

BANGALORE ELECTRICITY SUPPLY COMPANY LIMITED

Technical Specification for L.T. HR PVC Insulated Single Core Multi Strand Aluminium Lead Wire.

1. SCOPE:

The scope of this specification covers the design, manufacture, stage inspection at work, inspection and testing of finish cables at manufacturers works, testing at independent test house, packing, transport and delivery to consignee address of 1.1 kV stranded aluminum, HR PVC insulated cable for working voltages up to and including 1100Volts as per specified construction.

2 TECHNICAL REQUIREMENT:

The heat resisting PVC insulation of maximum rated conductor temperature 85°C intended for cables. The Aluminium lead wire (multi strand) shall be single core. aluminum conductor HRPVC insulated single core multi-strand cable unsheathed lead wire

3 STANDARDS:

The 1.1 kV HR PVC insulated un-sheathed cable shall, in general meet the requirements of the latest edition of the Bureau of Indian Standards (Generally refereed as IS), IS: 694: 2010.

The cables and components in general shall meet the requirements of the following standards with **latest up to date amendments** or equivalent international standards.

IS:694	2010	:	Specification for polyvinyl chloride insulated unsheathed and sheathed cables/cords with rigid and flexible conductor for rated voltages up to and including 450/750V.
IS:8130	2013 (RA 2018)	:	Specifications for conductors for insulated Electric Cables.
IS:10810 (Part 1 to 64)	1984to 2003	:	Specification for test on cables.
IS:5831	1984	:	Specification for PVC insulation and sheath of electric cables.
IS:10418	1982	:	Specification for drums for electric cables.
IS:10462	1983	:	Fictitious calculation method for determination of dimensions of protective coverings of cables: part 1 elastomeric and thermoplastic insulated cable.

4. CABLE CONSTRUCTION REQUIREMENTS

1. The lead wire (multi strand) shall be manufactured, tested and supplied as per IS-694 of 2010 with latest amendments if any.
2. **CONDUCTOR :** The conductors shall be composed of Aluminium wires complying with IS-8130 of 2013 with latest amendments, if any. The aluminium conductors shall be stranded type of Class-2 as per IS-8130.

➤ H2/H4 grade Aluminium Conductor having purity of 99.7%

➤ Conductor Resistivity of 0.028264 $\Omega\text{mm}^2/\text{m}$

3. The cable particulars shall be as noted below.

Note: The Un-Sheathed Aluminium conductor multi-strand single core Type-“C” HR PVC insulation lead wire shall satisfy the requirement of resistance as per IS-8130-2013 with latest amendments and also the nominal cross section, weight of the conductor and cable etc., below:

Sl. No.	Cable	Conductor	The DC resistance at 20°C Ω/km	Insulation Thickness in mm (ti)	Max. overall Dia of the cable in mm	Weight of Aluminium in kgs/100m (Approx)	Wt of cable in kgs/100m (Approx)
1	50Sq. mm	19/1.83mm	0.641	1.4mm	13.9	13.8	22.0
2	70 Sq.mm	19/2.17mm	0.443	1.4mm	16.0	18.7	28.5
3	95 Sq mm	19/2.52mm	0.320	1.6mm	18.2	25.0	36.0
4	120 Sq mm	37/2.03mm	0.253	1.6mm	20.2	32.0	45.5
5	150 Sq mm	37/2.27mm	0.206	1.8mm	22.5	41.4	57.0
6	185Sq .mm	37/2.52 mm	0.164	2.0mm	24.9	49.0	68.0
7	240 Sq .mm	37/2.85 mm	0.125	2.2mm	28.4	63.5	87.0

4. **INSULATION:** The conductor shall be provided with Heat Resistant PVC insulation applied by extrusion and the PVC compound shall be Type ‘C’ HR (Heat Resistant) PVC as per IS: 5831 of 1984 with latest amendments, if any.

