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**SPECIFICATION FOR
PVC INSULATED ELECTRIC CABLES
(FIRST REVISION)
PART 2 : NON ARMoured CABLES FOR
VOLTAGE UPTO AND INCLUDING 600/1 000V**

SRI LANKA STANDARDS INSTITUTION

Sri Lanka Standard
SPECIFICATION FOR PVC INSULATED ELECTRIC CABLES
(First revision)
Part 2 : Non armoured cables for voltage upto and including 600/1 000V

SLS 987 : Part 2 : 2010

Gr. 15

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Sri Lanka Standard
SPECIFICATION FOR PVC INSULATED ELECTRIC CABLES
(First revision)

Part 2: Non armoured cables for voltage up to and including 600/1 000 V

FOREWORD

This standard was approved by the Sectoral Committee on Electric Cables and Conductors and was authorized for adoption and publication as a Sri Lanka Standard by the Council of the Sri Lanka Standards Institution on 2010-10-15

SLS 987:2010 :Specification for PVC insulated electric cables, is the first revision of **SLS 987:1992** and this is published in two parts as follows:

Part 1:PVC insulated armoured cables for voltages of 600/1 000V and 1 900/3 300V

Part 2 : PVC insulated non-armoured cables for voltage up to and including 600/ 1 000V

This is the Part 2 of the standard and it specifies requirements, dimensions and methods of test of PVC insulated non-armoured cables.

Appendix A, B, C, J and K are informative.

Appendix D,E,F,G,H and L are normative.

For the purpose of deciding whether a particular requirement of the standard is complied with the final value, observed or calculated, expressing the results of a test or an analysis shall be rounded off in accordance with **SLS 102**. The number of figures to be retained in the rounded off value shall be same as that of the specified value in the standard.

In the preparation of this standard the assistance derived from BS 6346 : 1989 PVC insulated cables for electricity supply including Amd. No.1:1992 and Amd. No 2: 1993, published by British Standard Institution, is gratefully acknowledged.

1. SCOPE

This Sri Lanka Standard specifies requirements, dimensions and methods of test for PVC insulated cables for operation at nominal voltages up to and including 600 V to earth and 1 000 V between conductors.

This standard covers cables intended for general use where the combination of the ambient temperature and temperature rise due to the loading current results in a conductor temperature not exceeding 70 °C.

The cables specified in this standard are as follows:

- Single-core cables with circular stranded copper conductors
- Single-core cables with circular solid / stranded aluminium conductors
- Two-core cables with copper conductors
- Two-core cables with solid / stranded aluminium conductors
- Three-core cables with copper conductors
- Three-core cables with solid / stranded aluminium conductors
- Four-core cables with copper conductors
- Four-core cables with solid / stranded aluminium conductors

Appendix A gives recommendations for the selection and operation of cables while recommendations for the installation of cables are given in Appendix B. Appendix C lists the information that should be given with an enquiry or order.

2. REFERENCES

The following referenced documents are required for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

- IEC 60050 Electrotechnical vocabulary
Chapter 461 : Electric cables.
- SLS 906 Spark testing of electric cables.
- SLS 695 Specification for conductors in insulated cables and cords.
- SLS 1007 Tests on electric cables under fire conditions
- SLS 1282 Specification for insulating and sheathing materials for electric cables
Part 2 : PVC insulating and sheathing compound.
- SLS 1199 Common tests methods for insulating and sheathing materials for electric cables.
Part 1 : General application
Section 1 : Measurement of thickness and overall dimensions—Tests for determining the mechanical properties.
Section 2 : Thermal ageing methods.

3 DEFINITIONS

For the purposes of this standard the definitions given in IEC 60050 : Chapter 461 shall apply together with the following.

3.1 approximate value : A value which is only indicative.

NOTE : *In this standard, values described as approximate do not constitute requirements to be checked by measurement.*

3.2 maximum voltage U_m : The maximum sustained power-frequency voltage between phase conductors for which the cable is suitable.

3.3 nominal value : The value by which a quantity is designated and which is often used in tables.

NOTE : *In this standard, nominal values usually give rise to values to be checked by measurements taking into account specified tolerances.*

3.4 rated voltage U_o : The nominal power-frequency voltage between conductor(s) and earth for which the cable is suitable.

3.5 rated voltage U : The nominal power-frequency voltage between phase conductors for which the cable is suitable.

3.6 routine tests (symbol R) : Tests made on all production lengths to demonstrate their integrity.

3.7 sample tests (symbol S) : Tests made on samples of completed cable, or components taken from a completed cable adequate to verify that the finished product meets the design specifications.

3.8 tests after installation : tests intended to demonstrate the integrity of the cable and its accessories as installed.

3.9 type tests (symbol T) : Tests required to be made before supplying a type of cable specified in this standard, on a general commercial basis, in order to demonstrate satisfactory performance characteristics to meet the intended application. 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 material, design or type of manufacturing process which might change the performance characteristics.

4 VOLTAGE DESIGNATION

The cables shall be designated by the rated voltages U_o and U , expressed in the form U_o/U .

The rated voltages recognized for the purposes of this standard are 600/1 000 V.

The maximum designated voltages (U_m) for the purposes of this standard is recognized as 1 200 V.

5 GENERAL REQUIREMENTS

5.1 Conductors

The conductors shall be either annealed copper, solid aluminium or stranded aluminium as given in Table 4 to Table 11 inclusive, and shall conform to the requirements detailed in SLS 695.

