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Indian Standard

(Reaffirmed 2001)

SPECIFICATION FOR
PVC INSULATION AND SHEATH OF
ELECTRIC CABLES
(*First Revision*)

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BUREAU OF INDIAN STANDARDS
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PVC INSULATION AND SHEATH OF
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(First Revision)

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(*Continued on page 2*)

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Indian Standard

SPECIFICATION FOR
PVC INSULATION AND SHEATH OF
ELECTRIC CABLES
(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 30 April 1984, after the draft finalized by the Power Cables Sectional Committee had been approved by the Electro-technical Division Council.

0.2 This standard was originally published in 1970 with a view to bring under a single cover the various requirements for PVC insulation and sheath of different types of cables.

0.3 This revision has been undertaken to update it in the light of further experience and developments and to align with international practice, where appropriate. Details about methods of test have been, by and large, taken out from this standard and are now covered in a separate standard, to which reference has been made at appropriate places.

0.4 This standard is complementary to the individual specification for different types of cables.

0.5 In preparing this standard, considerable assistance has been derived from IEC Publication 502 (1983) ' Extruded solid dielectric insulated power cables for rated voltages from 1 kV up to 30 kV ', issued by the International Electrotechnical Commission (IEC).

0.6 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test shall be rounded off in accordance with IS :2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Rules for rounding off numerical values (revised).

1. SCOPE

1.1 This standard specifies the physical and electrical requirements for PVC insulation and sheath of electric cables.

1.2 The types of PVC compounds covered by this standard are given below:

- Type A General purpose insulation for maximum rated conductor temperature 70°C intended for cables with rated voltages U_0/U up to and including 3.3/3.3 kV.
- Type B General purpose insulation for maximum rated conductor temperature 70°C intended for cables with rated voltages U_0/U above 3.3/3.3 kV.
- Type C Heat resisting insulation for maximum rated conductor temperature 85°C intended for cables with rated voltages up to and including 1 100 volts.
- Type ST1 General purpose sheath intended for use in cables operating at a maximum rated conductor temperature 70°C.
- Type ST2 Heat resisting sheath intended for use in cables operating at a maximum rated conductor temperature 90°C.

2. TERMINOLOGY

2.0 For the purpose of this standard, the definitions given in IS : 1885 (Part 32)-1971* shall apply, in addition to the following.

2.1 Variation — Difference between the median value obtained after ageing and the median value obtained without ageing, expressed as a percentage of the latter.

3. COMPOSITION

3.1 The insulation or sheath shall consist of a compound based on one of the following materials, which have been suitably compounded and processed to meet the requirements of this standard:

- a) Polyvinyl chloride (PVC),
- b) Suitable co-polymers of which the major constituent shall be vinyl chloride,
- c) Mixture of (a) and (b).

4. TEST REQUIREMENTS

4.1 The insulation and sheath shall satisfy the test requirements stated in Tables 1 and 2 respectively, to the extent specified in the relevant cable standard.

*Electrotechnical vocabulary : Part 32, Cables, conductors and accessories for electric supply.

TABLE 1 TEST REQUIREMENTS FOR PVC INSULATION

(Clause 4.1)

Sl. No.	TEST	UNIT	TYPE OF INSULATION			METHOD OF TEST (REF TO PART No. OF IS: 10810*)
			A	B	C	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
	i) Volume resistivity, Min					43
	a) at 27°C (see Note 1)	Ohm-cm	1 x 10 ³	1 x 10 ¹⁴	1 x 10 ¹³	
	b) at maximum rated temperature (see 1.2)	Ohm-cm	1 x 10 ¹⁰	1 x 10 ¹¹	1 x 10 ¹⁰	
	ii) Insulation resistance constant, Min					43
	a) at 27°C (see Note 1)	M Ω km	36.7	367	36.7	
	b) at maximum rated temperature (see 1.2)	M Ω km	0.037	0.37	0.037	
	iii) Without ageing					7
	a) Tensile strength, Min	N/mm ²	12.5	12.5	12.5	
	b) Elongation at break, Min	percent	150	135	125	
	iv) After ageing in air oven					11
	a) Treatment { Temperature (tolerance ± 2°C)	°C	80	100	135	
	{ Duration	days	7	7	7	
	b) Tensile strength					
	1) Value after ageing, Min	N/mm ²	12.5	12.5	12.5	
	2) Variation, Max	percent	± 20	± 25	± 25	
	c) Elongation at break					
	1) Value after ageing, Min	percent	150	125	125	
	2) Variation, Max	percent	± 20	± 25	± 35	
	v) Loss of mass in air oven					10
	a) Treatment { Temperature (tolerance ± 2°C)	°C	80	—	—	
	{ Duration	days	—	—	—	

