



**SPECIFICATIONS FOR SUPPLY & INSTALLATION OF CONDUIT WIRING
OF ELEVATED STATION**

Draft-1



DELHI METRO RAIL CORPORATION LIMITED

DMRC ELECTRICAL STANDARDS & DESIGN WING (DESDW)

SPECIFICATION NO.

DMES- E/0007/DMRC-E-E&M-CONDUIT WIRING-01

SPECIFICATIONS FOR SUPPLY & INSTALLATION OF CONDUIT WIRING OF ELEVATED STATION

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1. DETAILED DESCRIPTION OF THE EQUIPMENT AND ITS APPLICATION IN DMRC: CONDUIT WIRING

1.1 The scope of the specification covers supply of wires/conduits/sockets etc, installation, testing and commissioning of the wire in conduit with related works, earthing of distribution/sub-distribution boards, plug sockets etc.

1.2 This specification does not cover conduits which are detailed in DMRC specification for supply and installation of conduits, associated fittings and accessories No. DMES-E/0001/DMRC-E-E&M-CONDUIT-01. This specification covers electrical wires, installation of light fixtures, point wiring, sub-main wiring etc.

2. GOVERNING SPECIFICATIONS

2.1 Electrical wiring along with other related items shall conform to the latest standard or harmonize as per the respective standard as given below or specified along with the equipment in the specification.

2.2 In case of any conflict between specifications & the standards, the instructions/decision of the Engineer' or Employer's authorized representative shall be binding.

2.3 STANDARDS

2.3.1 All equipment, components, materials and entire work shall be carried out in conformity with applicable and relevant IS/BS/IEC Standards and Codes of Practice. In addition relevant clause of Indian electricity act 2003 and Indian electricity rule1956 amended up to date shall apply.

2.3.2 It is to be noted that updated and current standards shall be applicable irrespective of dates mentioned along with standards in the tender documents

STANDARD	DESCRIPTION
IS STANDARD	
IS 694:2010	Polyvinyl chloride insulated sheathed and unsheathed cables with rigid and flexible conductor for rated voltages up to and including 450/750 V
IS 732:1989	Code of practice for electrical wiring installations (third revision)
IS 2309:1989	Code of practice for protection of buildings and allied structures against lightning (second revision)
IS 5831:1984	PVC insulation and sheath of electric cables (first revision)
IS 8130	Conductors for insulated electric cables and flexible cords (second revision)

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2.3.3 Codes and standards mean the latest. Where not specified otherwise the installation shall generally follow the Indian standards/British Standards/IEC standards.

2.4 ABBREVIATIONS

S. No.	Abbreviation	Description
1	PVC	Poly-vinyl Chloride
2	XLPE	Cross-Linked Polyethylene
3	FR	Fire Retardant
4	FRLSH	Flame Retardant Low Smoke and Halogen
5	MS	Mild Steel
6	GI	Galvanised Iron



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3. TECHNICAL REQUIREMENT

3.1 PVC Cables/Wires for rated voltages up to 450/750 V.

3.2 Electrical wires shall conform to IS 694-2010. Generally there are three types of electrical wires used in Metro system described at SI No. 17, 19 and 20 of the specification IS 694-2010..

3.3 SI. No. 17: Single core non-sheathed cables with flexible conductors for general purpose with maximum temperature of 70°C

3.3.1 450/750 V grade

3.3.2 FR-PVC insulated (Type A vide clause 5.1 of IS 694:2010). PVC shall conform to IS 5831.

3.3.3 Stranded Copper conductors class 5 as per IS 8130

3.3.4 Size and purpose

- a) Light and Fans: 2.5 mm² multi-strand copper conductors or as specified in BOQ
- b) 6/16 socket and group wiring of lighting and fan circuits: 4/6 mm² multi-strand copper conductors or as specified in BOQ.

