilever brackets
- n. SWL for pendants as a bending moment in kg and /or as a force in N
- o. The appropriate material specification and environmental conditions, chemical environments or aggressive agents for which the product is suitable

5.0 **Testing**

5.1 MV cables shall be tested upon installation with a 500V Meggar and the following readings established:

- 1) Continuity on all phases
- 2) Insulation Resistance
 - (a) between conductors
 - (b) all conductors and ground

All test readings shall be recorded and shall form part of the completion documentation.

6.0 **Mode of measurement**

6.1 Cable will be measured on the basis of a common rate per unit length indoor or outdoor and shall include the following:

For cables laid indoors:

- i) Cables and clamps
- ii) Installation, commissioning and testing

iii) Cable marking

OR

For cable buried underground:

i) Cables and protective bricks & tiles

ii) Installation, commissioning & testing

iii) Cable markers

6.2 Cable trays/racks will be measured on the basis of unit length for individual sizes and shall include

i) Galvanised steel tray with necessary suspenders and frame supporting the tray, anchor fasteners, insert plates & necessary support arrangement for completeness of the installation.

ii) Installation and painting in 2 coats of black bituminous paint on one coat of red oxide primer.

6.3 Each cable termination will be measured as one unit for payment. Certain cable sizes are grouped together and rates shall be furnished against each group. The item shall include the following:

i) Lugs, glands, bolts, nuts

ii) All jointing materials

iii) Installations, testing and commissioning

iv) Earthing the glands

6.4 For cables buried under ground excavation shall be paid for additionally for the following per unit volume:

i) Excavation and back filling

ii) 6” Soft Earth Cushioning below and above cable

The cost of laying protective tiles shall be part of cable cost as stated above.