



PM/ IS 694/ 1/ July 2018

# **PRODUCT MANUAL FOR POLYVINYL CHLORIDE INSULATED UNSHEATHED AND SHEATHED CABLES/CORDS WITH RIGID AND FLEXIBLE CONDUCTOR FOR RATED VOLTAGES UP TO AND INCLUDING 1100 V ACCORDING TO IS 694: 2010**

*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	:	IS 694: 2010	
	Title	:	Polyvinyl Chloride Insulated Unsheathed And Sheathed Cables/Cords With Rigid And Flexible Conductor For Rated Voltages Up To And Including 1100 V	
	No. of Amendments	:	3	
2.	Sampling Guidelines:			
a)	Raw material	:	Annealed, bare or tinned high conductivity copper wires Aluminium wires	IS 8130
b)	Grouping guidelines	:	Please refer <a href="#">ANNEX – A</a>	
c)	Sample Size	:	(i) 5 meters Copper/Aluminium wire (before stranding) (ii) 25 meters PVC Insulated Cable/ Cord	
3.	List of Test Equipment	:	Please refer <a href="#">ANNEX – B.</a>	
4.	Scheme of Inspection and Testing	:	Please refer <a href="#">ANNEX – C.</a>	
5.	Possible tests in a day	:	Please refer <a href="#">ANNEX - D</a>	
6.	<b>Scope of the Licence :</b>  PVC Insulated, Unsheathed/Sheathed, Circular/Flat, Cables/Cords with Rigid/Flexible Copper (Bare/Tinned)/Aluminum Conductor, Class 1/2/5, Insulation Type A/C/D, Sheath Type ST1/ST2/ST3, Category 01/02/FR/FR-LSH, for working Voltages upto and including 1100 V, for the following varieties: a) Single Core for Sizes upto and including ..... b) Multi-core upto and including .... Cores, Sizes upto and including .....			

**ANNEX A****Grouping Guidelines**

I. 1(a). Samples of each variety of Cable shall be tested considering the following:

- i. Material for Conductor – Aluminium, Copper
- ii. Type of Conductor – Rigid (Class 1, 2) , Flexible (Class 5)
- iii. No. of Cores (Single Core, Multi-core)
- iv. Type of Insulation (A, C, D)
- v. Type of Sheath (ST1, ST2, ST3)
- vi. Category of Cable (01, 02, FR ,FR-LSH)

1(b). The following relaxation may be given when a variety is tested for all the requirements:

<b>Variety Tested</b>	<b>Additional Variety that may be covered</b>
Tinned Copper	Bare Copper
Stranded (Class 2)	Solid (Class 1)
Multi-core	Single Core
Type A Insulation	Type D Insulation
Sheathed	Unsheathed
Type ST1 Sheath	Type ST3 Sheath
(a) FR-LSH	(a) FR and 01
(b) FR	(b) 01
(c) 02	(c) 01
Flat Cable	Circular Cable

2. The Firm shall declare the Varieties and Sizes of various Cables they intend to cover in the Licence. Cable with any Size (Nominal Cross Sectional Area of Conductor) and no. of Cores, preferably the largest, 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.
3. 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.

II. 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: Three Core Cable, Rigid Aluminium Stranded Conductor (Class 2), Insulation Type A, Sheath Type ST1, Category 02.

*and*

- (b) Sample 2: Two Core Flat Cable, Flexible tinned Copper Conductor (Class 5), Insulation Type C, Sheath Type ST2, Category FR-LSH.

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

Sl. No.	Test Equipment	Tests used in with Clause Reference	
		Cl. Ref.	Tests
1	Vernier Callipers	4, 17.1.1, 5.3, 8.3, 9	Measurement of thickness & Outer Dia.
2	Steel Scale	10.4, 4.1, 5.4	Measurement of Flammability, Annealing and Elongation
3	Micrometer	4, 17.1.1	Measurement of Wire Dia.
4	Measuring Microscope	4, 17.1.1, 10	Measurement of thickness (insulation & sheath) and hot deformation test
5	Graduated Magnifying Glass	4, 17.1.1, 10	Measurement of thickness (insulation & sheath) and hot deformation test
6	Tensile Testing Machine	10	Tensile Strength, Elongation Test & Annealing Test
7	Dumb-Bell Cutting Machine with Die	10	Tensile Strength & Elongation Test
8	Hot Air oven with thermostatic Temperature controller	10	Heat Shock, Hot Deformation & Shrinkage Test
9	Thermal Ageing Oven with Thermostatic Temperature controller, Air flow Meter & Hour Meter	10	Tensile Strength & Elongation After ageing, Loss Of Mass Test
10	Water Bath with thermostatic temperature controller, Stirrer & Hour Meter	10.1, 10.2	Water immersion A.C. & D.C. Test, Insulation Resistance Constant/ Volume Resistivity Test
11	Megohmmeter	10.1	Insulation Resistance Constant/ Volume Resistivity Test
12	Heat Shock Mandrels	10	Heat Shock Test