(Continued)

TABLE 1 TEST REQUIREMENTS FOR PVC INSULATION — Contd

Sl. No.	TEST	UNIT	TYPE OF INSULATION			METHOD OF TEST (REF TO PART No. OF IS : 108105)
			A	B	C	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
vi)	Hot deformation test					15
	a) Test temperature (tolerance $\pm 2^{\circ}\text{C}$)	$^{\circ}\text{C}$	80	80	95	
	b) Time under load (see Note 2)					
	First case	hours	4	—	—	
	Second case	hours	6	6	6	
	c) Depth of indentation, Max	percent	50	50	50	
vii)	Heat shock test					14
	a) Treatment { Temperature (tolerance $\pm 2^{\circ}\text{C}$)	$^{\circ}\text{C}$	150	150	150	
	Duration	hour	1	1	1	
	b) Visual examination	—	No signs of cracks or scales			
viii)	Shrinkage test					12
	a) Treatment { Temperature (tolerance $\pm 2^{\circ}\text{C}$)	$^{\circ}\text{C}$	150	150	150	
	Duration	minutes	15	15	15	
	b) Shrinkage, Max	percent	4	4	4	
ix)	Cold bend test (for diameter ≤ 12.5 mm)					20
	a) Test temperature (tolerance $\pm 2^{\circ}\text{C}$)	$^{\circ}\text{C}$	- 15	- 5	- 15	
	b) Visual examination		No signs of cracks or scales			
x)	Cold impact test (for diameter > 12.5 mm)					21
	a) Test temperature (tolerance $\pm 2^{\circ}\text{C}$)	$^{\circ}\text{C}$	- 5	- 5	- 5	
	b) Visual examination		No signs of cracks or scales			

(Continued)

TABLE 1 TEST REQUIREMENTS FOR PVC INSULATION — *Contd*

Sl. No.	TEST	UNIT	TYPE OF INSULATION			METHOD OF TEST (REP TO PART No. OF IS : 10810*)
			A	B	C	
(1)	(2)	(8)	(4)	(5)	(6)	(7)
xi)	Colour fastness to daylight exposure, <i>Min</i>	rating	4	4	4	18
xii)	Colour fastness to water					(see Note 3)
a)	Treatment { Temperature (tolerance $\pm 2^{\circ}\text{C}$) (Duration	$^{\circ}\text{C}$ hours	70 48	70 48	70 48	
b)	Visual examination	—	free from traces of colour			
xiii)	Thermal stability					(see Note 4)
a)	Test temperature (tolerance $\pm 0.5^{\circ}\text{C}$)	$^{\circ}\text{C}$	200	200	200	
b)	Time, <i>Min</i>	minutes	80	100	100	
xiv)	Bleeding and blooming test					19
a)	Treatment { Temperature (tolerance $\pm 2^{\circ}\text{C}$) (Duration	$^{\circ}\text{C}$ hours	50 72	50 72	50 72	
b)	Observation		no appreciable staining of indicator compound or filter paper			
xv)	Water absorption test (gravimetric)					33
a)	Treatment { Temperature (tolerance $\pm 2^{\circ}\text{C}$) (Duration	$^{\circ}\text{C}$ days	—	85 14	—	
b)	Water absorbed, Max	mg/cm^2	—	10	—	

NOTE 1 — Volume resistivity and insulation resistance tests may be done at room temperature instead of 27°C . However, in case of doubt or dispute, the test results shall be confirmed by testing at 27°C .

NOTE 2 — Time under load:

First case—Cables having a rated voltage not exceeding 33/33.3 kV and a conductor cross-section not exceeding 35 mm^2 .

Second case—Cables not covered under the first case.

NOTE 3 — Under preparation. In the meantime, test method given in Appendix A shall be followed.

NOTE 4 — Under preparation. In the meantime, test methods given in Appendix B shall be followed.

*Methods of test for cables.