Where the manufacturer deems it necessary to use tinned copper conductors, they shall conform to the requirements of **SLS 695**, for metal coated conductors.

The conductors shall be circular, circular sectoral or shaped solid (class 1), or circular, circular compacted or shaped stranded (class 2), as specified in Table 4 to Table 11 inclusive.

5.2 Insulation

5.2.1 General

The insulation shall be PVC compound TI 1 conforming to **SLS 1282 : Part 2** . The insulation shall be applied by the extrusion process to form a compact and homogeneous layer.

5.2.2 Thickness of insulation

The thickness of insulation, when determined by taking the average of a number of measurements in accordance with Appendix D, shall be not less than the value given in Table 4 to Table 11, as appropriate, and the smallest of the measured values shall not fall below the value given in Table 4 to Table 11, as appropriate, by more than (10 % + 0.1 mm).

5.2.3 Spark testing of insulation

The core insulation shall conform to the requirements for spark testing specified in **SLS 906** when tested in accordance with the a.c. or d.c. test methods specified in that standard.

5.3 Sheath

5.3.1 General

The sheath shall be an extruded layer of PVC material conforming to the requirements for TM 1 material specified in **SLS 1282 : Part 2**

NOTE : *Sheaths are normally black in colour but colours other than black may be provided by agreement between the manufacturer and the purchaser, subject to their suitability for the particular exposure conditions in which the cables are to be used.*

5.3.2 Thickness of sheath

The minimum thickness of the sheath, when measured in accordance with Appendix D, shall not fall below the value given in Table 4 to Table 11, as appropriate, by an amount exceeding (20 % + 0.2 mm).

6 IDENTIFICATION OF CORES

6.1 General

The cores of all cables shall be identified either by colour or by numbers. Numbers shall be marked sequentially starting with the number 1. Colour coding shall be in accordance with the following sequence.

Number of cores	Identification
Single-core	Brown or blue
Two-core	Brown, blue
Three-core	Brown, black, grey
Four-core	Blue, brown, black, grey
Five-core	Green-and-yellow, blue, brown, black, grey

The colour shall be applied either throughout the insulation or on its external surface. Numbers on each core shall be printed in a colour contrasting with that of the insulation. The height of the individual number shall be not less than 1.5 mm.

The spacing shall be such that each number is repeated at intervals not greater than 70 mm.

Conformity shall be checked by visual examination and measurement.

6.2 Bi-colour combination

On the core marked with the bi-colour combination green-and-yellow, the distribution of the colours shall be such that for every 15 mm length of core, one of these colours shall cover at least 30 per cent and at most 70 per cent of the surface of the core, while the other colour covers the remainder of the surface.

NOTES

- 1. In cases of dispute and where appropriate to the method of colour marking of the insulation, a suitable test for checking conformity is given in Appendix L.*
- 2. It is understood that the colours green and yellow when they are combined as specified above are recognized as identifying exclusively the core intended for use as an earth connection or similar protection.*

6.3 Clarity and durability

The colour or the number used for core identification shall be clearly identifiable and durable such that it cannot be removed when rubbed 10 times with a piece of cotton wool or cloth soaked in water.

7 LAYING-UP

7.1 General

The cores of cables having two, three, four or five cores shall be laid-up with a right-hand or right-and-left-hand alternating direction of lay. Cores shall be laid-up in the sequence given in 6.1.

Conformity shall be checked by visual examination.

It shall be possible to strip the fillers, if any, from the cable without damaging the insulation of the cores.

8 CABLE MARKING

8.1 End marking

The ends of each factory length of cable having three or more cores of conductor size 25 mm² and above shall be marked red or green. The end at which the sequence of core colours, as specified in Clause 6, is clockwise shall be marked red and the other end shall be marked green.

8.2 External marking

The external surface of all cables conforming to this Sri Lanka Standard shall be legibly marked with the following elements.

Element	Example of marking
a) Electric cable	ELECTRIC CABLE
b) Voltage designation	600/1 000 V
c) Manufacturer's identification	XYZ
d) Number of cores, type and nominal area of conductor	

i) Copper conductor cables 4 x 50

NOTE : 4 x 50 indicates a four-core cable with 50 mm² copper conductors.

ii) Aluminium conductor cables 4 x 50AL

NOTE : 4 x 50AL indicates a four-core cable with 50 mm² aluminium conductors.

The marking of the items a) to d) shall be by embossing or indenting on the sheath.

For cables with tabulated approximate overall diameters greater than 15 mm, items a), b) and c) shall appear, in any sequence that is deemed neither to confuse nor conflict, on two or more primary lines along the axis of the cables, approximately equally spaced around the circumference of the cable.

Items d) and e) shall appear either on one of the primary lines, or on a secondary line or lines, in any sequence that is deemed neither to confuse nor conflict.

NOTE : Items d) and e) need not both appear on the same line.

For cables with tabulated approximate overall diameters up to and including 15 mm, the elements of the marking shall be disposed as for cables of greater than 15 mm diameter except that the marking for items a), b) and c) shall appear on one or more primary lines.

The letters and figures shall consist of upright block characters with a minimum height of 3 mm. The distance between the end of one element of marking and the beginning of the next identical element of marking shall be not greater than 550 mm for items a), b) and c) and not greater than 1 100 mm for items d) and e).

Conformity shall be checked by visual examination and measurement.

8.3 Identification of year of manufacture

A means of identifying the year of manufacture shall be provided throughout the length of cable, by marking.

