



**PRODUCT MANUAL FOR
CROSSLINKED POLYETHYLENE INSULATED THERMOPLASTIC
SHEATHED CABLES FOR WORKING VOLTAGES UP TO AND
INCLUDING 1100 V
ACCORDING TO IS 7098 (Pt 1): 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 7098 (Pt 1): 1988
	Title	:	Crosslinked Polyethylene insulated Thermoplastic sheathed cables for working voltages up to and including 1100 V
	No. of Amendments	:	5
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) XLPE insulated Thermoplastic sheathed Cable - 15 meters
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 : Crosslinked Polyethylene Insulated, Thermoplastic Sheathed Cables for electric supply and control purposes, Armoured/Unarmoured, with Aluminium/Copper Conductor, Class 1/2, Category 01/C1/C2, except/suitable for use in Mines, excluding/including Low Temperature Applications, for working Voltages up to and including 1100 V, for the following varieties: a) Single Core for Sizes upto and including mm ² . b) Multi-core upto and including Cores, Sizes upto and including mm ² .		

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. Construction of Conductor – Solid (Class 1), Stranded (Class 2)
 - iii. No. of Cores (Single Core to Multicore)
 - iv. Armoured/Unarmoured
 - v. Category of Cable [(01, C1(FR), C2(FR-LSH))]
 - vi. Cables intended for use in Mines
 - vii. 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
Stranded (Class 2)	Solid (Class 1)
Multicore	Single Core
Armoured	Unarmoured
(a) C2 (FR-LSH)	(a) C1(FR) and 01
(b) C1(FR)	(b) 01

3. 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/CSoL 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. Only one Factory Sample and one Market Sample shall be drawn during an operative period of one year. Out of the above, one sample shall be tested for all tests and another for all tests excluding type tests.
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: Three Core, Armoured, Cable with Stranded (Class 2) Copper Conductor, Category C2, suitable for use in Mines.
 - and*
 - b. Sample 2: Single Core, Unarmoured, Cable with Solid (Class 1) Aluminium Conductor, 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 Calliper	Measurement of thickness & Outer Dia. for Cl 9.2, 12.3, 13.3, 15.1(d),15.2(e)& (b)
2	Steel Scale	Measurement of dimensions for Cl 13.3, 15.1 (d)i, 15.2 (a) & (b)
3	Digital Micro meter	Measurement of Wire Dia. For Cl 9.2, 12.3, 13.3, 13.6(b), 15.1(d),15.2(a) & (b)
4	Measuring Microscope	Measurement of thickness for Cl 9.2, 12.3, 15.1(d)
5	Graduate Magnifying Glass	Measurement of dimensions for Cl 9.2, 12.3, 15.1(d)
6	Tensile Testing Machine	Tensile Strength, Elongation Test & Annealing Test for Cl 13.3, 15.1(d)
7	Dumb-Bell Cutting Machine with Die	Tensile Strength & Elongation Test for Cl 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 Cl 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 (f), 16.3
11	Million Mega ohm Meter	Insulation Resistance constant/ Volume Resistivity Test for Cl 15.1 (f)
12	Heat Shock Mandrels	Heat Shock Test for Cl 15.1 (e),vi
13	Cold Bend Mandrels	Cold Bend Test for Cl 15.4 (a) (optional requirement)
14	Cold Impact Apparatus	Cold Impact Test for Cl 15.4 (b) (optional requirement)

15	Hot Deformation Apparatus with weight	Hot Deformation Test for Cl 15.1(e)v
16	Physical Weighing Balance with Weight	Loss of Mass Test & Thermal Stability Test for Cl15.1(e),iii,vii
17	Double Kelvin Bridge with galvanometer, D.C. Source & Conductivity attachment	Conductor Resistance Test for Cl 15.1 (a)iv,15.3c
18	Flammability Test apparatus with burner, Gas cylinder, Scale, Stopwatch & 0.71 mm copper wire	Flammability Test for Cl 16.3
19	Conditioning chamber & Defreezer with Humidity. Indicator	Tensile Strength, Elongation Test, cold bend, cold Impact & Thermal stability Test for Cl 15.1 and 15.4
20	AC Spark Tester	For Spark Testing
21	D.C. High Voltage	D.C. High Voltage Test for Cl 15.1 g
22	A C. high voltage	A.C. High Voltage Test for Cl 16.1.1
23	H.V. Mega Ohm Box	Insulation Resistance Test for Cl 13.5.2, 15.1 (a)
24	Glass Thermometer	Conductor & Insulation Resistance Test for Cl 13.5.2, 15.1 (a)
25	Balance Digital	Flammability Test for Cl 16.4
26	Stop Watch	Flammability Test for Cl 4.1,4,a
27	Thermal stability test apparatus with pH paper & tubes	Thermal Stability Test for Cl 15.1 (e),vii
28	Room Thermometer	Flammability Test, Shrinkage, Annealing & Elongation Test for Cl.4.1,Table-1, (iii)a, (iv)a, (v)a, (vi)a, 16.2.1, 16.1.4
29	Water Absorption(Gravimetric)	Cl.4.1,vi Table 1
30	Air Conditioner	For Maintain Room Temp.

