**SRI LANKA STANDARD 987 : PART 1 : 2010**

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**SPECIFICATION FOR**

# PVC INSULATED ELECTRIC CABLES

**(FIRST REVISION)**

**PART 1 : ARMOURED CABLES FOR VOLTAGES OF 600/1 000V AND 1 900/ 3 300V**

**SRI LANKA STANDARDS INSTITUTION**

**Sri Lanka Standard**

# SPECIFICATION FOR PVC INSULATED ELECTRIC CABLES
**(First revision)**
**Part 1: Armoured cables for voltages of 600/1 000 V and 1 900 /3 300V**

**SLS 987 : Part 1 : 2010**

**Gr. 19**


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Sri Lanka Standards are subject to periodical revision in order to accommodate the progress made by industry. Suggestions for improvement will be recorded and brought to the notice of the Committees to which the revisions are entrusted.

This standard does not purport to include all the necessary provisions of a contract.

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**Sri Lanka Standard**
# SPECIFICATION FOR PVC INSULATED ELECTRIC CABLES
***(First Revision)***
## Part 1: Armoured cables for voltages of 600/1 000 V and 1 900 /3 300V

## 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 600/1 000 V and 1 900/ 3 300 V

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

This is the Part 1 of the standard and it specifies requirements, dimensions and methods of test of PVC insulated armoured cables.

Appendix A,B,C, K, M and N are informative.
Appendix D, E, F,G, H, J 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 : 1997**: Electric cables - PVC insulated, armoured cables for voltages of 600/1 000 V, and 1 900 /3 300 V, including Amd. No.1: 2004, published by British Standard Institution is gratefully acknowledged.

## 1. SCOPE

This Sri Lanka Standard specifies requirements for construction and describes methods of test for armoured cable with PVC insulation of rated voltages 600/1 000 V and 1 900/3 300 V. Cables specified in this standard are intended for use in fixed installations in industrial areas, buildings and similar applications.

The insulation and other components are suitable to permit operation of the cables at a maximum sustained conductor temperature of 70 °C and for a maximum short-circuit conductor temperature of 160 °C for conductor sizes up to and including 300 $mm^2$ and 140 °C for conductor sizes greater than 300 $mm^2$.

The cables specified in this standard are as follows:

a) 600/1 000 V cables, either wire or aluminium strip armoured and oversheathed having:
   single-core stranded copper conductor;
   single-core solid aluminium conductor;
   two-, three-, four- and five-core stranded copper conductor;
   two-, three-, and four-core solid aluminium conductor; and
   multicore auxiliary stranded copper conductor.

b) 1 900/3 300 V cables, wire armoured and oversheathed having :
   single-core stranded copper conductor;
   single-core solid aluminium conductor;
   three-core stranded copper conductor; and
   three-core solid aluminium conductor.

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.

BSEN 10244 Steel wire and wire products - Non ferrous metallic coatings on steel wire.
Part 2 : Zinc or Zinc alloy coatings on steel wire.

IEC 60050 Electrotechnical vocabulary.
Chapter 461 : Electric cables.

SLS 695 Specification for conductors in insulated cables and cords
SLS 906 Spark testing of electric cables.
SLS 978 Metallic materials - Tensile testing at ambient temperature.
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 :** 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 $U_0$ and U, expressed in the form $U_0/U$.
The rated voltages recognized for the purposes of this standard are 600/1 000 V and 1 900/3 300 V.

The maximum designated voltages ($U_m$) for the purposes of this standard for 600/1 000 V and 1 900/3 300 V cables are recognized as 1 200 V and 3 600 V respectively.
**NOTE** : *Guidance on the selection of cables of appropriate voltage designations for particular systems is given in A.2 of Appendix A.*

## 5 GENERAL REQUIREMENTS

### 5.1 Conductors

The conductors shall be either annealed copper or solid aluminium, as given in Table **5** to Table **18** 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 **5** to Table **18** 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 **5** to Table **18**, as appropriate, and the smallest of the measured values shall not fall below the value given in Table **5** to Table **18**, 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 Oversheath

#### 5.3.1 *General*

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

**NOTE :** *Oversheaths 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 oversheath*

The minimum thickness of the oversheath, when measured in accordance with Appendix **D**, shall not fall below the value given in Table **5** to Table **18**, as appropriate, by an amount exceeding (20 % + 0.2 mm).

### 5.3.3 *Spark testing of oversheath*

The oversheath 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.

## 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 percent and at most 70 percent 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. For multicore auxiliary cables the direction of lay shall alternate for each successive layer. Auxiliary cables having up to and including seven cores may be laid-up with a right-hand or left-hand or with a 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 BEDDING

### 8.1 General

For single core 600/1 000 V cables the bedding shall consist of an extruded layer of polymeric material compatible with the operating temperature of the cable. When tested in accordance with **SLS 1199 : Part 1.1**, it shall have a tensile strength of not less than 4 $N/mm^2$ and elongation at break not less than 50 per cent.

For multicore 600/1 000 V cables the bedding shall be either :

a) an extruded layer of polymeric material compatible with the operating temperature of the cable which, when tested in accordance with **SLS 1199: Part 1.1**, shall have a tensile strength of not less than 4 $N/mm^2$ and elongation at break not less than 50 per cent ; or

b) for cables having a nominal conductor area of 16 $mm^2$ and above, a taped bedding (as indicated in the relevant tables) comprising two or more layers of PVC tape or other synthetic tape applied so that any gaps between adjacent edges of each tape are not coincident through the thickness of the bedding. If there is a gap between adjacent edges of each tape, it shall not exceed 15 per cent of the tape width, as determined by measurement in accordance with clause **17.3**.

The bedding of all 1 900/3 300 V cables shall consist of an extruded layer of polymeric material compatible with the operating temperature of the cable. When tested in accordance with **SLS 1199 : Part 1.1,** it shall have a tensile strength of not less than 4 $N/mm^2$ and elongation at break not less than 50 per cent.

It shall be possible to remove the bedding without damaging the insulation of the core(s).

### 8.2 Thickness of bedding

The approximate thickness of the taped bedding shall be 0.8 mm.

The minimum thickness of extruded bedding, measured in accordance with Appendix **D**, shall not fall below the value given in Table **5** to Table **18**, as appropriate, by an amount more than (20 % + 0.2 mm).