3.4 SI. No. 19: Multi-core sheathed cables with flexible conductors for general purpose with maximum temperature of 70°C

3.4.1 450/750 V grade

3.4.2 FR-PVC insulated (Type A vide clause 5.1 of IS 694:2010). PVC shall conform to IS 5831.

3.4.3 Stranded Copper conductors class 5 as per IS 8130

3.4.4 Sheath shall be PVC of type ST1 with 70°C PVC compound confirming to IS 5831 Table 2

3.4.5 Size and purpose

- a) Size: 4 to 300 mm² as specified in BOQ
- b) Number of Conductors: 1,2,3,4 and 5 core as specified in BOQ

3.5 SI. No. 20: Multi-core sheathed cables with flexible conductors for general purpose with maximum temperature of 70°C

3.5.1 450/750 V grade

3.5.2 FR-PVC insulated (Type A vide clause 5.1 of IS 694:2010). PVC shall conform to IS 5831.



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- 3.5.3 Stranded Copper conductors class 5 as per IS 8130
- 3.5.4 Sheath shall be PVC of type ST1 with 70⁰C PVC compound confirming to IS 5831 Table 2
- 3.5.5 Size and purpose
 - a) Size: 0.5 to 2.5 mm² as specified in BOQ
 - b) Number of Conductors: 6 to 25 cores as specified in BOQ

4. INSTALLATION REQUIREMENT

4.1 WIRING DIAGRAM

- 4.1.1 Before execution of works, the Contractor shall submit the copies of drawings which are necessary to ensure correct supply of equipment, components, fittings and material and to enable correct erection of the installation for satisfactory and trouble free performance as detailed in the specifications. All drawings for approval shall be prepared and submitted by the Contractor in standard size as approved by engineer and multiples thereof as required by the engineer.
- 4.1.2 Revision and modification: Approval for any revision and / or modification in job specifications shall be taken from the Engineer before implementation.
- 4.1.3 Change in construction drawings: Any change required during and / or after approval of detailed construction drawings on account of functional requirements or in the interest of efficient running of the system, keeping the basic parameters unchanged, shall be carried out by the Contractor at no extra cost.

4.2 GUIDELINES FOR DRAWING OF WIRES

4.2.1 Bunching Of Wires

- 4.2.1.1 Wires carrying current shall be so bunched in conduits that the phase and neutral wires are drawn into the same conduit. Wires originating from two different phases shall not be run in the same conduit.

4.2.2 Termination / Jointing Of Wires

- 4.2.2.1 Wiring shall be carried out in looping system. Joints shall be made only at distribution board terminals, switches/buzzers and at ceiling roses/connectors/lamp holder's terminals of lights/fans/socket outlets. No joints shall be made inside conduits or junction/draw/inspection boxes.



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- 4.2.2.2 Wiring conductors shall be continuous from outlet to outlet. Joints where unavoidable, due to any specified reasons shall be brought to the notice of Engineer and made by approved connectors only with his permission. Specific prior permission from Engineer in writing shall be obtained before making such joint.
- 4.2.2.3 Insulation shall be shaved off for a length of 15 mm at the end of wire and it shall not be removed by cutting it square or wringing. Strands of wires shall not be cut for connecting terminals.
- 4.2.2.4 Conductors having nominal cross sectional area up to 10-sqmm shall be cage clamped.
- 4.2.2.5 Heat-shrinkable sleeves of good quality of relevant standard as approved by the Engineer shall be used on thimble connections.
- 4.2.2.6 At all bolted terminals, current carrying or non-current carrying shall be provided with adequately sized flat and spring washer as per the requirements. Brass nuts and bolts shall be used for all current carrying connections.
- 4.2.2.7 The pressure applied to tighten terminal screws shall be just adequate, and should not dent or damage or cut any strand of the conductor.
- 4.2.2.8 Switches controlling lights, fans, socket outlets etc. shall be connected to the phase wire of circuits only.
- 4.2.2.9 Only certified and licensed wire-men shall be employed to do wiring / jointing work.
- 4.2.3 Load Balancing - Balancing of circuits in three-phase installation shall be planned before the commencement of wiring and shall be strictly adhered to. Distribution of circuits in three phase installation shall be as per distribution chart indicated in drawings.

4.2.4 Colour Code of Conductors· All wires shall be colour coded as follows:

Phase	Colour of Wire
R	Red
Y	Yellow
B	Blue
N	Black
Earth control, if any	Grey

4.3 PRECAUTIONS DURING DRAWING OF WIRES

4.3.1 The drawing of wires shall be executed with due regard to the following:



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- 4.3.1.1 No wire shall be drawn into any conduit, until all work of any nature that may cause damage to wires is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire. Bushes shall be provided at conduit edges.
- 4.3.1.2 Before the wires are drawn, conduits shall be thoroughly cleaned of moisture, dust, dirt or any other obstruction by forcing compressed air through the conduits if necessary.