If the identification is by internal marking, the distance between the end of one mark and the beginning of the next mark shall be not greater than 550 mm.

If the identification is by marking on the surface, the maximum distance between marks shall not be greater than 1 100 mm.

8.4 The mark of an approval organization

If the mark of an approval organization is used it shall be provided throughout the length of the cable.

If the mark is applied to the surface of the cable, it shall be in the form of symbol(s) specified by the approval organization, and the maximum distance between marks shall not be greater than 1 100 mm.

8.5 Additional marking

Any additional marking shall be throughout the length of the cable, and shall be on the external surface of the cable.

Such marking, however made, shall be repeated at intervals not exceeding 1 100 mm.

If the additional marking is applied to the surface of the cable, it shall not be such as to render illegible the marking specified in **8.2**, **8.3** and **8.4**.

9 END SEALING

Before dispatch, the manufacturer shall cap the ends of the cable in order to form a seal to prevent the ingress of water during transportation and storage.

10 METHODS OF TESTS

The tests to be performed on cables specified in this standard shall be as scheduled in Table 1, which refers to the relevant clauses of the standard specifying the requirements and test methods as well as the category of each test which applies, i.e. T, S or R (as defined in Clause 3). Table 1 also indicates which tests relate to complete cable, and which relate to components.

10.1 Test conditions

a) Ambient temperature

Tests shall be performed at an ambient temperature of $(20 \pm 15) ^\circ\text{C}$ unless otherwise specified in the details for the particular test.

b) Frequency and waveform of power frequency test voltages

Unless otherwise specified in the particular test, the frequency of the alternating test voltages shall be in the range of 49 Hz to 61 Hz. The waveform shall be substantially sinusoidal.

TABLE 1 - Schedule of tests

Test	Requirement given in clause	Test method	Category
(1)	(2)	(3)	(4)
Tests on components			
Conductor construction	5.1	SLS 695	S
Insulation			
material	5.2.1	SLS 1282 : Part 2	T
thickness	5.2.2	Appendix D	S
spark test	5.2.3	SLS 906	R
Sheath			
physical properties	5.3.1	SLS 1282 : Part 2	T
thickness	5.3.2	Appendix D	S
Core identification	6	Visual examination and measurement	S
Laying-up			
direction and sequence of lay	7.1	Visual examination	S
fillers and binders	7.1	Visual examination	S
Tests on completed cables			
Cable markings	8	Visual examination and measurement	R
Conductor resistance test	10.2.2	SLS 695	R
Voltage test on completed cables	10.2.3	Appendix F	R
Insulation resistance test	10.2.4	Appendix G	R
Tests under fire conditions			
flame propagation test on single cable	10.3.2	SLS 1007	S
Compatibility test	10.4.2	Appendix H and SLS 1199 : Part 1.1 and Part 1.2	T
NOTE : Tests classified as sample (S) and routine (R) may be required as part of a type approval scheme.			

10.2 Routine tests

10.2.1 General

Routine tests shall be performed as indicated by the symbol "R" in Table 1.

NOTE : Those requirements for which routine testing is specified, and which are not fully covered by earlier clauses, are detailed in 10.2.2, 10.2.3, and 10.2.4.

10.2.2 Conductor resistance

The d.c. resistance of each conductor shall conform to **SLS 695** when measured in accordance with that standard and corrected to 20 °C.

NOTE : *For convenience, maximum conductor resistance values are given in Table E.1 of Appendix E.*

10.2.3 Voltage test on completed cables

When the completed cable is tested in accordance with Appendix F, the insulation shall not break down.

10.2.4 Insulation resistance

When the completed cable is tested in accordance with Appendix G, the insulation resistance shall not be less than the appropriate value given in Table 2.

TABLE 2 — Minimum insulation resistance values

Nominal cross-sectional area of conductor mm ²	Insulation resistance per kilometre at 20 °C MΩ
(1)	(2)
1.5	10
2.5	9
4	8
6	7
10	7
16	6
25 and above	5

10.3 Sample tests

10.3.1 General

Sample tests shall be performed as indicated by the symbol "S" in Table 1.

NOTE : *Those requirements for which sample testing is specified, and which are not fully covered by earlier clauses, are detailed in 10.3.2*

10.3.2 Flame propagation on single cable

Cables shall be tested in accordance with **SLS 1007**. The test shall be carried out on a sample of completed cable. After the test, the cable shall conform to the performance recommendations given in **SLS 1007**.

10.4 Type tests

10.4.1 General

Type tests shall be performed as indicated by the symbol "T" in Table 1 (see also Appendix J).

NOTE : *Those requirements for which type testing is specified, and which are not fully covered by earlier clauses, are detailed in 10.4.2.*

10.4.2 Compatibility test

When a sample of complete cable is aged in accordance with H.2 of Appendix H, the insulation and sheath shall conform to the requirements given in Table 3. In addition, at the end of the test period in the oven, the blotting paper shall be free of stains.

TABLE 3 - Compatibility test requirements

(1) Component	(2) Test	(3) Requirement	
		TI 1	TM 1
Insulation	Minimum tensile strength (N/mm ²)	12.5	--
	Minimum percentage elongation at break	125	--
	Maximum percentage variation ^a of tensile strength	20	--
	Maximum percentage variation ^a of elongation at break	20	--
sheath	Minimum tensile strength (N/mm ²)	--	12.5
	Minimum percentage elongation at break	--	125
	Maximum percentage variation ^a of tensile strength	--	20
	Maximum percentage variation ^a of elongation at break	--	20

^a The variation is the difference between the respective values obtained prior to and after heat treatment, expressed as a percentage of the former.