## 9 ARMOUR

### 9.1 General

The armour shall consist of a single layer of wires or aluminium strips having nominal dimensions as given in Table **5** to Table **18**, as appropriate. The armour shall be applied helically with a left-hand lay for cables having up to and including five cores. For multicore auxiliary cables, the armour shall be applied helically with a direction of lay opposite to that of the final layer of cores, except that for cables which have been laid-up with alternating right-and-left-hand lay, the armour may be applied with either a right-hand or a left-hand lay.

The manufacturer shall, where necessary, apply a suitable binder tape over the armour.

### 9.2 Aluminium strip armour

The thickness and width of aluminium strip, determined in accordance with **E.6** of Appendix **E**, shall not differ from the values specified in the appropriate table by more than 10 %. The tensile strength of aluminium strip when tested in accordance with **E.4** of Appendix **E,** shall not be less than 145 $N/mm^2$

### 9.3 Wire armour

Wire armour for cables having two or more cores shall consist of a single layer of galvanized steel wires. Wire armour for single-core cables shall consist of a single layer of aluminium wires.

The armour wire shall conform to the following.

a) When determined in accordance with **E.1** of Appendix **E,** the diameter of the round armour wires, whether of galvanized steel or plain aluminium, shall fall within the minimum and the maximum wire diameters given in Table **1**.
b) When determined in accordance with **E.2** of Appendix **E,** the mass of zinc coating of galvanized steel armour wire shall be not less than the value given in Table **1**.
c) When tested in accordance with **E.3** of Appendix **E,** the mechanical characteristics of galvanized armour wires shall be such that none of the wires shall break.
d) When tested in accordance with **E.4** of Appendix **E,** the tensile strength of aluminium armour wires shall be not less than 125 $N/mm^2$

**TABLE 1 — Diameter of armour wire and mass of zinc coating**

| Nominal wire diameter mm | Wire diameter | | Minimum mass of zinc coating $g/m^2$ |
|---|---|---|---|
| | Minimum mm | Maximum mm | |
| (1) | (2) | (3) | (4) |
| 0.9 | 0.85 | 0.95 | 112 |
| 1.25 | 1.18 | 1.32 | 150 |
| 1.6 | 1.51 | 1.69 | 172 |
| 2.0 | 1.90 | 2.10 | 180 |
| 2.5 | 2.37 | 2.63 | 195 |
| 3.15 | 2.99 | 3.31 | 206 |

### 9.4 Joints

Joints in steel wire armour shall be brazed or welded and any surface irregularity shall be removed.
Joints in aluminium wire or strip shall be made by cold pressure or fusion welding and all surface irregularities shall be removed.
A joint in any wire or strip shall be not less than 1 m from the nearest joint in any other armour wire or strip in the complete cable.

### 9.5 Armour resistance

When measured and corrected to 20 °C in accordance with **E.5** of Appendix **E,** the d.c. resistance of the armour of the completed cable shall not exceed the appropriate value given in Table **F.I,** Table **F.2**, Table **F.3**, Table **F.4** or Table **F.5.**

## 10 CABLE MARKING

### 10.1 End marking

The ends of each factory length of cable having three or more cores of conductor size 25 $N/mm^2$ 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.

### 10.2 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<br>3 300 V<br>600/1 000 V AUX |
| 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 $mm^2$ copper conductors.*

ii) Aluminium conductor cables 4 x 50AL
**NOTE** : *4 x 50AL indicates a four-core cable with 50 $mm^2$ aluminium conductors.*

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

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.

### 10.3 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 be not greater than 1 100 mm.

### 10.4 The mark of an approval organization

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

### 10.5 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 **10.2**, **10.3** and **10.4**.

## 11 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.

## 12 METHODS OF TEST

The tests to be performed on cables specified in this standard shall be as scheduled in Table **2**, 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 **2** also indicates which tests relate to complete cable, and which relate to components.

### 12.1 Test conditions

**a) Ambient temperature**

Tests shall be performed at an ambient temperature of (20 ± 15) °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 51 Hz. The waveform shall be substantially sinusoidal.

## TABLE 2 - Schedule of tests

| Test | Requirement given in clause | Test method | Category |
|---|---|---|---|
| (1) | (2) | (3) | (4) |
| **Tests on components** | | | |
| Conductor construction | 5 | 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 |
| Core identification | 6.1 | 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 |
| Bedding | | | |
| taped bedding - gaps | 8.1 | 12.3.3 | S |
| extruded bedding - | | | |
| physical properties | 8.1 | SLS 1199: Part 1.1 | T |
| thickness | 8.2 | Appendix D | S |
| Armour | 9 | | |
| Wire armour | | | |
| diameter | 9.3 a) | E.I | S |
| mass of zinc coating | 9.3 b) | E.2 | T |
| wrapping test | 9.3 c) | E.3 | T |
| tensile test (aluminium wire) | 9.3 d) | E.4 | T |
| Aluminium strip armour | | | |
| dimensions of individual strips | 9.2 | E.6 | S |
| tensile test | 9.2 | E.4 | T |
| Oversheath | | | |
| physical properties | 5.3.1 | SLS 1282:Part 2 | T |
| thickness | 5.3.2 | Appendix D | S |
| spark test | 5.3.3 | SLS 906 | R |
| **Tests on completed cables** | | | |
| Cable markings | 10 | Visual examination and measurement | R |
| Conductor resistance test | 12.2.2 | SLS 695 | R |
| Voltage test on completed cables | 12.2.3 | Appendix G | R |
| Insulation resistance test | 12.2.4 | Appendix H | R |
| Armour resistance test | 10.5 | E.5 | S |
| Tests under fire conditions | | | |
| flame propagation test | | | |
| on single cable | 12.3.2 | SLS 1007 | S |
| Compatibility test | 12.4.2 | Appendix J 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*

## 12.2 Routine tests

**12.2.1** *General*
Routine tests shall be performed as indicated by the symbol "R" in Table **2**.

**NOTE** : *Those requirements for which routine testing is specified, and which are not fully covered by earlier clauses, are detailed in* ***12.2.1,12.2.2, 12.2.3.***

**12.2.2** ***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 F.I,F.2, F.3, F.4 and F.5 of*** *Appendix F.*

**12.2.3** ***Voltage test on completed cables***
When the completed cable is tested in accordance with Appendix **G**, the insulation shall not break down.

