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*Draft Indian Standard*

**Instrumentation & Control Cables**

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Power Cables Sectional  
Committee, ETD 09

Last date for comments - **09/08/2024**

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FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Power Cables Sectional Committee had been approved by the Electrotechnical Division Council.

This standard covers the specification of multi-element cables suitable for connecting instruments and control systems for analogue or digital signal transmission having maximum rated voltage upto 500V a.c.

These cables shall not be directly connected to mains electricity supply or other low impedance sources. These cables are not designed to be used for power supply.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the results of a test, shall be rounded off in accordance with IS 2:2022 'Rules for rounding off numerical values (*second revision*)' . The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Indian Standards***INSTRUMENTATION & CONTROL CABLES****1 SCOPE**

**1.1** This standard covers the specification of multi-element cables suitable for connecting instruments and control systems for analogue or digital signal transmission having Maximum Rated Voltages of (upto 500V ac.)

Note: 1. 300 V ac cables can be used for 500 V dc

2. 500 V ac cables can be used for 750 V dc

**1.2** These cables shall not be directly connected to mains electricity supply or other low impedance sources. These cables are not designed to be used for power supply.

NOTE — Provision of Moisture Barrier in the cable is optional.

**2 REFERENCES**

The standards listed below contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below

<i>IS No.</i>	<i>Title</i>
IS 1554 Part 1: 1988	Specification for PVC Insulated (heavy duty) electric cables for working voltages upto and including 1100 volts ( <i>Third Revision</i> )
IS 1885 : Part 32: 2019	Electrotechnical Vocabulary Part 32 Electric Cables ( <i>Second Revision</i> )
IS 3975 :1999	Low carbon galvanized steel wires, formed wires and tapes for armouring of cables - Specification ( <i>Third Revision</i> )
IS 4905:2015	Random sampling and randomization procedures ( <i>First Revision</i> )
IS 5831:1984	Specification for PVC insulation and sheath of electric cables ( <i>First Revision</i> )
IS 7098 Part 1 : 1988	Specification for crosslinked polyethylene insulated pvc sheathed cables: Part 1 for working voltages up to and including 1100 volts ( <i>First Revision</i> )
IS 8130:2013	Conductors for insulated electric cables and flexible cords— Specification ( <i>Second Revision</i> )
IS 10462 Part 1: 1983	Fictitious calculation method for determination of dimensions of protective coverings of cables: Part 1 elastomeric and thermoplastic insulated cables
IS 10579:1983	Specification for polyethylene (PE) insulation and sheath of telecommunication cables
IS 13360 : Part 6 : Sec 9:2001	Plastics - Methods of testing: Part 6 thermal properties section 9 determination of density of smoke from the burning or decomposition of plastics

IS 10810 series	Methods of test for cables
IS 17048:2018	Halogen free flame retardant (HFFR) cables for working voltages up to and including 1 100 Volts - Specification
IS/IEC 60189: Part 1:2018	Low-Frequency Cables and Wires with PVC Insulation and PVC Sheath Part 1 General Test and Measuring Methods
IS/IEC 60189 : Part 2:2007	Low-Frequency Cables and Wires with PVC Insulation and PVC Sheath Part 2 Cables in Pairs, Triples, Quads and Quintuples for Inside Installations

### 3 TERMINOLOGIES

For the purpose of this standard, the following definitions in addition to those given in IS 1885 (Part 32) shall apply.

**3.1 Routine Test** — Test made by the manufacturer on all finished cable lengths to demonstrate the integrity of the cable.

**3.2 Type Test** — Test required to be made before supply on a general commercial basis a type of cable in order to demonstrate satisfactory performance characteristics to meet the intended application.

NOTE — These tests are of such a nature that after they have been made they need not be repeated unless changes are made in the cable materials or design which might change the performance characteristics.

**3.3 Acceptance Tests** — Tests carried out on samples taken from a lot for the purpose of acceptance of the lot.

**3.4 Optional Tests** — Special tests to be carried out, when required, by agreement between the purchaser and the supplier.