TAELE 2 TEST REQUIREMENTS FOR PVC SHEATH

(Clause 4.1

Sl. No.	TEST	UNIT	TYPE OF SHEATH		METHOD OF TEST (REF PART No. OF IS: 10810*)
			ST1	ST2	
(1)	(2)	(3)	(4)	(5)	(6)
	i) Without ageing				7
	a) Tensile strength, <i>Min</i>	N/mm ²	12.5	12.5	
	b) Elongation at break, <i>Min</i>	percent	150	150	
	ii) After ageing in air oven				11
	a) Treatment { Temperature (tolerance $\pm 2^{\circ}\text{C}$) (Duration	$^{\circ}\text{C}$ days	80 7	100 7	
	b) Tensile strength				
	1) Value after ageing, <i>Min</i>	N/mm ² *	12.5	12.5	
	2) Variation, <i>Max</i>	percent	± 20	± 25	
	c) Elongation at break				
	1) Value after ageing, <i>Min</i>	percent	150	150	
	2) Variation, <i>Max</i>	percent	± 20	± 25	
	iii) Loss of mass in air oven				10
	a) Treatment { Temperature (tolerance $\pm 2^{\circ}\text{C}$) (Duration	$^{\circ}\text{C}$ days	80 7	100 7	
	b) Loss of mass, <i>Max</i>	mg/cm ²	2	2	
	iv) Hot deformation test				15
	a) Test temperature (tolerance $\bullet 2^{\circ}\text{C}$)	$^{\circ}\text{C}$	80	30	
	b) Time under load (see Note 1)				
	First case	hours	4	4	
	Second case	hours	6	6	
	c) Depth of indentation, <i>Max</i>	percent	90	50	

(Continued)

TABLE 2 TEST REQUIREMENTS FOR PVC SHEATH — Contd

SL No.	TEST	UNIT	TYPE OF SHEATH		METHOD OF TEST (REF TO PART NO. OF IS: 10810*)
			ST1	ST2	
(1)	(2)	(3)	(4)	(5)	(6)
	v) Heat shock test				14
	a) Treatment { Temperature (tolerance $\pm 2^{\circ}\text{C}$) Duration	$^{\circ}\text{C}$ hour	150 1	150 1	
	b) Visual examination	—	No signs of cracks or scales		
	vi) Shrinkage test				12
	a) Treatment { Temperature (tolerance $\pm 2^{\circ}\text{C}$) Duration	$^{\circ}\text{C}$ minutes	150 15	150 15	
	b) Shrinkage, <i>Mux</i>	percent	4	4	
	vii) Cold bend test for diameter ≤ 12.5 mm				20
	a) Test temperature (tolerance $\pm 2^{\circ}\text{C}$)	$^{\circ}\text{C}$	- 15	- 15	
	b) Visual examination		No signs of cracks or scales		
	viii) Cold impact test for diameter > 12.5 mm				21
	a) Test temperature (tolerance $\pm 2^{\circ}\text{C}$)	$^{\circ}\text{C}$	- 5	- 5	
	b) Visual examination	—	No signs of cracks or scales		
	ix) Colour fastness to daylight exposure, <i>Min</i>	rating	4	4	18
	x) Colour fastness to water				(See Note 2)
	a) Treatment { Temperature (tolerance $\pm 2^{\circ}\text{C}$) Duration	$^{\circ}\text{C}$ hours	70 48	70 48	
	b) Visual examination		Free from traces of colours		

(Continued)

TABLE 2 TEST REQUIREMENTS FOR PVC SHEATH — Contd

SL No.	TEST	UNIT	TYPE OF SHEATH		METHOD OF TEST (REP TO PART No. OF IS :10810*) (6)
			ST1	ST2	
(1)	(2)	(3)	(4)	(5)	(6)
	xi) Thermal stability				(See Note 3)
	a) Test temperature (tolerance $\pm 0.5^{\circ}\text{C}$)	$^{\circ}\text{C}$	200	200	
	b) Time, <i>Min</i>	minutes	40	80	
	xii) Bleeding and blooming				19
	a) Treatment { Temperature (tolerance $\pm 2^{\circ}\text{C}$) Duration	$^{\circ}\text{C}$ hours	50 72	50 72	
	b) Observations		No appreciable staining of indicator compound or filter paper		
	xiii) Oxygen index	—	(Under consideration)		

NOTE 1— Time under load:

First case-4 hours for test piece having an outer diameter not exceeding 12.5 mm.