TABLE 4 - Single core 600/1 000 V cables with circular stranded copper conductors

Nominal cross sectional area of conductor^a mm²	Thickness of insulation mm	Thickness of sheath mm	Approximate overall diameter mm
(1)	(2)	(3)	(4)
50	1.4	1.4	15.1
70	1.4	1.4	16.9
95	1.6	1.5	19.4
120	1.6	1.5	21.0
150	1.8	1.6	23.2
185	2.0	1.7	25.8
240	2.2	1.8	29.0
300	2.4	1.9	32.1
400	2.6	2.0	35.8
500	2.8	2.1	39.6
630	2.8	2.2	43.8
800	2.8	2.3	48.3
1000	3.0	2.5	53.7

^a Circular or circular compacted stranded conductors

TABLE 5 - Single-core 600/1 000 V cables with circular solid / circular stranded aluminium conductors

Nominal cross-sectional area of conductor^a mm²	Thickness of insulation mm	Thickness of sheath mm	Approximate overall diameter mm
(1)	(2)	(3)	(4)
50	1.4	1.4	13.8
70	1.4	1.4	15.4
95	1.6	1.5	17.6
120	1.6	1.5	19.0
150	1.8	1.6	21.0
185	2.0	1.7	23.3
240	2.2	1.8	26.1
300	2.4	1.9	28.9
Circular sectoral conductors			
380 (4 x 95)	2.6	2.0	32.4
480 (4 x 120)	2.8	2.1	35.7
600 (4 x 150)	2.8	2.2	38.7
740 (4 x 185)	2.8	2.3	42.2
960 (4 x 240)	3.0	2.4	47.4
1200 (4 x 300)	3.0	2.6	52.0
^a Circular solid / circular stranded conductors			

TABLE 6 – Two-core 600/1 000 V cables with copper conductors

Nominal cross-sectional area of conductor mm²	Thickness of insulation mm	Thickness of sheath mm	Approximate overall diameter mm
(1)	(2)	(3)	(4)
1.5 ^a	0.6	-	-
1.5 ^b	0.6	-	-
2.5 ^a	0.7	-	-
2.5 ^b	0.7	-	-
4 ^b	0.8	-	-
6 ^b	0.8	-	-
10 ^b	1.0	1.8	16.1
16 ^b	1.0	1.8	18.6
25 ^c	1.2	1.8	18.4
25 ^b	1.2	1.8	22.1
35 ^c	1.2	1.8	20.1
35 ^b	1.2	1.8	24.5
50	1.4	1.8	22.8
70	1.4	1.9	25.5
95	1.6	2.0	29.3
120	1.6	2.1	31.8
150	1.8	2.2	35.1
185	2.0	2.4	39.1
240	2.2	2.5	43.9
300	2.4	2.7	48.7
400	2.6	2.9	54.2

^a Circular solid conductors
^b Circular or circular compacted stranded conductors
^c Shaped stranded conductors

NOTE : *Cables having conductors of nominal cross-sectional area 50 mm² and above have shaped stranded conductors*

TABLE 7 - Two-core 600/1 000 V cables with solid / stranded aluminium conductors

Nominal cross-sectional area of conductor mm ²	Thickness of insulation mm	Thickness of sheath mm	Approximate overall diameter mm
(1)	(2)	(3)	(4)
16 ^a	1.0	1.8	17.4
25 ^b	1.2	1.8	16.6
25 ^a	1.2	1.8	20.4
35 ^b	1.2	1.8	18.0
35 ^a	1.2	1.8	22.4
50	1.4	1.8	20.4
70	1.4	1.9	22.8
95	1.6	2.0	26.2

^a Circular solid / circular stranded conductors
^b Shaped solid / shaped stranded conductors
NOTE : Cables having conductors of nominal cross-sectional area 50 mm² and above have shaped solid conductors

TABLE 8 - Three-core 600/1 000 V cables with copper conductors

Nominal cross-sectional area of conductor mm ²	Thickness of insulation mm	Thickness of sheath mm	Approximate overall diameter mm
(1)	(2)	(3)	(4)
1.5 ^a	0.6	-	-
1.5 ^b	0.6	-	-
2.5 ^a	0.7	-	-
2.5 ^b	0.7	-	-
4 ^b	0.8	-	-
6 ^b	0.8	-	-
10 ^b	1.0	1.8	17.0
16 ^b	1.0	1.8	19.7
25 ^c	1.2	1.8	20.4
25 ^b	1.2	1.8	23.5
35 ^c	1.2	1.8	22.4
35 ^b	1.2	1.8	26.2
50	1.4	1.8	25.5
70	1.4	1.9	28.7
95	1.6	2.1	33.3
120	1.6	2.2	36.3
150	1.8	2.3	40.0
185	2.0	2.5	44.6
240	2.2	2.6	50.1
300	2.4	2.8	55.6
400	2.6	3.1	62.2

^a Circular solid conductors
^b Circular or circular compacted stranded conductors
^c Shaped stranded conductors

NOTE : Cables having conductors of nominal cross-sectional area 50 mm² and above have shaped stranded conductors

TABLE 9 - Three-core 600/1 000 V cables with solid / stranded aluminium conductors