### 4 CONDUCTOR

a) Material

- 1) Conductor shall comply to IS 8130
- 2) Conductor shall be Annealed Tinned Copper (ATC) or Annealed Bare Copper (ABC)
- 3) Conductor shall be:
  - Class 1 – solid in accordance with IS 8130
  - Class 2 – stranded in accordance with IS 8130
  - Class 5 – flexible in accordance with IS 8130

b) Conductor sizes

- Conductor shall be:
- 0.5 sq. mm, 0.75 sq. mm, 1.0 sq. mm, 1.5 sq. mm, 2.5 sq. mm

c) Conductor Resistance

- 1) In case of single Core / Pair / Triad / Quad cables and multi-core cables maximum conductor resistance shall be as below:
  - i. Class 1 conductor – in accordance with Table 1 of IS 8130.

- ii. Class 2 conductor – in accordance with Table 2 of IS 8130, except for 0.5 Sq. mm & 0.75 Sq.mm conductor resistance shall be in accordance with Table 1 of IS 8130.
- iii. Class 5 conductor – in accordance with Table 3 of IS 8130.

2) In case of multi-pair / triad / quad cables the maximum conductor resistance shall be increased by 2% from above mentioned and rounded off to two decimal digits.

## 5 INSULATION

### 5.1 Types of Compounds

Insulation applied by extrusion on conductor shall be with any of the below Compounds as per requirement:

- 1) **PVC** – in accordance with IS 5831(Type A, Type C)
- 2) **PE** – in accordance with IS 10579
- 3) **XLPE**– in accordance with IS 7098 (part 1)
- 4) **HFFR (Thermoplastic or Cross-linked)** – in accordance with Annexure A of IS 17048 (HFI-TP70, HFI-XL70, HFI-XL 90)

### 5.2 Insulation Thickness

The insulation thickness corresponding to various conductor sizes and voltage grades is given in Table 1.

**Table 1 Thickness of Insulation**

Sl. No.	Conductor Size (mm <sup>2</sup> )	Insulation Thickness (Nominal) (mm) $t_i$	
		For 300 V ac	For 500 V ac
(1)	(2)	(3)	(4)
i)	0.5	0.40	0.60
ii)	0.75	0.40	0.60
iii)	1.0	0.40	0.60
iv)	1.5	0.50	0.60
v)	2.5	0.60	0.70

#### 5.2.1 Tolerance on thickness of Insulation

The smallest of measured values of thickness of insulation shall not fall below the nominal value ( $t_i$ ) specified in above table by more than  $0.1\text{mm} + 0.1 t_i$

### 5.2.2 Application of Insulation

The insulation shall be so applied that it fits closely on the conductor (or barrier if any) and it shall be possible to remove it without damaging the conductor.

## 6 CABLING ELEMENTS

Below are the individual cabling elements

- a) Single Insulated Wire
- b) Pair
- c) Triad
- d) Quad

### 6.1 Lay Length of Cabling Elements

The lay length of each pair, triad or quad shall be in accordance with Table 2.

**Table 2 Lay Length**

Sl.No.	Conductor Size(mm <sup>2</sup> )	Max Lay Length (mm)
(1)	(2)	(3)
i)	Up to 1.5	100
ii)	2.5	150

### 6.2 Identification of Cabling Elements

Identification of cabling elements shall be in accordance with:

#### 6.2.1 Identification by number printing

Each core in multi-core cable and each core of pair / triad / quad shall be numbered sequentially, starting from the inner layer. The numbers shall be printed in numerals and words in contrasting colours. Such printed numbers shall be repeated at regular intervals along the core and consecutive numbers shall be inverted to each other.