Second case--6 hours for test piece having an outer diameter exceeding 12.5 mm.

NOTE 2 — Under preparation. In the meantime, test method given in Appendix A shall be followed.

NOTE 3 — Under preparation. In the meantime, test method given in Appendix B shall be followed.

*Methods of test for cables.

APPENDIX A

[Table 1, Item (xii) and Table 2, Item (x)]

TEST FOR COLOUR FASTNESS TO WATER

A-1. A piece about 100 mm long of insulation or sheath is cut into small pieces and immersed for the specified period in about 10 times its own volume of distilled water maintained at the specified temperature. At the end of the period, the water shall be examined. It shall be free from any trace of colour.

APPENDIX B

[Table 1, Item (xiii) and Table 2, Item (xi)]

THERMAL STABILITY TEST

B-1. Testing Equipment

B-1.1 Class tubes closed at one end 110 mm long with an outer diameter of approximately 5 mm and an inner diameter of 4.0 ± 0.5 mm.

B-1.2 Universal indicating paper with a *pH* range of 1 to 10.

B-1.3 Thermostatically controlled heating apparatus for the specified temperature.

B-1.4 Thermometer calibrated in divisions of 0.1°C .

B-1.5 Stop-watch or a suitable time meter.

B-2. Testing Method

- a) From the insulation of each core to be tested or from the sheath to be tested, three samples, each of 50 ± 5 mg, shall be taken in the form of strip, if possible. For small thickness the sample may consist of two or more strips. Each sample shall be inserted into a glass tube as specified in B-1.1. The sample shall occupy the bottom of the tube and not project more than 30 mm above the bottom.
- b) A strip of dry universal indicating paper as specified in B-1.2, about 15 mm long and 3 mm wide, shall be inserted into the open end (top) of the glass tube so that the strip protrudes about 5 mm out of the tube and can be bent to keep it in position.

- c) The glass tube shall be placed into the heating apparatus, as specified in **B-1.3**, which has already attained the test temperature specified. The glass tube shall be inserted into the heating apparatus for a depth of 60 mm.
- d) The time taken for the universal indicating paper to change colour from a *pH* value of 5 to a *pH* value of 3 shall be measured, or the test continued for the specified duration without the colour change occurring. The colour change point shall be considered to have been reached when the red colouring of the universal indicating paper characteristic of a *pH* value of 3 is just becoming visible. The universal indicating paper shall be renewed (especially for long duration stabilities) towards the end of the expected test time every 5 to 10 min, so that the change point is better visible.

B-3. Evaluation

B-3.1 The average value of the thermal stability times of the three samples shall not be lower than the value specified in Table 1 or Table 2 as applicable.

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AMENDMENT NO. 1 APRIL 1985

TO

IS:5831 -1984 SPECIFICATION FOR PVC INSULATION
AND SHEATH OF ELECTRIC CABLES

(First Revision)

[Page 5, Table 1, Sl No.(v), item (a)] - Insert the following after this item:

(1)	(2)	(3)	(4)	(5)	(6)	(7)
b)	Loss of mass, Max	mg/cm ²	2	-	-	'

[Page 6, Table 1, Sl No, (vi), item (b), first case, col (6)] - Substitute '4' FOR '-'.

[Page 7, Table 1, Sl No. (xv)]:

a) - Substitute 'tolerance' for 'toterance'.

b) - Substitute 'absorbed' for 'absorted'.

[Page 8, Table 2, Sl No.(iv), item(a), col (5)] - Substitute '80' for '30'.

(Page 11, clause A-1, line 1)- Substitute 'cut' for 'out'.

(Page 11, clause B-1.1, 'line 1)- Substitute 'Glass' for 'Class'.

(ETDC 59)

AMENDMENT NO. 2 DECEMBER 1995.
TO
IS 5831 : 1984 SPECIFICATION FOR PVC
INSULATION AND SHEATH OF ELECTRIC CABLES
(First Revision)

(Page 4, clause 1.2) -- Add the following matter between 'Type C' and 'Type ST1':

'Type D General purpose insulation for maximum rated conductor temperature 70°C intended for flexible cables with rated voltage U_0/U up to and including 3.3/3.3 kV.'

(Page 4, clause 1.2) -- Add the following new para for Type ST3 Compound:

'Type ST3 General purpose sheath intended for use in flexible cables operating at maximum rated conductor temperature 70°C.'

