



**PRODUCT MANUAL FOR
PVC INSULATED (HEAVY DUTY) ELECTRIC CABLES FOR WORKING
VOLTAGES FROM 3.3 KV UP TO AND INCLUDING 11KV
ACCORDING TO IS 1554 (Pt 2): 1988**

This Product Manual shall be used as reference material by all Regional/Branch Offices & licensees to ensure coherence of practice and transparency in operation of certification under Scheme-I of Bureau of Indian Standards (Conformity Assessment) Regulations, 2018 for various products. The document may also be used by prospective applicants desirous of obtaining BIS certification licence/certificate.

1.	Product Standard	:	IS 1554 (Pt 2): 1988
	Title	:	PVC Insulated (Heavy Duty) Electric Cables for working voltages from 3.3 kV up to and including 11kV
	No. of Amendments	:	4
2.	Sampling Guidelines:		
a)	Raw material	:	Plain copper/ aluminium wires IS 8130 Armour material IS 3975
b)	Grouping guidelines	:	Please refer ANNEX – A
c)	Sample Size	:	(i) Copper/Aluminium wire (before stranding) - 5 meters (ii) Cu wire – 100 g (for Cu purity test) (iii) Armour material – 5 meters (iv) PVC Insulated HD Cable - 15 metres (for category 01), 50 metres (for category C1, C2)
3.	List of Test Equipment	:	Please refer ANNEX – B
4.	Scheme of Inspection and Testing	:	Please refer ANNEX – C
5.	Possible tests in a day	:	Please refer ANNEX - D
6.	Scope of the Licence: PVC Insulated and Sheathed Heavy Duty Cables for electric supply purposes, Armoured/ Unarmoured, Screened/Unscreened, with Aluminium/Copper conductor for sizes up to and including mm ² (for single core) and mm ² (for three core), Insulation type A/B, Sheath Type ST1, Category 01/C1/C2, except/suitable for use in Mines, excluding/including Low Temperature Applications, for working Voltages from 3.3 kV to 11 kV.		

ANNEX A**Grouping Guidelines**

1. Each variety of Cable shall be tested for GoL/CSoL considering the following:
 - i. Material for Conductor – Aluminium, Copper
 - ii. No. of Cores (Single Core, Three core)
 - iii. Type of Insulation (A, B)
 - iv. Screened/ Unscreened
 - v. Armoured/Unarmoured
 - vi. Category of Cable [(01, C1(FR), C2(FR-LSH)]
 - vii. Voltage Grade
 - viii. Cables intended for use in Mines
 - ix. Low Temperature Application

2. The following relaxation may be given when a variety is tested for all the requirements and the manufacturing process remains the same:

Variety Tested	Additional Variety that may be covered
Particular Voltage Grade Uo/U	Grades upto and including Voltage Grade Uo/U
Three core	Single Core
Screened	Unscreened
Armoured	Unarmoured
(a) C2 (FR-LSH)	(a) C1(FR) and 01
(b) C1(FR)	(b) 01

3. The Firm shall declare the Varieties and Sizes of various Cables they intend to cover in the Licence. Cable with the largest Size (Nominal Cross Sectional Area of Conductor) intended to be covered in the Licence may be drawn for Testing. The Scope of Licence may be restricted based on the Manufacturing and Testing capabilities of the Manufacturer. The Conductor Cross Sectional Area recommended for Grant of Licence/Inclusion shall not be larger than that of the tested cable.

4. During the operation of the Licence, BO shall ensure that all the Varieties covered in the Licence are tested in rotation to the extent possible.

5. A typical example for drawal of samples to cover the entire Varieties under the Scope of the Licence is given below for the purpose of general guidance:
 - a) Sample 1: Single Core, Armoured, Unscreened Cable with Copper Conductor, Type A Insulation, Category C2, suitable for use in Mines.
 - and*
 - b) Sample 2: Three Core, Armoured, Screened Cable with Aluminium Conductor, Type B Insulation, Category 01, including Low Temperature Applications.