Core colours: The cores within each cabling element shall be in following colours:

- i. The two cores in each Pair shall be coloured White and Blue
- ii. The three cores in each Triad shall be coloured White, Blue and Turquoise
- iii. The four cores in each Quad shall be coloured White, Blue, Turquoise and Violet
- iv. Cores in a multi core cable shall be identified by different colouring of insulation by adopting the following scheme
  - a) 1 core: red , black, yellow ,blue or natural(non-pigmented)
  - b) 2 cores: red and black
  - c) 3 cores: red , yellow and blue

- d) 4 cores: red , yellow, blue and black
- e) 5 cores : red ,yellow, blue, black and grey
- f) 6 cores and above: Two adjacent cores(counting and direction core)in each layer ,blue and yellow, remaining cores grey or in accordance with scheme given in for cables having more than 5 cores, as an alternate to the provision of (f), the core identification may be done by numbers. .In that case, the insulation of cores shall be the same colour and numbered sequentially, starting with number 1 for the inner layer. The number shall be printed in Hindu-Arabic numerals on the outer surface of the cores. All the numbers shall be of the same colour which shall contrast with the colour of the insulation. The numeral shall be legible.

Any specific colour scheme as agreed between manufacturer and purchaser is permitted.

NOTE — This identification method does not apply to single-core cables i.e. colour identification of single insulated wire

### 6.2.2 Identification by number tape

Polyester number tape shall be provided over each pair / triad / quad and such tapes shall be applied such that the cabling elements are numbered sequentially, starting from the inner layer.

Core colours: The core colours shall be in accordance with Clause 6.2.1.

NOTE — This identification method does not apply to single / multi-core cables.

### 6.2.3 Identification by colour coding

In case of pair cables, identification shall be in accordance with columns ‘Cabling Element’ and ‘Colour of Insulation’ as given in Table 3.

**Table 3 Colour Code**

Sl. No. (1)	Counting Block (2)	Colour Block (3)	Cabling Element (4)	Colour Of Insulation (5)	
				Wire a	Wire b
i)	1	1	1	White	Blue
ii)		1	2	White	Orange
iii)		1	3	White	Green
iv)		1	4	White	Brown
v)		1	5	White	Grey
vi)		2	6	Red	Blue
vii)		2	7	Red	Orange
viii)		2	8	Red	Green
ix)		2	9	Red	Brown
x)		2	10	Red	Grey
xi)		3	11	Black	Blue
xii)		3	12	Black	Orange
xiii)		3	13	Black	Green
xiv)		3	14	Black	Brown
xv)		3	15	Black	Grey

xvi)		4	16	Yellow	Blue
xvii)		4	17	Yellow	Orange
xviii)		4	18	Yellow	Green
xix)		4	19	Yellow	Brown
xx)		4	20	Yellow	Grey
xxi)	2	5	21	White - blue	Blue
xxii)		5	22	White - blue	Orange
xxiii)		5	23	White - blue	Green
xxiv)		5	24	White - blue	Brown
xxv)		5	25	White - blue	Grey
xxvi)		6	26	Red - blue	Blue
xxvii)		6	27	Red - blue	Orange
xxviii)		6	28	Red - blue	Green
xxix)		6	29	Red - blue	Brown
xxx)		6	30	Red - blue	Grey
xxxi)		7	31	Black - blue	Blue
xxxii)		7	32	Black - blue	Orange
xxxiii)		7	33	Black - blue	Green
xxxiv)		7	34	Black - blue	Brown
xxxv)		7	35	Black - blue	Grey
xxxvi)		8	36	Yellow - blue	Blue
xxxvii)		8	37	Yellow - blue	Orange
xxxviii)		8	38	Yellow - blue	Green
xxxix)		8	39	Yellow - blue	Brown
xl)		8	40	Yellow - blue	Grey
xli)	3	9	41	White- orange	Blue
xlii)		9	42	White- orange	Orange
xliii)		9	43	White- orange	Green
xliv)		9	44	White- orange	Brown
xlv)		9	45	White- orange	Grey
xlvi)		10	46	Red - orange	Blue
xlvii)		10	47	Red - orange	Orange
xlviii)		10	48	Red - orange	Green
xliv)		10	49	Red - orange	Brown
l)		10	50	Red - orange	Grey
li)		11	51	Black - orange	Blue