[Page 7, Table 1, col 7, Sl No. (xiii)] -- Substitute '60' for '(see Note 4)'.

(Page 7, Table 1, Note 4) -- Delete.

(Pages 5, 6 and 7, Table 1) -- Add the following test requirements for the new insulation type 'Type D' under column heading 'Type of Insulation' as col 7 of this table and renumber the existing col 7 as col 8 :

Table 1 Test Requirements for PVC Insulation
(Clause 4.1)

Sl No.	Test	Unit	Type of Insulation
			D
(1)	(2)	(3)	(7)
i)	Volume resistivity, <i>Min</i>		
	a) at 27°C (see Note 1)	Ohm-cm	1×10^{11}
	b) at maximum rated temperature (see 1.2)	Ohm-cm	1×10^{10}
ii)	Insulation resistance constant, <i>Min</i>		
	a) at 27°C (see Note 1)	M Ω km	3.67
	b) at maximum rated temperature (see 1.2)	M Ω km	0.004
iii)	Without ageing		
	a) tensile strength, <i>Min</i>	N/mm ²	10
	b) Elongation at break, %	Percent	150

Price Group 1

Table 1 (Continued)

Sl No.	Test	Unit	Type of Insulation
(1)	(2)	(3)	(7)
iv)	After ageing in air oven		
a)	Treatment { Temperature (tolerance $\pm 2^{\circ}\text{C}$) Duration	$^{\circ}\text{C}$ days	70 7
b)	Tensile strength		
1)	Value after ageing, <i>Min</i>	N/mm ²	10
2)	Variation, <i>Max</i>	percent	± 20
c)	Elongation at break		
1)	Value after ageing, <i>Min</i>	percent	150
2)	Variation, <i>Max</i>	percent	± 20
v)	Loss of mass in air oven		
a)	Treatment { Temperature (tolerance $\pm 2^{\circ}\text{C}$) Duration	$^{\circ}\text{C}$ days	80 7
b)	Loss of mass, <i>Max</i>	mg/cm ²	2
vi)	Hot deformation test		
a)	Test temperature (tolerance $\pm 2^{\circ}\text{C}$)	$^{\circ}\text{C}$	80
b)	Time under load (see Note 2)		
1)	First case	hours	4
2)	Second case	hours	
c)	Depth of indentation, <i>Max</i>	percent	65
vii)	Heat shock test		
a)	Treatment { Temperature (tolerance $\pm 2^{\circ}\text{C}$) Duration	$^{\circ}\text{C}$ hour	150 J
b)	Visual examination	---	No signs of cracks or scales
viii)	Shrinkage test		
a)	Treatment { Temperature (tolerance $\pm 2^{\circ}\text{C}$) Duration	$^{\circ}\text{C}$ minutes	150 15
b)	Shrinkage, <i>Max</i>	percent	6
ix)	Cold bend test (for diameter ≤ 12.5 mm)		
a)	Test temperature (tolerance $\pm 2^{\circ}\text{C}$)	$^{\circ}\text{C}$	-15
b)	Visual examination	---	No signs of cracks or scales
x)	Cold impact test (for diameter > 12.5 mm)		
a)	Test temperature (tolerance $\pm 2^{\circ}\text{C}$)	$^{\circ}\text{C}$	-5
b)	Visual examination	---	No signs of cracks or scales

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Table 1 (Concluded)

Sl No.	Test	Unit	Type of Insulation
			D (7)
(1)	(2)	(3)	
xi)	Colour fastness to daylight exposure, <i>Min</i>	rating	4
xii)	Colour fastness to water		
	a) Treatment { Temperature (tolerance $\pm 2^{\circ}\text{C}$)	"C	70
	{ Duration	hours	48
	b) Visual examination	--	Free from traces of colour
xiii)	Thermal stability		
	a) Test temperature (tolerance $\pm 0.5^{\circ}\text{C}$)	$^{\circ}\text{C}$	200
	b) Time, <i>Min</i>	Minute	80
xiv)	Bleeding and blooming test		
	a) Treatment { Temperature (tolerance $\pm 2^{\circ}\text{C}$)	$^{\circ}\text{C}$	50
	{ Duration	hours	72
	b) Observation	--	No appreciable staining of indicator compound or filter paper
xv)	Water absorption test (gravimetric)		
	a) Treatment { Temperature (tolerance $\pm 2^{\circ}\text{C}$)	"C	--
	{ Duration	days	--
	b) Water absorbed, <i>Max</i>	mg/cm ²	--

[Page 10, Table 2, col 6, Sl No. (xi)] --- Substitute '60' for '(See Note 3)'.