**12.2.4** ***Insulation resistance***
When the completed cable is tested in accordance with Appendix **H** the insulation resistance shall not be less than the appropriate value given in Table **3.**

**TABLE 3 - Minimum insulation resistance values**

| Nominal cross-sectional area of conductor | Insulation resistance per kilometre at 20 °C | |
|---|---|---|
| | 600/1 000V | 1 900/ 3 300 V |
| $mm^2$ | MΩ | MΩ |
| (1) | (2) | (3) |
| 1.5 | 10 | -- |
| 2.5 | 9 | -- |
| 4 | 8 | -- |
| 6 | 7 | -- |
| 10 | 7 | -- |
| 16 | 6 | 10 |
| 25 | 5 | 8 |
| 35 | 5 | 7 |
| 50 | 5 | 6 |
| 70 | 5 | 6 |
| 95 and above | 5 | 5 |

### 12.3 Sample tests

#### 12.3.1 *General*

Sample tests shall be performed as indicated by the symbol "S" in Table **2**.

**NOTE :** *Those requirements for which sample testing is specified, and which are not fully covered by earlier clauses, are detailed in **12.3.2** and **12.3.3**.*

#### 12.3.2 *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.**

#### 12.3.3 *Measurement of gap between tapes of taped bedding*

The gap between adjacent edges of each bedding tape, measured at right angles to the tape, and the tape width, shall be measured on a representative sample of cable 300 mm long, taken not less than 150 mm from the end of a factory length.

The measurements shall be made by suitable means in which the error of determination does not exceed 0.5 mm. The gaps shall be measured at four positions, approximately 50 mm apart, along the length of the sample.

The average gap determined from the results shall not exceed the limit specified in **8.1**.

### 12.4 Type tests

#### 12.4.1 *General*

Type tests shall be performed as indicated by the symbol "T" in Table **2** ( see also Appendix **M**).

**NOTE :** *Those requirements for which type testing is specified, and which are not fully. covered by earlier clauses, are detailed in 12.4.2.*

#### 12.4.2 *Compatibility test*

When a sample of complete cable is aged in accordance with **J.2** of Appendix **J**, the insulation and oversheath shall conform to the requirements given in Table **4**. In addition, at the end of the test period in the oven, the blotting paper shall be free of stains.

**TABLE 4 - Compatibility test requirements**

| (1) | (2) | (3) | |
|---|---|---|---|
| **Component** | **Test** | **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 | -- |
| Oversheath | 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 5 - Single-core 600/1 000 V cables with circular stranded copper conductor**

| Nominal cross-sectional area of conductor[a] $mm^2$ | Thickness of insulation mm | Thickness of extruded bedding mm | Nominal aluminium armour wire diameter mm | Thickness of oversheath mm | Approximate overall diameter mm |
|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) |
| 50 | 1.4 | 0.8 | 1.25 | 1.5 | 19.1 |
| 70 | 1.4 | 0.8 | 1.25 | 1.6 | 21.1 |
| 95 | 1.6 | 0.8 | 1.25 | 1.6 | 23.4 |
| 120 | 1.6 | 1.0 | 1.6 | 1.7 | 26.3 |
| 150 | 1.8 | 1.0 | 1.6 | 1.7 | 28.3 |
| 185 | 2.0 | 1.0 | 1.6 | 1.8 | 30.8 |
| 240 | 2.2 | 1.0 | 1.6 | 1.9 | 34.1 |
| 300 | 2.4 | 1.0 | 1.6 | 1.9 | 37.0 |
| 400 | 2.6 | 1.2 | 2.0 | 2.1 | 42.0 |
| 500 | 2.8 | 1.2 | 2.0 | 2.1 | 45.6 |
| 630 | 2.8 | 1.2 | 2.0 | 2.2 | 49.7 |
| 800 | 2.8 | 1.4 | 2.5 | 2.4 | 55.8 |
| 1 000 | 3.0 | 1.4 | 2.5 | 2.5 | 61.0 |

[a] Circular or compacted circular stranded conductor (class 2).

## TABLE 6 - Single-core 600/1 000 V cables with solid /stranded aluminium conductor

| Nominal cross-sectional area of conductor | Thickness of insulation | Thickness of extruded bedding | Nominal aluminium armour wire diameter | Armour strip | | Thickness of ovrsheath | Approximate overall diameter | |
|---|---|---|---|---|---|---|---|---|
| | | | | Nominal thickness | Nominal width | | Wire-armoured | Strip-armoured |
| $mm^2$ | mm | mm | mm | mm | mm | mm | mm | mm |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| ***Circular solid/stranded conductor (Class 1 / Class 2)*** | | | | | | | | |
| 50 | 1.4 | 0.8 | 1.25 | 0.6 | 2.4 | 1.5 | 17.8 | 16.5 |
| 70 | 1.4 | 0.8 | 1.25 | 0.6 | 2.4 | 1.6 | 19.6 | 18.3 |
| 95 | 1.6 | 0.8 | 1.25 | 0.6 | 2.4 | 1.6 | 21.7 | 20.4 |
| 120 | 1.6 | 1.0 | 1.6 | 0.6 | 2.4 | 1.7 | 24.3 | 22.3 |
| 150 | 1.8 | 1.0 | 1.6 | 0.6 | 2.4 | 1.7 | 26.1 | 24.1 |
| 185 | 2.0 | 1.0 | 1.6 | 1.0 | 3.6 | 1.8 | 28.3 | 27.1 |
| 240 | 2.2 | 1.0 | 1.6 | 1.0 | 3.6 | 1.9 | 31.2 | 30.0 |
| 300 | 2.4 | 1.0 | 1.6 | 1.0 | 3.6 | 1.9 | 33.7 | 32.5 |
| ***Circular/ sectoral conductor*** | | | | | | | | |
| 380 (4 x 95) | 2.6 | 1.2 | 2.0 | 1.4 | 4.8 | 2.0 | 38.4 | 37.2 |
| 480 (4 x 120) | 2.8 | 1.2 | 2.0 | 1.4 | 4.8 | 2.1 | 41.7 | 40.5 |
| 600 (4 x 150) | 2.8 | 1.2 | 2.0 | 1.4 | 4.8 | 2.2 | 44.6 | 43.4 |
| 740 (4 x 185) | 2.8 | 1.4 | 2.5 | 1.4 | 4.8 | 2.3 | 49.5 | 47.3 |
| 960 (4 x 240) | 3.0 | 1.4 | 2.5 | 1.8 | 6.4 | 2.5 | 54.9 | 53.5 |
| 1 200 (4 x 300) | 3.0 | 1.6 | 2.5 | 1.8 | 6.4 | 2.6 | 59.7 | 58.3 |