lii)		11	52	Black - orange	Orange
liii)		11	53	Black - orange	Green
liv)		11	53	Black - orange	Brown
lv)		11	55	Black - orange	Grey
lvi)		12	56	Yellow-orange	Blue
lvii)		12	57	Yellow-orange	Orange
lviii)		12	58	Yellow-orange	Green
lix)		12	59	Yellow-orange	Brown
lx)		12	60	Yellow-orange	Grey
lxi)	4	13	61	White-green	Blue
lxii)		13	62	White-green	Orange
lxiii)		13	63	White-green	Green
lxiv)		13	64	White-green	Brown
lxv)		13	65	White-green	Grey
lxvi)		14	66	Red - green	Blue
lxvii)		14	67	Red - green	Orange
lxviii)		14	68	Red - green	Green
lxix)		14	69	Red - green	Brown
lxx)		14	70	Red - green	Grey
lxxi)		15	71	Black -green	Blue
lxxii)		15	72	Black -green	Orange
lxxiii)		15	73	Black -green	Green
lxxiv)		15	74	Black -green	Brown
lxxv)		15	75	Black -green	Grey
lxxvi)		16	76	Yellow - green	Blue
lxxvii)		16	77	Yellow - green	Orange
lxxviii)		16	78	Yellow - green	Green
lxxix)		16	79	Yellow - green	Brown
lxxx)		16	80	Yellow - green	Grey
lxxxii)	5	17	81	White - brown	Blue
lxxxii)		17	82	White - brown	Orange



lxxxiii)	17	83	White - brown	Green	
lxxxiv)	17	84	White - brown	Brown	
lxxxv)	17	85	White - brown	Grey	
lxxxvi)	18	86	Red - brown	Blue	
lxxxvii	18	87	Red - brown	Orange	
lxxxvii	18	88	Red - brown	Green	
lxxxix)	18	89	Red - brown	Brown	
xc)	18	90	Red - brown	Grey	
xcii)	19	91	Black - brown	Blue	
xciii)	19	92	Black - brown	Orange	
xciv)	19	93	Black - brown	Green	
xcv)	19	94	Black - brown	Brown	
xcvi)	19	95	Black - brown	Grey	
xcvii)	20	96	Yellow-brown	Blue	
xcviii)	20	97	Yellow-brown	Orange	
xcix)	20	98	Yellow-brown	Green	
c)	20	99	Yellow-brown	Brown	
ci)	20	100	Yellow-brown	Grey	
cii)	6	21	101	White - grey	Blue
ciii)	21	102	White - grey	Orange	
civ)	21	103	White - grey	Green	
cv)	21	104	White - grey	Brown	
cvi)	21	105	White - grey	Grey	
cvii)	22	106	Red - grey	Blue	
cviii)	22	107	Red - grey	Orange	
cix)	22	108	Red - grey	Green	
cx)	22	109	Red - grey	Brown	
cxii)	22	110	Red - grey	Grey	
cxiii)	23	111	Black - grey	Blue	
cxiv)	23	112	Black - grey	Orange	
cxv)	23	113	Black - grey	Green	
	23	114	Black - grey	Brown	
	23	115	Black - grey	Grey	

cxvi)	24	116	Yellow - grey	Blue
cxvii)	24	117	Yellow - grey	Orange
cxviii)	24	118	Yellow - grey	Green
cxix)	24	119	Yellow - grey	Brown
cxx)	24	120	Yellow - grey	Grey

NOTE – The c and d wires, if any, shall be identically coloured in all elements, c- turquoise, d- violet.

In case of triad / quad cables: Referring above Annexure A of IS/IEC 60189-2, in case of Triad cables, Wire c shall be of turquoise colour. For Quad cables, Wire c shall be of turquoise colour and Wire d shall be of violet colour.

In case of dual colour of insulation colour mentioned first shall be base colour and colour mentioned second shall be by either band marking or bicolour extrusion.

In case of single / multi-core cables, insulated cores shall be coloured in accordance with *Clause 6.2.1*.