5. The 1.1kV Un-Sheathed Aluminium Multi-strand Type-C, Class HR (Heat Resistant) PVC Insulated Single Core cable (Lead wire) as per IS-694: 2010 with following parameters & as per BESCOM Requirements:

➤ Insulated through extrusion with HR PVC Compound

➤ HR PVC compound Insulation withstanding temperature of 85°C should pass minimum Thermal Stability of **100 Minutes** as per IS-5831-1984 Type- C

➤ The test requirement for PVC Type -C, HR PVC insulation shall be as per Table-1 (Clause 4.1) of IS-5831-1984/Annexure-I of this specification.

6. **THICKNESS OF INSULATION:** The mean value of the thickness of insulation shall be not less than the specified value for each type and size of cable shown in the relevant tables given in Section 2 and Section 3. The smallest of the measured values of thickness of insulation (ti) shall not fall below the nominal value (ti) specified in the relevant table by more than (0.1mm + 0.1 ti).

7. The colour of the cable Insulation shall be Black.

5. TESTS

The testing on the cables shall be conducted as given in Table 1 of IS: 694:2010 for each category of the cable listed under scope.

- I TYPE TESTS:** The type test conducted at CPRI/ERDA/Accredited Govt. Labs recognised by BIS as per Table-1 Tests (Clauses 1.1, 4.2 and 10) of S:694-2010 with its latest amendments if any/ BESCO Specification. The type test reports shall not be older than Five (5) years.

a) Tests on conductor:

- 1) Tensile test (for aluminium)
- 2) Wrapping test (for aluminium)
- 3) Conductor resistance test

b) Test for overall dimensions and thickness of insulation /sheath

c) Physical tests for insulation:

- 1) Tensile strength and elongation at break as per IS 5831 method as per IS 10810 part-1
- 2) Loss of mass test as per IS-5831 method as per IS 10810 part-2
- 3) Ageing in air oven as per IS-5831 method as per IS 10810 part -10
- 4) Shrinkage test as per IS-5831 method as per IS 10810 part-14
- 5) Heat shock test as per IS-5831 method as per IS 10810 part-15
- 6) Hot deformation as per IS-5831 method as per IS 10810 part-3
- 7) Thermal stability as per IS-5831 method as per IS 10810 part-53
- 8) Cold bend test as per IS-5831 method as per IS 10810 part-21
- 9) Cold impact test as per IS-5831 method as per IS 10810 part-23
- 10) Flammability test as per IS-694:2010 Clause 10.5 method as per IS 10810 (Part-53)
- 11) Oxygen index test as per IS 694:2010 Clause 10.6 method as per IS 10810 (Part-53)
- 12) Test for temperature index as per IS 694:2010 Clause 10.7 method as per IS 10810 (Part- 64)

II ROUTINE TESTS:

- a) Conductor resistance test As per IS: 8130 method as per IS 10810 part-5
- b) High voltage test or Spark test as per IS 694:2010 Clause 10.2 or 10.3

III ACCEPTANCE TESTS:

- a) Tensile test (for aluminium) as per IS 8130 method as per IS 10810 part- 2
- b) Wrapping test (for aluminium) as per IS 8130 method as per IS 10810 part- 3
- c) Conductor resistance test as per IS 8130 method as per IS 10810 part- 5
- d) Test for thickness of insulation As per relevant tables- Tables 3 to 10, method as per IS 10810 part-6
- e) Tensile strength and elongation at break of insulation As per IS 8130 method as per IS 10810 part- 7
- f) Insulation resistance test as per, IS 8130 method as per IS 10810 part- 43
- g) High voltage test or spark test as per IS 694:2010 Clause 10.2 or 10.3 or 44
- h) Flammability test as per IS 694:2010 Clause 10.4 method as per IS 10810 part- 53

IV SAMPLING OF CABLES

Sl.No	No. of Drums/ Coils/ Reels/Coils in the lot	No. of Drums/ Coils/ Reels/Coils to be taken as sample	Permissible No. of Defects
1	2	3	4
1	Up to 50	3	0
2	51- 100	5	0
3	101 -300	8	0
4	301 and above	13	1

V Test Certificates:-

- All the type test certificates stipulated in IS 694 of 2010 with latest Amendments, if any shall be produced for verification and approval.
- In case of an order, all the acceptance tests stipulated in IS: 694 shall be conducted in presence of BESCOM representative.
- Routine tests shall be conducted and test reports in the form of test certificates signed by a responsible officer of the firm shall be submitted to this office for approval before dispatch of the material.
- The bidder shall furnish the GTP as per Annexure-II and the successful shall obtain the approval from QS&S section before mass production.