**TABLE 7 — Two-core 600/1 000 V cables with stranded copper conductor**

| Nominal cross-sectional area of conductor | Thickness of insulation | Thickness of extruded bedding | Nominal steel armour wire diameter | Thickness of oversheath | Approximate overall diameter | |
|---|---|---|---|---|---|---|
| | | | | | Extruded bedding | Taped bedding |
| $mm^2$ | mm | mm | mm | mm | mm | mm |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1.5[a] | 0.6 | 0.8 | 0.9 | 1.4 | 12.3 | — |
| 2.5[a] | 0.7 | 0.8 | 0.9 | 1.4 | 13.6 | — |
| 4[a] | 0.8 | 0.8 | 0.9 | 1.4 | 15.1 | — |
| 6[a] | 0.8 | 0.8 | 0.9 | 1.5 | 16.5 | — |
| 10[a] | 1.0 | 0.8 | 1.25 | 1.6 | 20.1 | — |
| 16[a] | 1.0 | 0.8 | 1.25 | 1.6 | 21.9 | 21.9 |
| 25[b] | 1.2 | 1.0 | 1.6 | 1.7 | 23.0 | 22.6 |
| 25[a] | 1.2 | 1.0 | 1.6 | 1.7 | 26.7 | 26.3 |
| 35[b] | 1.2 | 1.0 | 1.6 | 1.8 | 24.8 | 24.4 |
| 35[a] | 1.2 | 1.0 | 1.6 | 1.8 | 29.2 | 28.8 |
| 50[b] | 1.4 | 1.0 | 1.6 | 1.9 | 27.8 | 27.4 |
| 70[b] | 1.4 | 1.0 | 1.6 | 1.9 | 30.4 | 30.0 |
| 95[b] | 1.6 | 1.2 | 2.0 | 2.1 | 35.5 | 34.7 |
| 120[b] | 1.6 | 1.2 | 2.0 | 2.2 | 38.0 | 37.2 |
| 150[b] | 1.8 | 1.2 | 2.0 | 2.3 | 41.3 | 40.5 |
| 185[b] | 2.0 | 1.4 | 2.5 | 2.4 | 46.4 | 45.2 |
| 240[b] | 2.2 | 1.4 | 2.5 | 2.5 | 51.2 | 50.0 |
| 300[b] | 2.4 | 1.6 | 2.5 | 2.7 | 56.4 | 54.8 |
| 400[b] | 2.6 | 1.6 | 2.5 | 2.9 | 61.9 | 60.3 |

[a] Circular or compacted circular stranded conductors (Class 2).
[b] Shaped stranded conductor (Class 2).

**TABLE 8 — Two-core 600/1 000 V cables with solid/stranded aluminium conductors**

| Nominal cross-sectional area of conductor | Thickness of insulation | Thickness of extruded bedding | Nominal steel armour wire diameter | Armour strip | | Thickness of oversheath | Approximate overall diameter | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Nominal thickness | Nominal width | | Wire-armoured | | Strip-armoured (taped bedding) |
| | | | | | | | Extruded bedding | Taped bedding | |
| $mm^2$ | mm | mm | mm | mm | mm | mm | mm | mm | mm |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| 16[a] | 1.0 | 0.8 | 1.25 | 0.6 | 2.4 | 1.6 | 20.6 | 20.6 | 19.3 |
| 25[b] | 1.2 | 1.0 | 1.6 | 0.6 | 2.4 | 1.7 | 21.3 | 20.9 | 18.9 |
| 25[a] | 1.2 | 1.0 | 1.6 | 0.6 | 2.4 | 1.7 | 25.0 | 24.6 | 22.6 |
| 35[b] | 1.2 | 1.0 | 1.6 | 0.6 | 2.4 | 1.8 | 22.9 | 22.5 | 20.5 |
| 35[a] | 1.2 | 1.0 | 1.6 | 0.6 | 2.4 | 1.8 | 27.2 | 26.8 | 24.8 |
| 50[b] | 1.4 | 1.0 | 1.6 | 0.6 | 2.4 | 1.9 | 25.5 | 25.1 | 23.1 |
| 70[b] | 1.4 | 1.0 | 1.6 | 1.0 | 3.6 | 1.9 | 27.7 | 27.3 | 26.1 |
| 95[b] | 1.6 | 1.2 | 2.0 | 1.0 | 3.6 | 2.1 | 32.4 | 31.6 | 29.6 |

[a] Solid /Stranded circular conductor (Class 1 / Class 2).
[b] Solid / Stranded sector shaped conductor (Class 1 / Class 2).

**TABLE 9 - Three-core 600/1 000 V cables with stranded copper conductors**

| Nominal cross-sectional area of conductor $mm^2$ | Thickness of insulation mm | Thickness of extruded bedding mm | Nominal steel armour wire diameter mm | Thickness of oversheath mm | Approximate overall diameter | |
|---|---|---|---|---|---|---|
| | | | | | Extruded bedding mm | Taped bedding mm |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1.5[a] | 0.6 | 0.8 | 0.9 | 1.4 | 12.8 | — |
| 2.5[a] | 0.7 | 0.8 | 0.9 | 1.4 | 14.1 | — |
| 4[a] | 0.8 | 0.8 | 0.9 | 1.4 | 15.8 | — |
| 6[a] | 0.8 | 0.8 | 1.25 | 1.5 | 18.0 | — |
| 10[a] | 1.0 | 0.8 | 1.25 | 1.6 | 21.2 | — |
| 16[a] | 1.0 | 0.8 | 1.25 | 1.6 | 23.1 | 23.1 |
| 25[b] | 1.2 | 1.0 | 1.6 | 1.7 | 25.0 | 24.6 |
| 25[a] | 1.2 | 1.0 | 1.6 | 1.7 | 28.2 | 27.8 |
| 35[b] | 1.2 | 1.0 | 1.6 | 1.8 | 27.1 | 26.7 |
| 35[a] | 1.2 | 1.0 | 1.6 | 1.8 | 30.8 | 30.4 |
| 50[b] | 1.4 | 1.0 | 1.6 | 1.9 | 30.5 | 30.1 |
| 70[b] | 1.4 | 1.2 | 2.0 | 2.0 | 35.0 | 34.2 |
| 95[b] | 1.6 | 1.2 | 2.0 | 2.1 | 39.3 | 38.5 |
| 120[b] | 1.6 | 1.2 | 2.0 | 2.2 | 42.2 | 41.4 |
| 150[b] | 1.8 | 1.4 | 2.5 | 2.4 | 47.5 | 46.3 |
| 185[b] | 2.0 | 1.4 | 2.5 | 2.5 | 51.9 | 50.7 |
| 240[b] | 2.2 | 1.6 | 2.5 | 2.6 | 57.8 | 56.2 |
| 300[b] | 2.4 | 1.6 | 2.5 | 2.8 | 63.2 | 61.6 |
| 400[b] | 2.6 | 1.6 | 2.5 | 3.0 | 69.6 | 68.0 |