### 6.3 Screening of Cabling Elements

When screening of individual cable elements is specified, screening shall be achieved by any of the following methods:

1) By applying a plain or tinned copper wire braid with minimum filling factor of 0.6. The braid wire diameter shall be in accordance with Table 4.

**Table 4 Braid Wire Diameter**

Sl. No. (1)	Calculated Diameter Under The Braid (2)		Nominal Diameter Of Braid Wire (3)	Tolerance On Wire Diameter (4)
	Above	Up To And Including		
i)	0 mm	6 mm	0.15mm	+/- 0.01 mm
ii)	6 mm	15 mm	0.20 mm	+/- 0.01 mm
iii)	15 mm	25 mm	0.30 mm	+/- 0.01 mm
iv)	25 mm	---	0.40 mm	+/- 0.01 mm

2) By Aluminum bonded polyester laminated tape having thickness minimum 0.018 mm applied helically with a minimum overlap of 20% and with a tin coated stranded copper drain wire of size 0.5 sq mm applied in direct contact with the metallic side of the tape.

3) By a combination of 1 & 2 above with a minimum filling factor of 0.3 for braid. Drain wire is optional in this case.

A polyester tape below and above the screen shall be applied helically having suitable thickness and overlap. The tapes may be transparent or coloured.

### **7 CABLE LAY-UP**

The cabling elements shall be arranged in concentric layers. A polyester or any non-hygroscopic tape shall be applied over this cable assembly with a minimum overlap of 20%.

### **8 SCREENING OF CABLE ASSEMBLY**

Shall be applied in accordance with clause 6.3.

### **9 MOISTURE BARRIERS (OPTIONAL)**

Moisture barrier may be provided wherever required from following options:

- a) By application of water swellable tapes
- b) By application of laminated sheath: Aluminum tape with one or both sides plastic coated shall be applied longitudinally with overlap and bonded to the overlapping as well as the inner surface of an extruded polyethylene sheath.

In case of single side plastic coated aluminum tape, a tinned copper drain wire shall be applied in direct contact with the metallic side.

The thickness of aluminum part of tape shall be minimum 0.15 mm.

### **10 INNER SHEATH**

In case of armoured cable an extruded inner sheath shall be applied in one of the following materials compatible with Insulation.

- a) PVC as per IS 5831(PVC type ST1 ,PVC type ST2, PVC type ST1/ST2 with FR and FR-LSH properties wherever required )
- b) PE as per IS 10579 (MDPE ,HDPE)
- c) HFFR / LSZH (Halogen Free Flame Retardant / Low Smoke Zero Halogen) as per IS 17048 (HFS-TP70,HFS-TP90,HFS-XL70 ,HFS-XL90)

Thickness of extruded inner sheath shall be in accordance with Table 5.

**Table 5 Thickness of Inner Sheath**

Sl. No. (1)	Calculated Diameter Under the Inner Sheath (2)	Thickness of Inner Sheath, Min (3)
	Above	Up to and including

<b>i)</b>	0 mm	25 mm	0.3 mm
<b>ii)</b>	25 mm	35 mm	0.4 mm
<b>iii)</b>	35 mm	45 mm	0.5 mm
<b>iv)</b>	45 mm	55 mm	0.6 mm
<b>v)</b>	55 mm	----	0.7 mm

## 11 ARMOUR

Armouring, when required, shall be done over inner sheath by one of the following methods:

- a) By applying galvanized steel wire
- b) By applying galvanized steel formed wire/ strip
- c) Double layer of galvanized steel tape
- d) Galvanized steel wire braid

The galvanized round steel wires / formed steel wires (strips) / tapes used for armouring shall be in accordance with IS 3975.

Dimensions of Galvanized Steel wire/flat wire shall be in accordance with Table 6.