ANNEX B**List Of Test Equipment***Major test equipment required to test as per the Indian Standard*

Sl. No.	Description Of the Test Equipment	Tests used in with Clause Reference
1	Digital Vernier Caliper	Measurement of thickness & Outer Dia. for Clause 9.2, 12.3, 13.3, 14.4, 15.1(d),15.2(a) & (b)
2	Steel Scale	Measurement of dimensions for Clause 13.3,15.1(d), 15.2 (a) & (b), 16.4
3	Digital Micro meter	Measurement of Wire Dia. For Clause 9.2, 12.3, 13.3,13.6(f), 14.4, 15.1(d),15.2(a) & (b)
4	Measuring Microscope	Measurement of thickness for Clause 9.2, 12.3, 14.4, 15.1(d)
5	Graduated Magnifying Glass	Measurement of dimensions for Clause 9.2, 12.3, 14.4,15.1(d)
6	Tensile Testing Machine	Tensile Strength, Elongation Test & Annealing Test for Clause 13.3, 15.1(d)
7	Dumb-Bell Cutting Machine with Die	Tensile Strength & Elongation Test for Clause 15.1(d)
8	Hot Air oven with thermostatic Temp. controller	Heat Shock, Hot Deformation & Shrinkage Test for Clause 13.6 (f), 15.1 (d)
9	Thermal Ageing Oven with Thermostatic Temperature control, Air flow Meter & Hour Meter	After Ageing Tensile Strength, Elongation Test & Loss Of Mass Test for Clause 15.1(d)
10	Water Bath with thermostatic temp. control Stirrer & Hour Meter,	Water immersion A.C. & D.C. Test, Insulation Resistance Constant & Volume Resistivity Test for Clause 15.1 (e), 16.3
11	Million Mega ohm Meter	Insulation Resistance constant/ Volume Resistivity Test for Clause 15.1 (e)
12	Heat Shock Mandrels	Heat Shock Test for Clause 15.1 (d)
13	Hot Deformation Apparatus with weight	Hot Deformation Test for Clause 15.1 (d)
14	Physical Weighing Balance with Weight	Loss of Mass Test & Thermal Stability Test for Clause 13.3, 13.6 (f), 15.1(d)
15	Double Kelvin Bridge with galvanometer, D.C. Source & Conductivity attachment	Conductor Resistance Test for Clause 13.5.2, 15.1(a)
16	Flammability Test apparatus with burner, Gas cylinder, Scale, Stopwatch & 0.71 mm copper wire	Flammability Test for Clause 16.4

17	Conditioning chamber & Defreezer with Humidity. Indicator	Tensile Strength, Elongation Test, cold bend, cold Impact & Thermal stability Test for Clause 15.1 (d), 15.4 (a) & (b)
18	AC Spark Tester	For Spark Testing
19	D.C. High Voltage	D.C. High Voltage Test for Clause 16.2
20	A C. high voltage	A.C. High Voltage Test for Clause 16.3
21	H.V. Mega Ohm Box	Insulation Resistance Test for Clause 13.5.2, 15.1 (a)
22	Glass Thermometer	Conductor & Insulation Resistance Test for Clause 13.5.2, 15.1 (a)
23	Balance Digital	Flammability Test for Clause 16.4
24	Stop Watch	Flammability Test for Clause 16.4
25	Thermal stability test apparatus with pH paper & tubes	Thermal Stability Test for Clause 15.1 (d)
26	Room Thermometer	Flammability Test, Shrinkage, Annealing & Elongation Test for Clause 15.1 (a), 15.1 (d), & 16.4
27	Air Conditioner	For maintaining room temperature
28	Cold Impact Test apparatus	Cold Impact test as per Clause 18.4
29	Bending Test apparatus	Bending test as per clause 19.3
30	Di-electric Power factor Test apparatus	Di-electric Power Factor test as per Clause 19.4
31	Heating Cycle Test apparatus	Heating Cycle Test as per Clause 19.5
32	Impulse Withstand Test apparatus	Impulse Withstand Test as per Clause 19.6
33	Partial Discharge Test apparatus	Partial Discharge Test as per Clause 19.2
Additional Testing Equipment for Armour Testing (in case non-ISI Strip/wire is used)		
1	Curvature Gauge	Measurement of thickness test for clause 13.3
2	Torsion test Apparatus	For Torsion test as per Clause 13.6 (c)
3	Mandrels (15 times the nom. Thickness of Strip 0.5 mm)	For Winding test as per Clause 13.6 (d)
4	Glass Container, Copper Sulphate Solution, Distilled Water, Hot Plate, Copper Carbonate or Copper Hydroxide, Hydrometer, Suitable Glassware	For Uniformity of Zinc Coating Testing as per Clause 13.6 (e)
5	Beaker (500 ml with a watch glass), Antimony Chloride, Conc. Hydro Chloric Acid, Stripping Solution, Trichloroethylene, Spirit	For Mass of Zinc Coating testing as per Clause 13.6 (f)