Nominal cross-sectional area of conductor mm ²	Thickness of insulation mm	Thickness of sheath mm	Approximate overall diameter mm
(1)	(2)	(3)	(4)
16 ^a	1.0	1.8	18.4
25 ^b	1.2	1.8	19.2
25 ^a	1.2	1.8	21.7
35 ^b	1.2	1.8	21.0
35 ^a	1.2	1.8	23.9
50	1.4	1.8	23.8
70	1.4	1.9	26.8
95	1.6	2.1	31.1
120	1.6	2.2	33.7
150	1.8	2.3	37.2
185	2.0	2.5	41.4
240	2.2	2.6	46.5
300	2.4	2.8	51.6

^a Circular solid / circular stranded conductors
^b Shaped solid / shaped stranded conductors

NOTE : Cables having conductors of nominal cross-sectional area 50 mm² and above have shaped solid conductors

TABLE 10 - Four-core 600/1 000 V cables with copper conductors

Nominal cross-sectional area of conductor mm²	Thickness of insulation mm	Thickness of sheath mm	Approximate overall diameter mm
(1)	(2)	(3)	(4)
1.5 ^a	0.6	-	-
1.5 ^b	0.6	-	-
2.5 ^a	0.7	-	-
2.5 ^b	0.7	-	-
4 ^b	0.8	-	-
6 ^b	0.8	-	-
10 ^b	1.0	1.8	18.6
16 ^b	1.0	1.8	21.6
25 ^c	1.2	1.8	22.9
25 ^b	1.2	1.8	25.9
35 ^c	1.2	1.8	25.4
35 ^b	1.2	1.8	28.9
50	1.4	1.9	29.2
70	1.4	2.0	33.0
95	1.6	2.2	38.3
120	1.6	2.3	41.8
150	1.8	2.5	46.3
185	2.0	2.6	51.3
240	2.2	2.8	58.0
300	2.4	3.1	64.6
400	2.6	3.3	72.0

^a Circular solid conductors
^b Circular or circular compacted stranded conductors
^c Shaped stranded conductors

NOTE : *Cables having conductors of nominal cross-sectional area 50 mm² and above have shaped stranded conductors*

TABLE 11 - Four-core 600/1 000 V cables with solid / stranded aluminium conductors

Nominal cross-sectional area of conductor mm²	Thickness of insulation mm	Thickness of sheath mm	Approximate overall diameter mm
(1)	(2)	(3)	(4)
16 ^a	1.0	1.8	20.2
25 ^b	1.2	1.8	21.5
25 ^a	1.2	1.8	23.8
35 ^b	1.2	1.8	23.6
35 ^a	1.2	1.8	26.3
50	1.4	1.9	27.1
70	1.4	2.0	30.6
95	1.6	2.2	35.5
120	1.6	2.3	38.6
150	1.8	2.5	42.8
185	2.0	2.6	47.4
240	2.2	2.8	53.5
300	2.4	3.1	59.6

^a Circular solid / circular stranded conductors
^b Shaped solid / shaped stranded conductors

NOTE : Cables having conductors of nominal cross-sectional area 50 mm² and above have shaped solid conductors

TABLE 12 - Five-core 600/1 000 V cables with copper conductors

Nominal cross sectional area of conductor mm²	Thickness of insulation mm	Thickness of over sheath mm	Approximate overall diameter mm
(1)	(2)	(3)	(4)
1.5	0.6	1.4	11.9
2.5	0.7	1.5	13.8
4.0	0.8	1.5	15.8
6.0	0.8	1.6	17.5
10	1.0	1.7	21.7
16	1.0	1.7	24.6
25	1.2	1.9	29.6
35	1.2	1.9	32.7

TABLE 13 - Five-core 600/1 000 V cables with solid / stranded aluminium conductors

Nominal cross sectional area of conductor mm²	Thickness of insulation mm	Thickness of over sheath mm	Approximate overall diameter mm
(1)	(2)	(3)	(4)
1.5	0.6	1.4	11.9
2.5	0.7	1.5	13.8
4.0	0.8	1.5	15.8
6.0	0.8	1.6	17.5
10	1.0	1.7	21.7
16	1.0	1.7	24.6
25	1.2	1.9	29.6
35	1.2	1.9	32.7

APPENDIX A
(Informative)

**RECOMMENDATIONS FOR THE SELECTION AND
OPERATION OF CABLES**

A.1 GENERAL

The cables specified in this standard are designed to be installed in air.

Where the cables are to be laid in any other environment, reference should be made to the cable manufacturer.

A.2 VOLTAGE RATINGS

The rated voltage of the cable for a given application should be suitable for the operating conditions in the system in which the cable is used. To facilitate the selection of the cable, systems are divided into three categories as follows:

a) Category A

This category comprises those systems in which any phase conductor that comes in contact with earth or an earth conductor is disconnected from the system within 1 minute.

b) Category B

This category comprises those systems which, under fault conditions, are operated for a short time with one phase earthed. This period, according to **IEC 60183**: Guide to the selection of high voltage cables, should not exceed 1 h. For cables specified in this standard, a longer period, not exceeding 8 h on any occasion, can be tolerated. The total duration of earth faults in any year should not exceed 125 h.

c) Category C

This category comprises all systems which do not fall into categories A and B.

NOTE : *It should be realized that, in a system where an earth fault is not automatically and promptly isolated, the extra stresses on the insulation of cables during the earth fault reduce the life of the cables to a certain degree. If the system is expected to be operated fairly often with a permanent earth fault, it may be advisable to classify the system into a higher category.*

Table **A.1** gives the lowest rated voltage of cable that should be used for an a.c. system according to the system voltage and category.