[a] Circular or compacted circular stranded conductors (Class 2).
[b] Shaped stranded conductor (Class 2).

**TABLE 10 — 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 extruded bedding mm | Nominal steel armour wire diameter mm | Armour strip | | Thickness of oversheath mm | Approximate overall diameter | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Nominal thickness mm | Nominal width mm | | Wire-armoured | | Strip-armoured (taped bedding) mm |
| | | | | | | | Extruded bedding mm | Taped bedding mm | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| 16[a] | 1.0 | 0.8 | 1.25 | 0.6 | 2.4 | 1.6 | 21.7 | 21.7 | 20.4 |
| 25[b] | 1.2 | 1.0 | 1.6 | 0.6 | 2.4 | 1.7 | 23.9 | 23.5 | 21.5 |
| 25[a] | 1.2 | 1.0 | 1.6 | 0.6 | 2.4 | 1.7 | 26.4 | 26.0 | 24.0 |
| 35[b] | 1.2 | 1.0 | 1.6 | 0.6 | 2.4 | 1.8 | 25.8 | 25.4 | 23.4 |
| 35[a] | 1.2 | 1.0 | 1.6 | 0.6 | 2.4 | 1.8 | 28.7 | 28.3 | 26.3 |
| 50[b] | 1.4 | 1.0 | 1.6 | 1.0 | 3.6 | 1.9 | 28.9 | 28.5 | 27.3 |
| 70[b] | 1.4 | 1.2 | 2.0 | 1.0 | 3.6 | 2.0 | 33.0 | 32.2 | 30.2 |
| 95[b] | 1.6 | 1.2 | 2.0 | 1.4 | 4.8 | 2.1 | 37.1 | 36.3 | 35.1 |
| 120[b] | 1.6 | 1.2 | 2.0 | 1.4 | 4.8 | 2.2 | 39.7 | 38.9 | 37.7 |
| 150[b] | 1.8 | 1.4 | 2.5 | 1.4 | 4.8 | 2.4 | 44.7 | 43.5 | 41.3 |
| 185[b] | 2.0 | 1.4 | 2.5 | 1.4 | 4.8 | 2.5 | 48.7 | 47.5 | 45.3 |
| 240[b] | 2.2 | 1.6 | 2.5 | 1.8 | 6.4 | 2.6 | 54.2 | 52.6 | 51.2 |
| 300[b] | 2.4 | 1.6 | 2.5 | 1.8 | 6.4 | 2.8 | 59.2 | 57.6 | 56.2 |

[a] Solid / Stranded circular conductor (Class 1/ Class 2).
[b] Solid / Stranded sector shaped conductor (Class 1/ Class 2).

**TABLE 11- Four-core 600/1 000 V cables with stranded copper conductors**

| Nominal cross-sectional area of conductor | Thickness of insulation | Thickness of extruded bedding | Nominal steel armour wire diameter | Thickness of oversheath | Approximate overall diameter | |
|---|---|---|---|---|---|---|
| | | | | | Extruded bedding | Taped bedding |
| $mm^2$ | mm | mm | mm | mm | mm | mm |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1.5[a] | 0.6 | 0.8 | 0.9 | 1.4 | 13.5 | — |
| 2.5[a] | 0.7 | 0.8 | 0.9 | 1.4 | 15.0 | — |
| 4[a] | 0.8 | 0.8 | 1.25 | 1.5 | 17.8 | — |
| 6[a] | 0.8 | 0.8 | 1.25 | 1.5 | 19.2 | — |
| 10[a] | 1.0 | 0.8 | 1.25 | 1.6 | 22.8 | — |
| 16[a] | 1.0 | 1.0 | 1.6 | 1.7 | 26.3 | 25.9 |
| 25[b] | 1.2 | 1.0 | 1.6 | 1.8 | 27.8 | 27.4 |
| 25[a] | 1.2 | 1.0 | 1.6 | 1.8 | 30.7 | 30.3 |
| 35[b] | 1.2 | 1.0 | 1.6 | 1.9 | 30.3 | 29.9 |
| 35[a] | 1.2 | 1.0 | 1.6 | 1.9 | 33.7 | 33.3 |
| 50[b] | 1.4 | 1.2 | 2.0 | 2.0 | 35.4 | 34.6 |
| 70[b] | 1.4 | 1.2 | 2.0 | 2.1 | 39.2 | 38.4 |
| 95[b] | 1.6 | 1.2 | 2.0 | 2.2 | 44.3 | 43.5 |
| 120[b] | 1.6 | 1.4 | 2.5 | 2.4 | 49.3 | 48.1 |
| 150[b] | 1.8 | 1.4 | 2.5 | 2.5 | 53.6 | 52.4 |
| 185[b] | 2.0 | 1.6 | 2.5 | 2.6 | 59.0 | 57.4 |
| 240[b] | 2.2 | 1.6 | 2.5 | 2.8 | 65.7 | 64.1 |
| 300[b] | 2.4 | 1.6 | 2.5 | 3.0 | 72.0 | 70.4 |
| 400[b] | 2.6 | 1.8 | 3.15 | 3.3 | 81.3 | 79.3 |

[a] Circular or compacted circular stranded conductors (Class 2).
[b] Shaped stranded conductor (Class 2).