**Table 6 Dimension of armour – round wires and strips**

Sl. No. (1)	Calculated fictitious diameter under armour (mm) (2)	Diameter of steel wire (mm) (nominal) (3)	Thickness of steel strip (mm) (nominal) (4)
i)	Up to & including 13mm	0.9	-
ii)	Over 13 up to & including 25mm	1.25	0.8
iii)	Over 25 up to & including 40mm	1.60	0.8
iv)	Over 40 up to & including 55mm	2.00	0.8
	Over 55 mm	2.50	0.8

The tolerance on diameter / Thickness shall be in accordance with IS 3975

Thickness of Galvanized steel tape shall be in accordance with Table 7.

**Table 7 Dimension of armour – tape**

Sl. No. (1)	Calculated Fictitious Diameter Under Armour (mm) (2)	Tape Thickness (mm) (Nominal) (3)
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i)	Up to & including 30 mm	0.2
ii)	Over 30 mm up to & including 70mm	0.5

The tolerance on thickness of tapes shall be  $\pm 10\%$ .

Diameter of Galvanized steel wire for braid shall be 0.3 mm (nominal) upto 20mm and 0.45mm nominal above 20mm fictitious diameter below armouring.

The tolerance on diameter shall be as per IS 3975 and minimum filling factor for braiding shall be 0.45.

## 12 OUTER SHEATH

Extruded outer sheath shall be applied in one of the following materials:

- a) PVC as per IS 5831 (PVC type ST1, PVC type ST2, PVC type ST1/ST2 with FR and FR-LSH properties wherever required)  
Table for details
- b) PE as per IS 10579 (MDPE, HDPE)
- c) HFFR / LSZH (Halogen Free Flame Retardant / Low Smoke Zero Halogen) as per IS 17048 (HFS-TP70, HFS-TP90, HFS-XL70, HFS-XL90)

Thickness of outer sheath shall be in accordance with Table 8.

**Table 8 Thickness of outer sheath**

Sl.No. (1)	Calculated Diameter Under the Outer Sheath Above (2)	Up to and Including (3)	Minimum Thickness for Armoured Cable (3)	Nominal Thickness for Unarmoured (4)
i)	0 mm	15 mm	1.24 mm	1.8 mm
ii)	15 mm	25 mm	1.4 mm	2 mm
iii)	25 mm	35 mm	1.56 mm	2.2 mm
iv)	35 mm	40 mm	1.72 mm	2.4 mm
v)	40 mm	45 mm	1.88 mm	2.6 mm
vi)	45 mm	50 mm	2.04 mm	2.8 mm
vii)	50 mm	55 mm	2.2 mm	3.0 mm
viii)	55 mm	60 mm	2.36 mm	3.2 mm
ix)	60 mm	65 mm	2.52 mm	3.4 mm

x)	65 mm	70 mm	2.68 mm	3.6 mm
xi)	70 mm	75 mm	2.84 mm	3.8 mm
xii)	75 mm	----	3.0 mm	3.9 mm

Unless otherwise specified, outer sheath's colour shall be black

### 13 TESTS & TEST REQUIREMENTS

**Table 9**

Tests		Test method	Test requirements
(1)		(2)	(3)
I	Routine test		
	a) Conductor resistance	10810-5	Cl. 4.c
	b) Dielectric strength	IS/IEC 60189-1 Clause 8.2	For 300V: 1KV AC, duration 01 minute For 500V: 2KV AC, duration 01 minute
II	Acceptance test		
	a) Conductor resistance	10810-5	Cl. 4.c
	b) Dielectric strength	IS/IEC 60189-1 Clause 8.2	For 300V: 1KV AC, duration 01 minute For 500V: 2KV AC, duration 01 minute
	c) Thickness of insulation and sheath		Clause 5,10,12
	d) Tensile strength and elongation on insulation and outer sheath		PVC IS 5831 PE IS 10579 XLPE IS 7098-1 LSZH/HFFR IS 17048
	e) Insulation resistance	IS/IEC 60189-1 Clause 8.3	Material IR(min) MΩ/Km PVC 10