TABLE A.1 — Selection of cables for a.c. systems

System voltage		System category	Minimum rated voltage of cable (U_0/U) kV
Nominal voltage (U) kV	Maximum sustained voltage (U_m) kV		
(1)	(2)	(3)	(4)
Up to 1.0	1.2	A, B or C	0.6 / 1

The nominal system voltage, U , given in Table A. 1 is the nominal voltage between phases.

The maximum sustained system voltage, U_m , is the highest voltage between phases that can be sustained under normal operating conditions at any time and at any point in the system. It excludes transient voltage variations, due, for example, to lightning impulses, fault conditions and rapid disconnection of loads.

Single-core 600/1 000 V cables are suitable for d.c. systems operating up to 1 000 V to earth and two-core 600/1 000 V cables up to 1 500 V between conductors.

However, consideration should be given to the peak value when determining the voltage of a d.c. system derived from rectifiers, bearing in mind that smoothing does not modify the peak value when the rectifiers are operating on an open circuit.

A.3 HAZARDOUS AREAS

Where cables are required to be installed in areas classified as hazardous, i.e. potentially explosive gas atmospheres, reference should be made to IEC 60079-14 :Electric apparatus for explosive gas atmospheres, Part 14 : Electrical installations in hazardous areas (other than mines)

A.4 CURRENT RATINGS

A.4.1 Cables installed in and around buildings

For current ratings of cables installed in and around buildings, reference should be made to IEE Wiring regulations (**BS 7671**)

A.4.2 Other installations

For the current ratings for cables installed in situations other than those covered by **A.4.1**, reference should be made to the manufacturer of the cables.

APPENDIX B (Informative)

RECOMMENDATIONS FOR THE INSTALLATION OF CABLES

B.1 GENERAL

Cables should be installed and used in association with other equipment in accordance with IEE Wiring Regulations (**BS 7671**) and/or the Electricity Safety, Quality and Continuity Regulations as appropriate.

In special environments, the appropriate regulations and codes of practice should be observed

B.2 MINIMUM TEMPERATURE DURING INSTALLATION

It is recommended that the cables specified in this standard be installed only when both the cable and ambient temperatures are above 0 °C and have been so for the previous 24 h, or where special precautions have been taken to maintain the cable above this temperature.

B.3 MINIMUM INSTALLATION RADIUS

None of the cables specified in this standard should be bent during installation to a radius smaller than that given in Table **B.1**.

TABLE B.1 — Minimum installation radius

Construction	Minimum internal radius of bend
(1)	(2)
Circular copper conductors	6D
Solid aluminium or shaped copper conductors	8D
NOTE : <i>D</i> is the tabulated overall diameter of the cable.	

Wherever possible, larger installation radii should be used.

B.4 PREVENTION OF MOISTURE INGRESS

Care should be exercised during installation to avoid any damage to cable coverings. This is important in wet or other aggressive environments. The protective cap should not be removed from the ends of the cable until immediately prior to termination or jointing.

When the caps have been removed, the unprotected ends of the cable should not be exposed to moisture.

The possibility of damage to moisture seals during handling and installation or during storage of the cable should be borne in mind. Where such damage may have occurred, the seals should be inspected and remade if necessary.

B.5 TEST AFTER INSTALLATION

A voltage test after installation is not a requirement of this standard, but if a test is made it should be performed with direct current. The value of the voltage is 3500 V, d.c.

During the test the voltage should be increased gradually to the full value and maintained continuously for 15 min.

No breakdown should occur.

The test voltage of 3 500 V, d.c. is intended for cables immediately after installation and not for cables that have been in service. When testing is required after cables have been in service, regardless of service duration, the manufacturer should be consulted for the appropriate test conditions, which depend on the individual circumstances.

APPENDIX C *(Informative)*

INFORMATION TO BE PROVIDED WITH ENQUIRY OR ORDER

The following information should be given with an enquiry or order:

- a) the number of this Sri Lanka Standard;
- b) length of cable required and individual drum lengths, if important;
- c) voltage designation (see Clauses 4 and A.2);
- d) number of cores;
- e) size of phase conductor;
- f) conductor material (i.e. copper or aluminium);
- g) type of conductor (i.e. stranded or solid, shaped or circular);
- h) whether cable is liable to be exposed to any potentially aggressive environments (e.g. water, oil or acid)

NOTE : *See Appendix A for recommendations for selection of cables.*

APPENDIX D *(Normative)*

MEASUREMENT OF THICKNESS

D.1 SAMPLING

For measurements of the thickness of insulation and sheath listed in Table 1, take a sample from one end of each drum length of cable selected for the test, discarding any portion which may have suffered damage.

D.2 TEST PROCEDURE

Make measurements for thickness of insulation and sheath either by the method described in **SLS 1199 : Part 1.1** or by use of a calibrated hand lens or micrometer. In case of dispute, use the equipment specified in **SLS 1199 : Part 1.1**

When determining an average thickness from several measurements, round the resultant value to the nearest 0.1 mm (0.05 mm rounded upwards).

If any of the thicknesses measured does not conform to **5.2.2**, and **5.3.2**, check two further samples in respect of the non-conforming dimensions. If both of the further pieces meet the specified requirements, the cable is deemed to conform, but if either does not meet the requirements the cable is deemed not to conform.