5. POINT WIRING

5.1 SYSTEM OF WIRING

- 5.1.1 Group wiring shall be used for the lighting circuits except for individual rooms and other small cubicles where light points may be wired individually. Each group shall cater for a load of approx. 800 watts and wiring shall be done by looping - out at each fitting as per drawing.
- 5.1.2 The wiring shall be carried out strictly as per IE Rules / Indian Standard Code of Practice for electrical wiring installation IS: 732-1989. The wiring shall be done on distribution system with distribution and sub-distribution boards located at convenient points.
- 5.1.3 Wires as specified above of nominal size 2.5-sqmm shall be used for wiring of single light points, fans and 6 A plug sockets or as specified for group wiring of light points. For 6/16 A sockets, the minimum conductor size used shall be 4-sqmm nominal.

5.2 PARAMETERS

- 5.2.1 Point wiring shall be carried out as per following parameters in concealed/surface conduit system unless otherwise stipulated.
 - 5.2.1.1 Only looping system of wiring shall be adopted through-out. All accessories shall be flush type unless otherwise stated.
 - 5.2.1.2 For estimation of load, following loads per point shall be assumed:

1	Light points	As per load of fixture
2	6 Amps socket outlet points	100 Watts
3	Fan points	60 Watts
4	Exhaust fan points	300 Watts or as specified
5	16 Amp socket outlet points	1000 Watts



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- 5.2.1.3 Light points, fan points and 6 amp socket outlet points may be wired on a common circuit. Each circuit shall not normally have more than a total of 10 light, fan or socket outlets or a load of 800 watts unless otherwise agreed by engineer. Wiring from DB to the first switch in each such circuit is defined as circuit wiring.
- 5.2.1.4 Power circuits shall normally have maximum two 16-amps socket outlet unless otherwise stated. Separate circuit shall be run for each geyser, kitchen equipment, window air conditioners and similar appliances.
- 5.2.1.5 Point wiring rates shall include cleaning of dust, splashes of colour wash or paint from all fixtures, fans, fittings, etc. at the time of taking over of the installation.

6. INSPECTION, CHECKS AND TESTS

- 6.1.1 Prototype tests on electrical wire shall be submitted of the vendor seeking approval. Factory acceptance tests for wire shall be carried out by Contractor along with witness by DMRC representative as per the proforma given at annexure A.
- 6.1.2 Installation test of conduct wiring shall be carried out by Contractor along with witness by DMRC representative during the process of installation and completion of the installation as per the prforma given at annexure B as stipulated in special conditions of contract.



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7. Annexure A:

Acceptance Test Report					
Customer Name:					
P.O. No. & Date:					
Description:					
Specification: IS 694:2010 & Data Sheet			Specified Values	Type Test Values	Observed Values
S. No.	Test Descriptions	Unit	(Specified Values shall be as per IS 694:2010 and the Cable selected)	Type test Values shall be the same as submitted at the time of Vendor	DRUM/COIL No.:
	Core Identification				
	Colour of Outer Sheath		Black	Black	Black
1	Maximum size of Conductor	mm			
2	Conductor Resistance (ohms/km corrected at 20 °C)	-			
3	Annealing Test (for Copper Wires After stranding)				
4	Thickness of Insulation	mm			
5	Thickness of Outer sheath	mm			
6	Overall dia of core	mm			
7	Test on Insulation (As per IS-5831-1984)	-			
	Type of compound				
	i) a) Volume resistivity (at 27 °C)	Ohm cm			
	b) Volume resistivity (at 90 °C)	Ohm cm			
	ii) a) Tensile strength (Before ageing)	N/mm ²			
	b) Elongation at break (Before ageing)	%			
8	Test on Outer Sheath (as per IS- 5831-1984)	-			
	Type of compound				
	i) a) Tensile strength (Before ageing)	N/mm ²			
	b) Elongation at break (Before ageing)	%			
9	Routine High Voltage test at R. temp.				
10	FR Test	-			
	i) Oxygen Index Test				
	ii) Temperature Index Test	-			
11	Flammability test				
	i) As per IS 10810 (Pt 53)				
	ii) Time of burning after removal the flame				
Date and Signature:					
	(Manufacturer)		(Contractor)		(DMRC Inspecting officer)



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8. Annexure B:

Checklist for Conduit Wiring

S. No.	Description	Remarks
Checks to be done before Drawing of Wire in Conduits as per the Specification for supply & installation of conduits, associated fittings & accessories Specification No. DMES-E/0001/DMRC-E-E&M-CONDUIT-01		
1	Steel wire of 1.6 sqmm size shall be left in all conduit runs to facilitate drawing of wires as per clause no. 3.9.1	
2	Check for any mechanical stress on the conduit.	
3	Check for use of approved quality metallic flexible conduits at expansion joints of the building	
4	Check allowance for running earthing wire as per clause no. 3.9.1	
5	Conduit should be kept within 300mm of floors and ceiling when running parallel to them	
6	Ensure conduit runs must not exceed 8 m or have more than two right angle bends.	
7	Check conduits from different Distribution Boards must not be connected to same junction box	
8	Check the water tightness of the Conduit system as per the 'Method Statement including Tests' submitted by the contractor.	
9	Check the coupling used in conduit system, conduits must be coupled using couplers or via boxes as per clause no. 3.9.3	
10	Check the joints and terminations of the conduits, conduit-threads must not be exposed and if unavoidable then must be treated as per section 4(b) of the specification.	
11	Check the conduit bends as per approval given by the Engineer at site.	
	In Recessed Conduit and Outlet Boxes	
12	Ensure minimum of 12mm of concrete must cover the conduit and outlet box.	
13	Ensure that the conduit must be tied to the reinforcement with steel wire(dia 1.5 mm) at an interval of maximum 1 m.	
14	Check the space between the concealed conduits entering the draw-in box must be minimum 25mm	
	In Case Of Conduit Recessed In Brick	



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15	Ensure 10 mm space must be available between conduits and depth must be sufficient so that minimum thickness of plaster over conduit is 6 mm	
16	Check the Heavy duty pressed steel clamps screwed to MS flat strip saddled at maximum 600mm must be provided where chase has been cut for conduiting	
17	Ensure Galvanised Chicken wire mesh of 0.6 mm thick with 10 to 15 mm aperture must be provided for full length of the chase in the plaster	
18	Ensure that all boxes for accessories and draw/junction boxes must have outer rim flushed in the finished surface, in case of concealed conduits	
In Case Of Surface Conduiting		
19	Check for approved make spacer saddle at an interval not exceeding 600 mm and 300 mm from the fittings.	
20	Good quality of workmanship must be ensured in case of surface conduiting	
21	Check that the loop earthing wire must be connected to a screwed earth stud inside outlet boxes to make an effective contact with the metal body.	
22	Ensure that all outlets and switch boxes shall be provided with temporary covers and plugs before plaster and concreting work to safeguard against filling up with mortar/plaster etc.	
23	Check entire conduit system including outlets and boxes must be thoroughly cleaned after completion of erection and before drawing of wires.	
24	Check loop earthing is provided by means of insulated stranded copper conductor wires of sizes as per BOQ laid along with wiring inside the conduits for all wiring outlets.	
Checks to be done after Drawing of Wire in Conduits as per the Specification for Conduit Wiring of Elevated Stations Specification No. DMES-E/0007/DMRC-E-E&M-WIRING-01		
25	Check the phase and neutral must be drawn in the same conduit.	
26	Ensure two different phases must not run in same conduit.	
27	Check the wiring, no joint must be present in the conduits or junction/draw/inspection boxes, except with prior written approval from Engineer at site.	
28	Check all bolted terminals, brass approved flat washer of large area must be used.	



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29	Check that good quality heat shrinkable sleeves are used at the terminations.	
30	Check the switches controlling lights, fans, socket outlets etc. must be connected to the phase wire of circuit only.	
31	Ensure bushes must be provided at the conduit edges and proper care must be taken so that no damage occurs to the insulation of the wire.	
32	Insulation resistance must be tested. This must not be less than 50 divided by the number of points in the circuit in mega ohms.(50/no. of circuits)	
33	Check the earth continuity of various equipment installed.	
34	Measure current and voltage of all the lighting circuits at the sub-distribution board with all the lamps switched on to ensure that these are within design values, in case of 3 phase the load must be balanced reasonably.	
35	Measure the minimum and maximum illumination levels after installation of all the lamps along with the supplier of lamp/luminaries and shall and shall comply with the designed value	
36	Check the phase sequence to ensure correct phase sequence.	
*Note: The test for insulation resistance must be carried out when all the equipment are disconnected from the circuit.		

Date & Sign

(Contractor)

(DMRC representative)