Additional Testing Equipment for Testing of Category C1(FR), C2(FR-LSH)		
1	Oxygen Index test apparatus, Oxygen & Nitrogen gas	For Oxygen Index temperature And Temperature Index Testing as per Clause 16.5 & 16.10
2	Flame Retardation Test (for Single Cable) Apparatus, Ignition Fluid	For Flame Retardation Testing (for Single Cable) as per Clause 16.6
3	Flame Retardation Test (for Bunched Cable) Apparatus	For Flame Retardation Testing (for Bunched Cable) as per Clause 16.7
4	Tube Furnace, Quartz Combustion Tube, Porcelain combustion tube, Wash Bottles (03 Nos.), Glass Tubing and Silicon Rubber Stoppers, Air Flow Meter, Sodium Hydroxide Soln.(0.1 N), Nitric Acid Soln.(6 N), Silver Nitrate Soln.(0.1 N), Ammonium Thiocyanate Soln.(0.1 N), Ferric Ammonium Soln.(40 %), Potassium Hydroxide (0.1 N), Sulphuric Acid (0.1 N)	For Halogen Acid Gas Evolution Testing as per Clause 16.9

The above lists are indicative only and may not be treated as exhaustive.

ANNEX C

Scheme of Inspection And Testing

1. LABORATORY - A laboratory shall be maintained which shall be suitably equipped (as per the requirement given in column 2 of Table 1) and staffed, where different tests given in the specification shall be carried out in accordance with the methods given in the specification.

1.1 The manufacturer shall prepare a calibration plan for the test equipment.

2. TEST RECORDS – The manufacturer shall maintain test records for the tests carried out to establish conformity.

3. LABELLING AND MARKING – In addition to requirements of IS 1554 (Pt 2): 1988, Identification in code or otherwise shall be either stencilled on reel/drum, packages of individual coil or contained in the label attached to the coil, in order that the date of manufacture and control unit can be traced back to factory records.

4. CONTROL UNIT – Every 25 delivery lengths or less of the same size and type of cable manufactured in a week under similar conditions of production shall constitute a control unit.

5. LEVELS OF CONTROL - The tests as indicated in column 1 of [Table 1](#) and the levels of control in column 3 of [Table 1](#), shall be carried out on the whole production of the factory which is covered by this plan and appropriate records maintained in accordance with paragraph 2 above.

5.1 All the production which conforms to the Indian Standards and covered by the licence should be marked with Standard Mark.

6. REJECTIONS – Disposal of non-conforming product shall be done in such a way so as to ensure that there is no violation of provisions of BIS Act, 2016.