(Page 10, Note 3) - Delete.

(Pages 8, 9 and 10, Table 2) --- Add the following Test Requirements for the new PVC Compound 'Type ST3' under column heading 'Type of Sheath' as col 6 of this table and renumber the existing col 6 as col 7 :

Table 2 Test Requirements for PVC Sheath
(Clause 4.1)

Sl No.	Test	Unit	Type of Sheath
			ST3 (6)
(1)	(2)	(3)	
i)	Without ageing		
	a) Tensile strength, <i>Min</i>	N/mm ²	10.0
	b) Elongation at break, <i>Min</i>	percent	150

Table 2 (Continued)

Sl No. (1)	Test (2)	Unit (3)	Type of Test (6)
ii)	After ageing in air oven		
	Temperature (tolerance $\pm 2^\circ\text{C}$)	$^\circ\text{C}$	7
a)	Treatment { Temperature (tolerance $\pm 2^\circ\text{C}$) Duration	days	7
	b) Tensile strength		
	1) Value after ageing, <i>Min</i>	N/mm ²	10.0
	2) Variation, <i>Max</i>	percent	± 20
	c) Elongation at break		
	1) Value after ageing, <i>Min</i>	percent	150
	2) Variation, <i>Max</i>	percent	± 20
iii)	Loss of mass in air oven		
	Temperature (tolerance $\pm 2^\circ\text{C}$)	$^\circ\text{C}$	80
a)	Treatment { Temperature (tolerance $\pm 2^\circ\text{C}$) Duration	days	7
	b) Loss of mass, <i>Max</i>	mg/cm ²	2.0
iv)	Hot deformation test		
	a) Test temperature (tolerance $\pm 2^\circ\text{C}$)	$^\circ\text{C}$	70
	b) Time under load (see Note 1)		
	1) First case	hours	4
	2) Second case	hours	6
	c) Depth of indentation, <i>Max</i>	percent	65
v)	Heat shock test		
	Temperature (tolerance $\pm 2^\circ\text{C}$)	$^\circ\text{C}$	150
a)	Treatment { Temperature (tolerance $\pm 2^\circ\text{C}$) Duration	hour	1
	b) Visual examination	—	No signs of cracks or scales
vi)	Shrinkage test		
	Temperature (tolerance $\pm 2^\circ\text{C}$)	$^\circ\text{C}$	150
a)	Treatment { Temperature (tolerance $\pm 2^\circ\text{C}$) Duration	minutes	15
	b) Shrinkage, <i>Max</i>	percent	6
vii)	Cold bend test for diameter < 12.5 mm		
	Test temperature (tolerance $\pm 2^\circ\text{C}$)	$^\circ\text{C}$	-15
a)	Test temperature (tolerance $\pm 2^\circ\text{C}$)	$^\circ\text{C}$	-15
	b) Visual examination	—	No signs of cracks or scales
viii)	Cold impact test for diameter > 12.5 mm		
	Test temperature (tolerance $\pm 2^\circ\text{C}$)	$^\circ\text{C}$	-5
a)	Test temperature (tolerance $\pm 2^\circ\text{C}$)	$^\circ\text{C}$	-5
	b) Visual examination	—	No signs of cracks or scales

Table 2 (Concluded)

Sl No. (1)	Test (2)	Unit (3)	Type of Sheath (6)
ix)	Colour fastness to daylight exposure, <i>Min</i>	rating	4
x)	Colour fastness to water		
	a) Treatment { Temperature (tolerance $\pm 2^{\circ}\text{C}$) Duration	$^{\circ}\text{C}$ hours	70 48
	b) Visual examination	—	Free from traces of colours
xi)	Thermal stability		
	a) Test temperature (tolerance $\pm 0.5^{\circ}\text{C}$)	$^{\circ}\text{C}$	200
	b) Time, <i>Min</i>	Minutes	40
xii)	Bleeding and blooming		
	a) Treatment { Temperature (tolerance $\pm 2^{\circ}\text{C}$) Duration	$^{\circ}\text{C}$ hours	50 72
	b) Observation		No appreciable stain- ing of indicator com- pound or filter paper

(ETD 09)

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