			PE 1000 XLPE 1000 LSZH/HFFR 10
	f) Mutual capacitance	IS/IEC 60189-1 Clause 8.4	PE/XLPE 150nf/Km(min) PVC/LSZH/HFFR: 250nf/Km(min)
	g) Capacitance unbalance between pairs	IS/IEC 60189-1 Clause 8.5	500pf/500m +/-8% (PE/XLPE only)
	h) Oxygen Index test(applicable for FR & FR-LSH sheath )	IS 10810 Part 58	Oxygen index shall not be less than 29
	i) Temperature Index test(applicable for FR & FR-LSH sheath )	IS 10810 Part 64	The measured value of temperature index shall not be less than 250 <sup>0</sup> C at 21% of oxygen
	j) Smoke Density test (applicable only for FR-LSH sheath )	IS 13360 (part 6/sec9)	Max 60%
	k) Test for halogen acid gas evolution l) (applicable only for FR-LSH sheath )	IS 10810 Part 59	The level of HCL evolved shall not exceed 20% by weight.
	m) Flame retardance test on single cable (applicable for FR & FR-LSH sheath )	IS 10810 Part 61	No visible damages on the test specimen within 300mm from its upper end. Marks from fixing devices, soot or changing of the colour are not considered as damages
	n) Inductance to Resistance ratio	Under consideration	-
III	Type test		
	a) Conductor resistance	10810-5	Cl. 4.c

	b) Annealing test (for copper)	10810-1	8130
	c) Test for armouring wires/strips	3975	Table 6 and 7
	d) Thickness of insulation and sheath		Clause 5,10,12
	e) Tensile strength and elongation on insulation and outer sheath		PVC IS 5831 PE IS 10579 XLPE IS 7098-1 LSZH/HFFR IS 17048
	f) Insulation resistance	IS/IEC 60189-1 Clause 8.3	Material IR(min) MΩ/Km PVC 10 PE 1000 XLPE 1000 LSZH/HFFR 10
	g) Dielectric strength	IS/IEC 60189-1 Clause 8.2	For 300V: 1KV AC, duration 01 minute For 500V: 2KV AC, duration 01 minute
	h) Flammability test (Not applicable for PE)	10810 – 53	-
	i) Mutual capacitance	IS/IEC 60189-1 Clause 8.4	PE/XLPE 150nf/Km(min) PVC/LSZH/HFFR: 250nf/Km(min)
	j) Capacitance unbalance between pairs	IS/IEC 60189-1 Clause 8.5	500pf/500m +/-8% (PE/XLPE only)



	k) Oxygen Index test (applicable for FR & FR-LSH sheath )	IS 10810 Part 58	Oxygen index shall not be less than 29
	l) Temperature Index test (applicable for FR & FR-LSH sheath )	IS 10810 Part 64	The measured value of temperature index shall not be less than 250 <sup>0</sup> C at 21% of oxygen
	m) Smoke Density test (applicable only for FR-LSH sheath )	IS 13360 (part 6/sec9)	Max 60%
	n) Test for halogen acid gas evolution o) (applicable only for FR-LSH sheath )	IS 10810 Part 59	The level of HCL evolved shall not exceed 20% by weight.
	p) Flame retardance test on single cable (applicable for FR & FR-LSH sheath )	IS 10810 Part 61	No visible damages on the test specimen within 300mm from its upper end. Marks from fixing devices, soot or changing of the colour are not considered as damages
	q) Flame retardance test on bunched cable (applicable for FR & FR-LSH sheath)	10810 - 62	The Charred or affected portion should not have reached a height exceeding 2.5 m above the bottom edge of the burner, measured at the front and rear of the cable assembly
	r) Inductance to Resistance ratio	Underconsideration	-
IV	Optional test		
	a) Cold bend	5831	10810 - 20
	b) Cold impact	5831	10810 - 21