Additional Testing Equipment for Armour Testing (in case non ISI Strip/wire is used)		
1	Curvature Gauge	Measurement of thickness test for Cl 13.3
2	Torsion test Apparatus	For Torsion test as per Cl 13.6 (c)
3	Mandrels (15 times the nom. Thickness of Strip 0.5 mm)	For Winding test as per Cl 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 Cl 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 Cl 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 Cl 16.5 & 16.10
2	Flame Retardation Test (for Single Cable) Apparatus, Ignition Fluid	For Flame Retardation Testing (for Single Cable) as per Cl 16.6
3	Flame Retardation Test (for Bunched Cable) Apparatus	For Flame Retardation Testing (for Bunched Cable) as per Cl 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 Cl 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 7098 (Pt 1): 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
		Cl	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.
15.1(a)	Tests on Conductor						
i	Annealing test (<i>for copper</i>)	7.1.2	IS 8130	1	R	one	Each length of finished cable. For annealing, every 10 spools of wire drawn or received (before stranding)
ii	Tensile test (<i>for Aluminium</i>)	7.2.1		2	R	one	
iii	Wrapping test (<i>for Aluminium</i>)	7.2.2		3	R	one	
iv	Conductor resistance	7.3, Table 1, 2		5	R	one	
15.1(b)	Test for armouring wires/ strips	13.3, 13.6	IS 7098 (Pt 1)	36 to 42	R	one	Each length of finished cable from same consignment of armour wires/ strips received. No further testing is required if accompanied with TC or ISI marked.
15.4(c)	Resistance of armour	Table 7	IS 7098 (Pt 1)	42	R	one	Each length of finished cable
3 to 7	Materials	3 to 7	IS 7098 (Pt 1)	-	R	one	Each length of conductor /finished cable
8	Construction of conductor	8	IS 7098 (Pt 1)	-	R	one	
9.4	Application of insulation	9.4	IS 7098 (Pt 1)	-	R	one	
10	Core identification	10	IS 7098 (Pt 1)	-	R	one	
11	Laying up of cores	11	IS 7098 (Pt 1)	-	R	one	

12	Inner sheath	12	IS 7098 (Pt 1)	-	R	one	
13	Armouring	13.1, 13.2 or 13.3 & 13.4	IS 7098 (Pt 1)	-	R	one	
15.1(c)	Thickness of insulation and sheath	9,12&14	IS 7098 (Pt 1)	6	R	one	Each length of finished cable.
15.1(d)	<i>Physical tests on insulation</i>						
i	Tensile strength and elongation at break	Table 1	IS 7098 (Pt 1)	7	R	one	Cables of each size and type manufactured in a day
ii	Aging in air oven	Table 1	IS 7098 (Pt 1)	11	R	one	Cables of each size and type manufactured in a fortnight, or 25 delivery lengths of same size and type, whichever is less. Additional samples shall be tested whenever there is a change in formulation of the XLPE compound.
iii	Hot Set test	Table 1	IS 7098 (Pt 1)	30	R	one	
iv	Shrinkage test	Table 1	IS 7098 (Pt 1)	12	R	one	
v	Water absorption (gravimetric) test	Table 1	IS 7098 (Pt 1)	33	R	one	
15.1(e)	<i>Physical tests on outer sheath</i>						
i	Tensile strength and elongation at break	Table 2	IS 5831	7	R	one	Cables of each size and type manufactured in a day
ii	Aging in air oven	Table 2	IS 5831	11	R	one	Cables of each size and type manufactured in a fortnight, or 25 delivery lengths of same size and type, whichever is less. Additional samples shall be tested whenever there is a change in formulation of the outer sheath compound.
iii	Loss of mass in air oven	Table 2	IS 5831	10	R	one	
iv	Shrinkage test	Table 2	IS 5831	12	R	one	
v	Hot deformation test	Table 2	IS 5831	15	R	one	
Vi	Heat shock test	Table 2	IS 5831	14	R	one	
vii	Thermal stability test	Table 2	IS 5831	60	R	one	

15.1(f)	Insulation resistance test (volume resistivity)	Table 1	IS 7098 (Pt 1)	43	R	one	Each length of finished cable.
15.1(g)	High voltage test	16.3	IS 7098 (Pt 1)	45	R	one	
15.1(h)	Flammability test	16.4	IS 7098 (Pt 1)	53	R	one	Cables of each size and type manufactured in a month, or 25 delivery lengths of same size and type, whichever is less.
15.4(a)	Cold bend test for outer sheath	Table 2	IS 5831	20	As per agreement between purchaser and supplier		
15.4(b)	Cold impact test for outer sheath			21			
<i>Additional type tests for cables with improved fire performance</i>							
15.1.1 & Appendix A	Oxygen Index Test	16.4	IS 7098 (Pt 1)	58	S	One	Every month for each size and type for one consignment of outer sheath compound.
	Flame Retardance Test on single cable	16.5		61			
	Flame Retardance Test on bunched cable	16.6		62			
	Temperature Index	16.9		64			
	Test for specific optical density of smoke	16.7		-			
	Smoke Density	16.10		63			
	Test for Halogen acid gas evolution	16.8		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 (at Room Temperature)
- xii. Flammability Test