**TABLE 12 - Four-core 600/1 000 V cables with solid / stranded aluminium conductors**

| Nominal cross-sectional area of conductor | Thickness of insulation | Thickness of extruded bedding | Nominal steel armour wire diameter | Armour strip | | Thickness of oversheath | Approximate overall diameter | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Nominal thickness | Nominal width | | Wire-armoured | | Strip-armoured (taped bedding) |
| | | | | | | | Extruded bedding | Taped bedding | |
| $mm^2$ | mm | mm | mm | mm | mm | mm | mm | mm | mm |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| 16[a] | 1.0 | 1.0 | 1.6 | 0.6 | 2.4 | 1.7 | 24.7 | 24.3 | 22.3 |
| 25[b] | 1.2 | 1.0 | 1.6 | 0.6 | 2.4 | 1.8 | 26.3 | 25.9 | 23.9 |
| 25[a] | 1.2 | 1.0 | 1.6 | 0.6 | 2.4 | 1.8 | 28.7 | 28.3 | 26.3 |
| 35[b] | 1.2 | 1.0 | 1.6 | 0.6 | 2.4 | 1.9 | 28.6 | 28.2 | 26.2 |
| 35[a] | 1.2 | 1.0 | 1.6 | 0.6 | 2.4 | 1.9 | 31.3 | 30.9 | 28.9 |
| 50[b] | 1.4 | 1.2 | 2.0 | 1.0 | 3.6 | 2.0 | 33.3 | 32.5 | 30.5 |
| 70[b] | 1.4 | 1.2 | 2.0 | 1.0 | 3.6 | 2.1 | 36.8 | 36.0 | 34.0 |
| 95[b] | 1.6 | 1.2 | 2.0 | 1.4 | 4.8 | 2.2 | 41.5 | 40.7 | 39.5 |
| 120[b] | 1.6 | 1.4 | 2.5 | 1.4 | 4.8 | 2.4 | 46.1 | 44.9 | 42.7 |
| 150[b] | 1.8 | 1.4 | 2.5 | 1.4 | 4.8 | 2.5 | 50.1 | 48.9 | 46.7 |
| 185[b] | 2.0 | 1.6 | 2.5 | 1.8 | 6.4 | 2.6 | 55.1 | 53.5 | 52.1 |
| 240[b] | 2.2 | 1.6 | 2.5 | 1.8 | 6.4 | 2.8 | 61.2 | 59.6 | 58.2 |
| 300[b] | 2.4 | 1.6 | 2.5 | 1.8 | 6.4 | 3.0 | 67.0 | 65.4 | 64.0 |

[a] Solid /Stranded circular conductor (Class 1/ Class 2).
[b] Solid / Stranded sector shaped conductor (Class 1/ Class 2).

**TABLE 13 – Five-core 600/1 000 V cables with stranded copper conductors**

| Nominal cross-sectional area of conductor[a] $mm^2$ | Thickness of insulation mm | Thickness of extruded bedding mm | Nominal steel armour wire diameter mm | Thickness of oversheath mm | Approximate overall diameter | |
|---|---|---|---|---|---|---|
| | | | | | Extruded bedding mm | Taped bedding mm |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1.5 | 0.6 | 0.8 | 0.9 | 1.4 | 14.3 | - |
| 2.5 | 0.7 | 0.8 | 0.9 | 1.5 | 16.3 | - |
| 4 | 0.8 | 0.8 | 1.25 | 1.5 | 19.0 | - |
| 6 | 0.8 | 0.8 | 1.25 | 1.6 | 20.9 | - |
| 10 | 1.0 | 1.0 | 1.6 | 1.7 | 25.8 | - |
| 16 | 1.0 | 1.0 | 1.6 | 1.7 | 28.4 | 28.0 |
| 25 | 1.2 | 1.0 | 1.6 | 1.9 | 33.5 | 33.1 |
| 35 | 1.2 | 1.0 | 1.6 | 1.9 | 36.6 | 36.2 |
| 50 | 1.4 | 1.2 | 2.0 | 2.1 | 43.0 | 42.2 |
| 70 | 1.4 | 1.2 | 2.0 | 2.2 | 48.1 | 47.3 |

[a]Circular or compacted circular stranded conductors (Class 2)

**TABLE 14 – Single-core 1 900/3 300 V cables with circular stranded copper conductor**

| Nominal cross-sectional area of conductor[a] $mm^2$ | Thickness of insulation mm | Thickness of extruded bedding mm | Nominal aluminium armour wire diameter mm | Thickness of oversheath mm | Approximate overall diameter mm |
|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) |
| 50 | 2.2 | 0.8 | 1.25 | 1.6 | 21.0 |
| 70 | 2.2 | 0.8 | 1.25 | 1.6 | 22.8 |
| 95 | 2.2 | 1.0 | 1.6 | 1.7 | 26.0 |
| 120 | 2.2 | 1.0 | 1.6 | 1.7 | 27.7 |
| 150 | 2.2 | 1.0 | 1.6 | 1.8 | 29.4 |
| 185 | 2.2 | 1.0 | 1.6 | 1.8 | 31.3 |
| 240 | 2.2 | 1.0 | 1.6 | 1.9 | 34.1 |
| 300 | 2.4 | 1.0 | 1.6 | 1.9 | 37.0 |
| 400 | 2.6 | 1.2 | 2.0 | 2.1 | 42.0 |
| 500 | 2.8 | 1.2 | 2.0 | 2.1 | 45.6 |
| 630 | 2.8 | 1.2 | 2.0 | 2.2 | 49.7 |
| 800 | 2.8 | 1.4 | 2.5 | 2.4 | 55.8 |
| 1000 | 3.0 | 1.4 | 2.5 | 2.5 | 61.0 |

[a]Circular or compacted circular stranded conductor (Class 2)