APPENDIX E
(Normative)
RESISTANCE OF CONDUCTORS

Table E.1 gives maximum values of the conductor resistance for aluminium and copper conductors.

TABLE E.1 — Maximum resistance of copper and aluminium conductors

Nominal cross-sectional area of conductor mm ²	Maximum resistance per km of cable at 20 °C	
	Copper Ω	Aluminium Ω
(1)	(2)	(3)
1.5	12.1	--
2.5	7.41	--
4	4.61	--
6	3.08	--
10	1.83	--
16	1.15	1.91
25	0.727	1.20
35	0.524	0.868
50	0.387	0.641
70	0.268	0.443
95	0.193	0.320
120	0.153	0.253
150	0.124	0.206
185	0.099 1	0.164
240	0.075 4	0.125
300	0.060 1	0.100
400	0.047 0	0.077 8
500	0.036 6	0.060 5
630	0.028 3	0.046 9
800	0.022 1	0.036 7
1000	0.017 6	0.029 1
Circular sectoral conductors		
380	—	0.080 0
480	—	0.063 3
600	—	0.051 5
740	—	0.041 0
960	—	0.031 3
1200	—	0.025 0

APPENDIX F
(Normative)

VOLTAGE TEST ON COMPLETED CABLES

Apply the alternating test voltage (r.m.s) of 3 500 V, between the conductors. Perform the test at room temperature, increasing the voltage gradually and maintaining it at the full value specified for 5 minutes.

APPENDIX G
(Normative)

INSULATION RESISTANCE TEST

After completion of the voltage test given in **10.2.3**, apply a minimum voltage of 500 V d.c. for 1 minute and measure the insulation resistance between each conductor and earth.

APPENDIX H
(Normative)

COMPATIBILITY TEST

H.1 GENERAL

This test is intended to demonstrate that the insulation and sheath are not likely to deteriorate due to contact with the other components in the cable.

H.2 TEST METHOD

Age the sample for 7 days at $(80 \pm 2) ^\circ\text{C}$ in an air oven in accordance with Clause **8.1.4** of **SLS 1199 Part 1.2**.

Place a sheet of clean white blotting paper under each test piece in the oven to detect any exudation which may drip from the cable.

After completion of the ageing test, the tensile strength and the elongation at break for insulation and sheath shall be measured in accordance with **SLS 1199 :Part 1.1**

APPENDIX J *(Informative)*

NOTES ON TYPE TESTS

J.1 GENERAL

Type tests, after they have been completed, need not be repeated unless changes have been made that affect conformity to the test requirements. This means that type tests should not normally be required on cables for individual contracts provided that such type tests have already been successfully performed by the manufacturer. (Report may be called from the manufacturer)

Subclauses **J.2**, **J. 3** and **J.4** give guidance as to the amount of type testing that may reasonably be required.

J.2 SAMPLE SELECTION FOR TYPE TESTS

Table 1 indicates which tests relate to complete cable and which relate to components. Type tests for components may be performed on any one cable sample.

NOTE : *The results of these type tests are not determined by the cable size or construction.*

For the type tests on finished cable, conformity to the requirements can be confirmed for the complete range of cables in this standard by selecting samples for test as follows:

- i) any one sample of cable having copper conductor(s); plus
- ii) any one sample of cable having solid aluminium conductor(s).

In addition, where manufacturers wish to demonstrate conformity to this standard, the cable samples should be subjected to full dimensional checks and to all other sample (S) and routine tests (R) given in Table 1.

J.3 TYPE TESTS

J.3.1 Compatibility test

One test should be carried out on each size of cable selected.

J.4 CHANGE OF MATERIAL

The tests referred to in **J.3** assume that the materials are consistent throughout the range of cables for which conformity is to be confirmed. Where a change occurs, it is necessary to include additional testing to ensure that such changes are adequately examined.

J.5 EVIDENCE OF TYPE TESTING

A certificate of type test signed by the representative of a competent witnessing body, or a properly authorized report by the manufacturer giving the test results, should be acceptable as evidence of type testing.

When evidence of type testing is required, this should be stated at the enquiry stage. Because of the possible variations in cable designs, it should not be assumed that full type test information will be available for the size and type of cable of a particular enquiry.

APPENDIX K *(Informative)*

GUIDE TO USE

K.1 AIM

The aim of this appendix is to inform users of characteristics and limitations of electric cables and thereby to minimize their misuse.

It is assumed that the design of installations and the specification, purchase and installation of cables specified in this Sri Lanka Standard is entrusted to suitably skilled and competent people.

In cases of doubt as to the suitability of cables in this Sri Lanka Standard for a particular use, further specific information should be obtained from the manufacturer.

K.2 CABLE SELECTION AND DESIGN

K.2.1 The products specified in this standard are intended to be used for the supply of electrical energy up to the rated voltage indicated on the cable. Clause **A.2** of Appendix **A** classifies the voltage ratings of cables manufactured to this specification. These ratings should not be exceeded.

K.2.2 These cables are intended for use within a nominal power frequency of 49 Hz to 61 Hz

K.2.3 In addition to the current ratings, due regard should be given to:

- a) the capability of the cable to withstand the worst anticipated fault condition of the system;
- b) the earth loop impedance;
- c) the operating characteristics of the connected equipment;
- d) the voltage drop requirements during normal load or motor starting conditions.

K.2.4 The possible effects of transient over-voltages should be recognized as they can be detrimental to cables.