TABLE 1

(1)					(2)	(3)	
Test Details					Test equipment requirement R: required (or) S: Sub-contracting permitted	Levels of Control	
Cl.	Requirement	Test		Test Methods		No. of Sample	Frequency
		Clause	Ref	Part Ref of IS 10810			
	Purity test for Cu	Table 4	IS 191	-	S	One	Each consignment. Further testing is not required if ISI marked or accompanied with TC.
18.3(a)	Conductor resistance	7.3, Table 1, 2	IS 8130	5	R	Each length of finished cable	
19.7.2	High voltage test (routine test)	19.7.2	IS 1554 (Pt 2)	45	R		
18.3(c)	Partial discharge test (for 6.35/ 11 kV cables only)	19.2	IS 1554 (Pt 2)	46	R		
18.3(d)	Armour resistance (<i>for mining cables</i>)	16.5	IS 1554 (Pt 2)	42	R	one	
18.2(a)	Annealing test (<i>for Copper</i>)	7.1.2	IS 8130	1	R	one	Every 10 spools of wire drawn or received (before stranding) and one sample from every control unit.
18.2(b)	Tensile test (<i>for Aluminium</i>)	7.2.1	IS 8130	2	R	one	
18.2(c)	Wrapping test (<i>for Aluminium</i>)	7.2.2		3		one	
18.2(e)	Test for thickness of insulation and sheath	11, 15, 17	IS 1554 (Pt 2)	6	R	one	Each length of finished cable. Additional samples shall be tested whenever there is a change in formulation of the PVC compound.
18.2(f)	Tensile strength and elongation at break of Insulation and Sheath	Table 1	IS 5831	7	R	one	

18.2(g)	Insulation Resistance	Table 1	IS 5831	43	R	one	
18.2(j)	High Voltage test (Acceptance/ Type test)	19.7.1	IS 1554 (Pt 2)	45	R	one	
18.1(b)	Tests for round steel wire/ formed steel wire (strip) armour		IS 1554 (Pt 2)		R	one	Each consignment of armour wires/ strips received. No further testing is required if accompanied with TC or ISI marked.
	Dimensions	16.3		36			
	Tensile Strength	16.6(a)		37			
	Elongation at break	16.6(b)		37			
	Torsion test for round wires	16.6(c)		38			
	Winding test for formed wires	16.6(d)		39			
	Uniformity of Zinc coating	16.6(e)		40			
Mass of Zinc coating	16.6(f)	41					
18.1(d)	Physical tests for insulation and outer sheath	Table 1	IS 5831		R	one	Every control unit. Additional samples shall be tested whenever there is a change in formulation of the PVC compound.
	Tensile strength and elongation at break after aging in air oven			11			
	Shrinkage test			12			
	Hot deformation test			15			
	Loss of mass in air oven			10			
	Heat shock test			14			
	Thermal Stability			60			
Water absorption (gravimetric test for insulation, where applicable)	33						
18.1(g)	Bending test	19.3	IS 1554 (Pt 2)	50	R	One	Every control unit
18.1(h)	Dielectric power factor test	19.4		48			
18.1(j)	Heating cycle test	19.5		49			
18.1(k)	Impulse withstand test	19.6		47			

18.1(n)	Flammability test	19.8		53	R		
18.1.3 & Appendix A	Oxygen Index Test	19.9	IS 1554 (Pt 2)	58	S	One	Every month for each size and type for every consignment of PVC compound.
	Flame Retardance Test on single cable	19.10		61			
	Flame Retardance Test on bunched cable	19.11		62			
	Test for specific optical density of smoke	19.12		-			
	Temperature Index	19.14		64			
	Smoke Density	19.15		63			
	Test for Halogen acid gas evolution	19.13		59			

Note-1: Sub-contracting is permitted to a laboratory recognized by the Bureau or Government laboratories empanelled by the Bureau.

Note-2: Levels of control given in column 3 are only recommendatory in nature. The manufacturer may define the control unit/batch/lot and submit his own levels of control in column 3 with proper justification for approval by BO Head.

ANNEX D

Possible Tests in a day

- i. Dimensions
- ii. Annealing Test (for Copper wires)
- iii. Tensile Test (for Al wires)
- iv. Wrapping test (for Al wires)
- v. Conductor Resistance
- vi. Tensile Test (before ageing) on Insulation and Sheath
- vii. Shrinkage Test
- viii. Hot Deformation
- ix. Heat Shock Test
- x. Insulation Resistance Test
- xi. HV Test (Routine test)
- xii. Flammability Test