**TABLE 15 - Single-core 1 900/3 300 V cables with solid / stranded aluminium conductor**

| Nominal cross-sectional area of conductor<br>$mm^2$ | Thickness of insulation<br>mm | Thickness of extruded bedding<br>mm | Nominal aluminium armour wire diameter<br>mm | Thickness of oversheath<br>mm | Approximate overall diameter<br>mm |
|---|---|---|---|---|---|
| **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| ***Circular solid / stranded conductor (Class 1 / Class 2).*** | | | | | |
| 50 | 2.2 | 0.8 | 1.25 | 1.6 | 19.8 |
| 70 | 2.2 | 0.8 | 1.25 | 1.6 | 21.3 |
| 95 | 2.2 | 1.0 | 1.6 | 1.7 | 24.3 |
| 120 | 2.2 | 1.0 | 1.6 | 1.7 | 25.6 |
| 150 | 2.2 | 1.0 | 1.6 | 1.8 | 27.1 |
| 185 | 2.2 | 1.0 | 1.6 | 1.8 | 28.8 |
| 240 | 2.2 | 1.0 | 1.6 | 1.9 | 31.2 |
| 300 | 2.4 | 1.0 | 1.6 | 1.9 | 33.7 |
| ***Circular sectoral conductor*** | | | | | |
| 380 (4 x 95) | 2.6 | 1.2 | 2.0 | 2.0 | 38.4 |
| 480 (4 x 120) | 2.8 | 1.2 | 2.0 | 2.1 | 41.7 |
| 600 (4 x 150) | 2.8 | 1.2 | 2.0 | 2.2 | 44.6 |
| 740 (4 x 185) | 2.8 | 1.4 | 2.5 | 2.3 | 49.5 |
| 960 (4 x 240) | 3.0 | 1.4 | 2.5 | 2.5 | 54.9 |
| 1 200 (4 x 300) | 3.0 | 1.6 | 2.5 | 2.6 | 59.7 |

**TABLE 16 - Three-core 1 900/3 300 V cables with stranded copper conductors**

| Nominal cross-sectional area of conductor<br>$mm^2$ | Thickness of insulation<br>mm | Thickness of extruded bedding<br>mm | Nominal steel armour wire diameter<br>mm | Thickness of oversheath<br>mm | Approximate overall diameter<br>mm |
|---|---|---|---|---|---|
| **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| 16[a] | 2.2 | 1.0 | 1.6 | 1.8 | 30.3 |
| 25[a] | 2.2 | 1.0 | 1.6 | 1.8 | 33.1 |
| 35[b] | 2.2 | 1.0 | 1.6 | 1.9 | 32.1 |
| 35[a] | 2.2 | 1.0 | 1.6 | 1.9 | 35.8 |
| 50[b] | 2.2 | 1.2 | 2.0 | 2.0 | 35.6 |
| 70[b] | 2.2 | 1.2 | 2.0 | 2.1 | 38.9 |
| 95[b] | 2.2 | 1.2 | 2.0 | 2.2 | 42.3 |
| 120[b] | 2.2 | 1.4 | 2.5 | 2.3 | 46.6 |
| 150[b] | 2.2 | 1.4 | 2.5 | 2.4 | 49.4 |
| 185[b] | 2.2 | 1.4 | 2.5 | 2.5 | 52.8 |
| 240[b] | 2.2 | 1.6 | 2.5 | 2.6 | 57.8 |
| 300[b] | 2.4 | 1.6 | 2.5 | 2.8 | 63.2 |
| 400[b] | 2.6 | 1.6 | 2.5 | 3.0 | 69.6 |

[a] Circular or compacted circular stranded conductors (Class 2).
[b] Shaped stranded conductors (Class 2).

## TABLE 17 - Three-core 1 900/3 300 V cables with solid/ stranded aluminium conductors

| Nominal cross-sectional area of conductor<br>$mm^2$ | Thickness of insulation<br>mm | Thickness of extruded bedding<br>mm | Nominal steel armour wire diameter<br>mm | Thickness of oversheath<br>mm | Approximate overall diameter<br>mm |
|---|---|---|---|---|---|
| **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| 16[a] | 2.2 | 1.0 | 1.6 | 1.8 | 28.9 |
| 25[a] | 2.2 | 1.0 | 1.6 | 1.8 | 31.3 |
| 35[b] | 2.2 | 1.0 | 1.6 | 1.9 | 30.6 |
| 35[a] | 2.2 | 1.0 | 1.6 | 1.9 | 33.7 |
| 50[b] | 2.2 | 1.2 | 2.0 | 2.0 | 33.9 |
| 70[b] | 2.2 | 1.2 | 2.0 | 2.1 | 36.9 |
| 95[b] | 2.2 | 1.2 | 2.0 | 2.2 | 40.0 |
| 120[b] | 2.2 | 1.4 | 2.5 | 2.3 | 44.0 |
| 150[b] | 2.2 | 1.4 | 2.5 | 2.4 | 46.5 |
| 185[b] | 2.2 | 1.4 | 2.5 | 2.5 | 49.6 |
| 240[b] | 2.2 | 1.6 | 2.5 | 2.6 | 54.2 |
| 300[b] | 2.4 | 1.6 | 2.5 | 2.8 | 59.2 |

[a] Solid / stranded circular conductor (Class 1/ Class 2)
[b] Solid / stranded sector shaped conductor (Class 1 / Class 2).

**TABLE 18 - 600/1 000 V armoured auxiliary cables with stranded copper conductors**

| Number of Cores[a] | Nominal cross-sectional area of Conductor[b] mm | Thickness of insulation mm | Thickness of extruded bedding mm | Nominal steel armour wire diameter mm | Thickness of oversheath mm | Approximate overall diameter mm |
|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 7 | 1.5 | 0.6 | 0.8 | 0.9 | 1.4 | 15.2 |
| 12 | | | 0.8 | 1.25 | 1.5 | 19.4 |
| 19 | | | 0.8 | 1.25 | 1.6 | 22.2 |
| 27 | | | 1.0 | 1.6 | 1.7 | 26.7 |
| 37 | | | 1.0 | 1.6 | 1.8 | 29.2 |
| 48 | | | 1.0 | 1.6 | 1.9 | 32.9 |
| 7 | 2.5 | 0.7 | 0.8 | 1.25 | 1.5 | 18.0 |
| 12 | | | 0.8 | 1.25 | 1.6 | 22.4 |
| 19 | | | 1.0 | 1.6 | 1.7 | 26.6 |
| 27 | | | 1.0 | 1.6 | 1.8 | 30.7 |
| 37 | | | 1.0 | 1.6 | 1.9 | 34.0 |
| 48 | | | 1.2 | 2.0 | 2.1 | 39.5 |
| 7 | 4 | 0.8 | 0.8 | 1.25 | 1.6 | 20.5 |
| 12 | | | 1.0 | 1.6 | 1.7 | 26.8 |
| 19 | | | 1.0 | 1.6 | 1.8 | 30.5 |
| 27 | | | 1.2 | 2.0 | 2.0 | 37.1 |
| 37 | | | 1.2 | 2.0 | 2.1 | 40.8 |
| 48 | | | 1.2 | 2.0 | 2.2 | 46.0 |

[a]The numbers of cores given here are preferred. Other numbers are permitted subject to agreement between the purchaser and manufacturer and, where such other numbers are manufactured, the dimensional details shall be as for the next highest preferred number of cores.