K.3 ENVIRONMENT AND APPLICATION

K.3.1 Reasonable protection against mechanical damage, appropriate to the choice of cable and the installation conditions, should be provided.

K.3.2 Cables specified in this standard contain PVC, and when exposed to the effects of external fire will produce harmful smoke and fumes, and where bundled together may propagate fire. When circumstances dictate, consideration should be given to the use of cables manufactured in accordance with appropriate environmental conditions.

K.3.3 Cables may be harmed by exposure to corrosive products or solvent substances, especially petroleum based chemicals or their vapours.

K.3.4 Special precautions are required when cables are to be installed in areas classified as hazardous and reference should be made to **IEC 60079-14** : Electric apparatus for explosive gas atmospheres, Part 14: Electrical installations in hazardous areas (other than mines)

K.3.5 Cables specified in this standard are not specifically designed for use:

- a) as self-supporting aerial cables;
- b) as submarine cable or for laying in water-logged conditions; and
- c) where any exposure to excessive heat is involved.

K.3.6 If cables in accordance with this specification are exposed to localized heat, solar radiation or high temperature ambient conditions, the current carrying capacity will be reduced.

K.3.7 The standard sheathing compounds supplied on these cables do not provide protection against damage by rodents, termites etc.

K.3.8 Loaded cables may have surface temperatures which require protection against accidental contact.

K.4 INSTALLATION

K.4.1 Precautions should be taken to avoid mechanical damage to the cables before and during installation.

K.4.2 Exceeding the manufacturer's recommended maximum pulling tensions may result in damage to the cable.

K.4.3 If cables are to be installed in ducts, the correct size of duct should be used. Reference may be made to ERA Publication 69-30, Part III or similar publication.

K.4.4 The type of jointing and filling compounds employed should be chemically compatible with the cable materials.

K.4.5 The cable support system should be such as to avoid damage or danger under normal or fault conditions.

K.4.6 Cables specified in this standard are designed for fixed installations only; e.g. they are not for use as trailing or reeling cables.

K.4.7 Repeated over-voltage testing can lead to premature failure of the cable.

K.4.8 The selection of cable glands, accessories and any associated tools should take account of all aspects of intended use.

K.5 STORAGE AND HANDLING OF DRUMS

K.5.1 Cable drums should be regularly inspected during storage to assess their physical condition.

K.5.2 Battens, where applied, should not be removed from drums until the cable is about to be installed.

K.5.3 When handling drums reasonable precautions should be taken to avoid injury. Due regard should be paid to the weight, method and direction of rolling, lifting, protruding nails and splinters.

K.5.4 Care should be taken to avoid deterioration of drums or their becoming a hazard to the general public.

K.5.5 A detailed guide to the safe handling of cable drums should be available from the cable manufacturer.

K.6 SCRAP CABLE — INCINERATION

Incineration of scrap cable should only be undertaken by a licensed contractor. For further information, the Central Environment Authority shall be consulted.

APPENDIX L (Normative)

METHOD OF MEASUREMENT OF GREEN AND YELLOW PROPORTION ON THE INSULATION OF CIRCUIT PROTECTIVE CONDUCTORS

L.1 GENERAL

It is sometimes necessary to check that the proportion of green and yellow colours on the insulation of circuit protective conductors complies with the relevant cable standard . the following method is recommended for use in case of dispute but is not appropriate where the colour marking forms a spiral on the insulation.

L.2 SELECTION OF SAMPLES

Take two samples of the green and yellow core, each approximately 100 mm in length, from places separated by at least 2 m.

L.3 PREPARATION OF TEST PIECES

Measure a 15 mm length from each of the samples and cut three sections of insulation from each 15 mm test piece length, one from each end and one from the centre.

L.4 PROCEDURE

Project a x 10 minimum magnified image of each cross section onto a ground glass screen and make a visual estimation of the centre of the cross section and of the colour boundaries at the outer surface of the core (see Figure 5). Measure to the nearest degree, using a protractor placed on the magnified image, the angle subtended at the centre of the cross section by each portion of green (or yellow if appropriate).

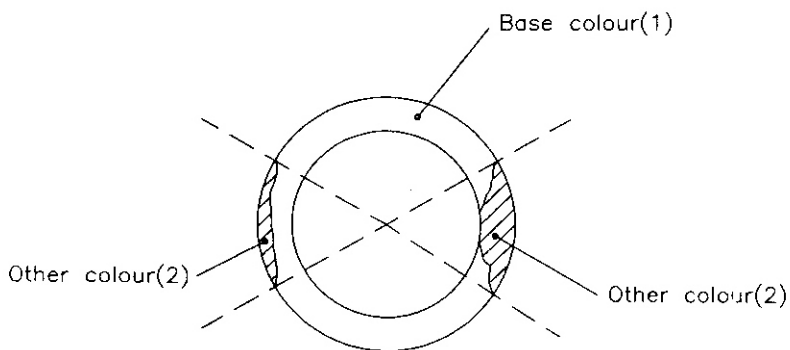


FIGURE L.1 – Measurement of green and yellow proportion on the insulation of circuit protective conductors

L.5 EVALUATION OF RESULTS

Calculate the percentage proportion (G_p) of green (or yellow if appropriate) for each cross section using the following equation:

$$G_p = \frac{A_T}{360} \times 100$$

where,

A_T is the total sum of each of the angles of rotation through each of the portions of green (or yellow if appropriate).

Calculate the mean of these and round to the nearest integer.

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