Table 10 Sampling Plan

Sl. No.	Number of drums in the lot (N)	Number of drums to be taken as sample (n)	Permissible number of defectives (a)
(1)	(2)	(3)	(4)
i)	Up to 50	2	0

ii)	51 to 100	5	0
iii)	101 to 300	13	0
iv)	301 to 500	20	1
v)	501 and above	32	2

**14 FICTITIOUS CALCULATION METHOD FOR DETERMINATION OF DIMENSIONS OF INNER SHEATH, ARMOUR AND OUTER SHEATH AS PER IS 10462 (PART-1) & AS GIVEN BELOW**

a) Conductor in accordance with the table given below:

Sl.No (1)	Conductor Cross Section (mm <sup>2</sup> ) (2)	Conductor Diameter (mm) (3)
i)	0.5	0.80
ii)	0.75	1.00
iii)	1.0	1.10
iv)	1.50	1.40
v)	2.50	1.80

b) Core – Conductor Diameter + 2 x Insulation Thickness

c) Pair – 2 x Core Diameter

d) Triad – 2.16 x Core Diameter

e) Quad – 2.42 x Core Diameter

f) Screened Element Diameter – 0.4 mm + Diameter of Pair / Triad / Quad

g) Lay up Factor – As per IS 10462 Part 1 Table 3

h) Cable Laid Up Diameter – Diameter of Cabling Element x Lay Up Factor x Crush Factor (Crush Factors given below)

**Crush Factors**

Individual Screened Pairs: 0.889

Overall Screened / Unscreened Pairs: 0.82

Individual Screened Triads: 0.939

Overall Screened/ Unscreened Triads: 0.865

Cores / Quads: 1.0

j) Diameter over overall screen – Cable Laid up Diameter + 0.5 mm

k) Diameter over inner sheath, armour and outer sheath shall be calculated as per IS 10462 Part 1.

## 15 IDENTIFICATION PACKING AND MARKING

### 15.1 Manufacturer's Identification

The manufacturer shall be identified throughout the length of the cables by manufacturer's name or trademark being printed, indented or embossed on the outer sheath only. In case none of these methods are employed, or if purchaser so desires, coloured identification threads in accordance with a scheme to be approved by the Bureau of Indian Standards shall be employed

### 15.2 Packing and Marking

The cable shall be wound on a drum (*see* IS 10418) or reels and packed. The ends of the cable shall be sealed by means of non-hygroscopic sealing material.

The drum or packaging shall carry the following information either stenciled on it or contained in a label attached to it:

- a) Reference to this Indian Standard for example, *see* IS XXXXX;
- b) Manufacture's name, brand name or trademark;
- c) Type of cable and voltage grade;
- d) Number of cores/quad/trial;
- e) Nominal cross-sectional area of conductor;
- f) Cable code;
- g) Length of cable on the drum;
- h) Number of lengths on the drum (if more than one);
- j) Direction of rotation of drum (by means of an arrow) in case of packed wooden drums;
- k) Approximate gross mass;
- m) Country of manufacture; and
- n) Year of manufacture.

### 15.3 BIS Certification Marking

The product may also be marked with the Standard mark.

**15.3.1** The use of the Standard mark is governed by the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of the Standard Mark may be granted to manufacturers and producers may be obtained from the Bureau of Indian Standards.

## 16. Cable code

Insulation	
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PVC A	YA
PVC C	YC
PE	2Y
XLPE	2X
HFI TP 70	Z
HFI XL 70	XZ7
HFI XL 90	XZ9
<b>Shield</b>	
Metal foil	SL
Braid ABC	BCY
Braid ATC	TCY
<b>ARMOR</b>	
WIRE	W
STRIP	F
<b>sheath</b>	
PVC ST-1	YA
PVC ST-2	YC
PE	2Y
HFI TP 70	Z
HFI XL 70	XZ7
HFI XL 90	XZ9
<b>Type of shield</b>	
Pair individual screened	PIS

triad individual screened	TIS
Quad individual screened	QIS
<b>IF REQUIREMENT IS XLPE/INDIVIDUAL AND OVERALL PAIR SHIELDED/TIN BRAIDED/WIRE ARM/PVC SHEATH</b>	
<b>2X-PIS-TCY-W-YC</b>	