13	Smooth metal Mandrels	10	Cold Bend Test
14	Low temperature Impact Apparatus	10	Cold Impact Test
15	Hot Pressure Test Apparatus with Weights	10	Hot Deformation Test
16	Physical Weighing Balance with Weights	4, 17.1.1, 10	Loss of Mass Test & Thermal Stability Test, Persulphate Test, Flammability Test
17	Kelvin Double Bridge with galvanometer, D.C. Source	10	Conductor Resistance Test
18	Flammability Test apparatus with burner, Gas cylinder, Scale, Stopwatch & 0.71 mm copper wire	10.4	Flammability Test
19	Conditioning chamber & Refrigerator with Humidity Indicator	10	Tensile Strength, Elongation Test, Cold Bend, Cold Impact & Thermal stability Test
20	AC Spark Tester	10.3	Spark Testing
21	D.C. High Voltage Test set	10.1	D.C. High Voltage Test
22	A C. High Voltage Test set	10.1, 10.2	A.C. High Voltage Test
23	Megohm Box	10.1	Insulation Resistance Test
24	Glass Thermometer	10	Conductor Resistance & Insulation Resistance Test
25	Balance Digital	10.4	Flammability Test
26	Stop Watch	10.4	Flammability Test
27	Thermal stability test apparatus with pH paper & tubes	10	Thermal Stability Test
<b>Additional Testing Equipment Required for Testing of Category (FR), (FR-LSH)</b>			
1	Oxygen Index test apparatus, Oxygen & Nitrogen gas	10	Oxygen Index and Temperature Index Test

2	Tube Furnace, Quartz Combustion Tube, Porcelain combustion boat, Wash Bottles, Glass Tubing and Silicon Rubber Stoppers, Air Flow Meter, Reagents	10	Halogen Acid Gas Evolution Testing
3	Smoke density test apparatus	10	Smoke density rating test

*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 the requirements of IS 694: 2010, Identification in code or otherwise shall be either stencilled on reel/drum, packages of individual 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** – A cable/ cord of continuous length manufactured/ extruded under similar conditions of production for one nominal cross-sectional area and class of conductor 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.

**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	Remarks
		Clause	Ref	Part	Ref				
4.1 & 4.2	Conductor Material					R	One	Each Coil/bobbin of finished wire drawn or received  For each consignment	No further testing is required if accompanied with Test Certificate or ISI marked.
	a) Resistance	7.3		5					
	b) Tensile strength (for Al, before stranding)	7.2.1		2					
	c) Annealing test (before stranding)	7.1.2.1, 7.2.3	IS 8130	1	IS 10810				
	d) Wrapping (for Al)	7.2.2		3					
	e) Purity test (for Cu)	Table 4	IS 191	-	-				
10	a) Conductor Resistance	7.3	IS 8130	5	IS 10810	R	Each Coil	Entire length of core after extrusion of insulation	If so desired these routine tests may be conducted on the entire length of the control unit before cutting into individual coils.
	a) High Voltage at room temperature <i>or</i>	10.2	IS 694	45					
	b) Spark test (as applicable)	10.3		44					
5.1, 6, 7, 8.2  11  18.1.3, 19.1.4, 20.1.3, 21.1.3, 22.1.3	a) Material  b) Identification  c) Assembly of cores	Section 2 & 3	IS 694			R	Each Control Unit	Visual examination	



5.3	a) Thickness of Insulation	Section 2 & 3						Each Control Unit of 10,000 m or less	
8.3	b) Thickness of Sheath	Sec 3	IS 694	6	IS 10810	R	Two		
9	c) Overall dimension	Section 2 & 3		-	-				
9.1	Ovality	Sec 3	IS 694			R	Two		
4.1	a) Tensile strength (for Al, after stranding)	7.2.1	IS 8130	2	IS 10810	R	Two		
	a) Wrapping test (for Al)	7.2.2		3					
4.2	Persulphate test	7.1.1	IS 8130	4	IS 10810	S	One	Once in a month	For tinned Copper Only
10	Insulation a) Tensile strength b) Elongation at break	Table 1	IS 5831	7	IS 10810	R	One	Cable/Cord of each size and type manufactured in a month from one consignment of PVC compound	#
	Sheath a) Tensile strength b) Elongation at break	Table 2							#
10	Insulation Resistance/ Volume Resistivity	Table 1	IS 5831	43	IS 10810	R	One		Either IR Constant or Volume Resistivity to be recorded
10	Insulation & Sheath	Table 1 & 2	IS 5831		IS 10810	R	One		#
	a) Heat Shock			14					
	b) Hot deformation			15					
	c) Loss of Mass			10					
	d) Tests after Ageing			11					
	e) Thermal Stability			60					
	f) Shrinkage			12					

10	High Voltage (Water Immersion) Test	10.1	IS 694	45	IS 10810	R	One	Cable/Cord of each size and type manufactured in a month from one consignment of PVC compound	
10	Flammability test	10.4	IS 694	53	IS 10810	R	One	Cables/ Cord manufactured from each consignment of PVC compound	
10	Cold Bend test Cold Impact test	Table 1 & 2	IS 5831	20 21	IS 10810	R	One		
10	Additional Ageing test	10.9	IS 694	-	IS 10810	R	One	Every month for each size and type from one consignment of PVC compound	For Category 02 cable only
	Oxygen Index test	10.5		58					For FR & FR-LSH
	Temperature Index test	10.7		64					For FR & FR-LSH
	Halogen Acid Gas evaluation	10.6		59					For FR-LSH
	Smoke density rating	10.8		IS 13360 (Part 6/Sec 9)					For FR-LSH

# In case of failure, marking of that type and size shall be stopped and reasons for failure shall be investigated. Marking shall be done only if the sample from the control unit of improved quality meets the specified requirements. The original frequency shall be restored only after five consecutive samples have passed the requirements.

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**

Dimensions

- Maximum Conductor dia.
- Overall dimensions
- Ovality
- Thickness of sheath and insulation

Annealing Test (for Copper wires)

Tensile Test (for Al wires)

Wrapping test (for Al wires)

Conductor Resistance

Tensile Test (before ageing) on Insulation and Sheath

Shrinkage Test

Hot Deformation

Heat Shock Test

Insulation Resistance Test

HV Test (at Room Temperature)

Flammability Test