6. PACKING & MARKING:

6.1 The Marking shall be as per IS: 694 of 2010 with the following details;

A) On the Lead Wire:

- Reference of Indian Standard IS 694;
- Manufacturer's name, Brand name or Trade-Mark;
- The letter "**BESCOM**".
- Year of manufacture
- Type of cable and Voltage Grade;
- Nominal cross sectional area of conductor;
- Cable code;
- Colour of core;
- The word 'suitable for outdoor use' ;


The printing, indentation or embossing shall be done on the insulation,. The distance between any two consecutive printings, indentations or embossing shall be not more than 1m.

B) On the Drum/Reel/Coils:

- Length of the cable on the reel, drum or coil;
- Direction of rotation of drum (by means of arrow);
- Approximate Gross Weight in kgs;
- Year of manufacture;
- Purchase Order reference and Date.

6.2 The packing of the cable Coils, reel or drum shall also be marked with the standard markings and BESCOM Purchase order reference.

General Manager (Ele)
QS&S BESCOM



Annexure-I

Sl. No	Particulars	As per BESCO Requirement
1	Aluminium rods.	EC Grade, class 2 as per 8130/2013 (R.A 2018)
a	Purity of Aluminium	99.7%
b	Resistivity of Aluminium	0.028264 $\Omega\text{mm}^2/\text{m}$
2	PVC insulation	
a	Material	PVC Type-C, HRPVC Compound
b	Minimum Volume resistivity at 27°C Ohm-Cm	1×10^{13}
c	Minimum Volume resistivity at 70°C Ohm-Cm	1×10^{10}
d	Without ageing	
i	Tensile strength	12.5N/Sq.mm
ii	Elongation	150%(Min)
e	After ageing in air oven at 80°C	
	Tensile strength	12.5N/Sq.mm (Min)
	variation in tensile strength	$\pm 20\%$ (Max)
	Elongation	150(Min)
	variation in elongation	$\pm 20\%$ (Max)
f	Elongation at break	150%
g	Loss of mass	2mg/Sq.cm
h	Thermal stability (minutes)	100 minutes(min)
3	Average dielectric strength	3 KV ac for 5 Minutes
4	Core operating temperature	85° C

Annexure-II

GUARANTEED TECHNICAL PARTICULARS (Bidder to be furnished)

Sl. No	Particulars	Particulars to be furnished by the bidder
	Name and Address of the Bidder	
1	Size of Cable Sq.mm lead wire
2	Nominal area of cross section in Square mm	
3	Number of strands and dia of each strand	
4	Voltage class	
5	Radial thickness of insulation in mm	
6	Nominal overall diameter of cable in mm	
7	Name of manufacture (Brand Name)	
8	Colour of Cable	
9	Maximum resistance of the conductor per KM at 20°C.	
10	Length of cable per coil	
11	Estimated conditional rating in amps corresponding to the temperature of 80°C	
12	Purity of Aluminium rods.	
13	PVC insulation	
a	Material	
b	Min. Volume resistivity at 27°C Ohm-Cm	
c	Min. Volume resistivity at 70°C Ohm-Cm	
d	Without ageing	
i	Tensile strength	
ii	Elongation	
e	After ageing in air oven at 80 °C	
	Tensile strength	
	variation in tensile strength	
	Elongation	
	variation in elongation	
f	Elongation at break	

g	Loss of mass	
h	Thermal stability (minutes)	
14	Average dielectric strength	
15	core operating temperature	
16	Weight of Aluminium in kg/ coil of 100 Mtrs. (Approx)	
17	Total weight of the Cable in kg/Coil of 100 mtrs. (Approx)	

Seal and Signature of the Bidder/Supplier