[b] Circular or compacted circular stranded copper conductors (Class 2).

# APPENDIX A
*(Informative)*

## RECOMMENDATIONS FOR THE SELECTION AND OPERATION OF CABLES

### A.I GENERAL

The cables specified in this standard are designed to be installed in air, or for burial in free draining soil conditions.

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 min.

**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 |
| 1.9 to 3.3 | 3.6 | A or B | 1.9 / 3.3 |

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 1000 V to earth and two-core 600/1 000 V cables up to 1 500 V between conductors. Single core 1 900/ 3 300 V cables are suitable for d.c. operating upto 3 000V to earth.

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)**

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 24h, 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.I.**

**TABLE B.I — Minimum installation radius**

| Construction | Minimum internal radius of bend |
|---|---|
| **(1)** | **(2)** |
| Circular copper conductors | 6D |
| Solid aluminium or shaped copper | 8D |
| **NOTE** : *D 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, especially for cables that do not have an extruded bedding. 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 EARTHING BONDS AND CLAMPS

Owing to the absence of a metal sheath, all earth fault currents will return through the armour unless there is a parallel bonding connection to relieve them of some of the fault current. In either event it is necessary to ensure that there is no discontinuity in the return circuit via the armour and no local spot of high resistance. Careful attention should therefore be paid to the design of all bonding clamps in joints and terminations to ensure that each armour wire contributes equally to the conductance of the bonding connection and that the resistance across a connector is not higher than that of the equivalent length of connected armour of the cable.

It is also important to ensure that all armour wires and all faces of armour clamps or connectors making contact with them are thoroughly cleaned during installation and that the clamps are adequately tightened to ensure good electrical contact.

Bonding clamps in joints should be electrically connected with a bond having a conductance at least equal to that of an equal length of the complete armour of the cable, and with adequate thermal capacity to avoid excessive overheating under short-circuit conditions.

## B.6 COMPOUND FILLING

For compound filled joints, the design of the box and the composition of the filling compound should provide an effective seal to prevent moisture gaining access to the conductor ferrules and armour connections. The filling compound should be compatible with the materials of the cable components with which it comes into contact. Account should be taken of the pouring temperatures or the temperatures resulting from exothermic reaction.

Compound filling is not necessary for terminations, provided that adequate clearances are maintained between phases and between each phase and earth. The minimum clearances should be related to the voltage and category of systems and environmental conditions. Guidance on minimum clearances can be obtained from the appropriate standards for equipment.

Where the required clearances cannot be achieved, it is necessary to provide some other effective means of insulation.

## B.7 EARTHING OF ARMOUR

Provision should be made for earthing the armour to the main earth system at the supply end by means of a metallic bond of adequate conductance, the bonding connection being as short and straight as possible.

Special precautions may be necessary to eliminate the risk of corrosion, especially corrosion due to the use of dissimilar metals.

## B.8 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 being as given in Table **B.2**

**TABLE B.2 - Test voltages after installation**

| Cable voltage designation V | D.C test voltage | |
|---|---|---|
| | Between conductors V | Between each conductor and armour V |
| (1) | (2) | (3) |
| 600/1 000 | 3 500 | 3 500 |
| 1 900/ 3 300 | 10 000 | 7 000 |

During the test the voltage should be increased gradually to the full value and maintained continuously for 15 min. The test should be between conductors and between each conductor and armour.

No breakdown should occur.

Sequence testing may be used to reduce overall testing time for multicore auxiliary cables, as indicated in Appendix **G**.

The test voltages given in Table **B.2** are 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 o**f Appendix **A**);
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);
j) type of finish; i.e :
i) armoured with aluminium wire (single-core only), steel wire or aluminium strip;
ii)whether taped or extruded bedding (where appropriate) is required for armoured cables. This will depend on the circumstances of installation and in particular on whether the environmental conditions are especially onerous, e.g. aggressive or wet. In cases of doubt advice should be sought from the cable manufacturer.

**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, bedding and oversheath listed in Table **2**, 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 ,bedding and oversheath 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**

For multicore cables, take measurements of insulation thickness on each core up to a maximum of five-cores.

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, 5.3.2** and **8.2,** 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)*

## ARMOUR WIRE TESTS

### E.1 MEASUREMENT OF DIAMETER OF ROUND WIRE ARMOUR

Take at random, from one sample of completed cable, 10 per cent of the total number of wires, and determine the diameter of each wire with a micrometer by taking two measurements at right angles to each other. Take the average of all the measurements as the wire diameter.

### E.2 MASS OF ZINC COATING OF GALVANIZED STEEL WIRE

Take at random, from one sample of completed cable, 10 per cent of the total number of wires and determine the mass of zinc coating by either a gravimetric or gas volumetric method as described in Clause **5.2** of **BSEN 10244-2**. Take the average of all the measurements as being the mass of zinc coating.

### E.3 WRAPPING TEST FOR GALVANIZED STEEL WIRE

Take at random, from one sample of completed cable, 10 per cent of the total number of wires. Wrap each wire round a cylindrical mandrel for one complete turn. The mandrel shall have a diameter of approximately four times the specified nominal wire diameter under test.

### E.4 TENSILE TEST FOR ALUMINIUM WIRES

Take at random, from one sample of completed cable, 10 per cent of the total number of wires. Measure the tensile strength of each wire in accordance with **SLS 978.**
The load shall be applied gradually and the rate of separation of the jaws of the testing machine shall be not less than 25 mm/min and not greater than 100 mm/min. The initial distance between the grips of the machine shall be (250 ± 2) mm.
The average of all the measurements shall be taken as being the tensile strength.

### E.5 ARMOUR RESISTANCE TEST

Determine the d.c. resistance of the armour by measuring the resistance of all the armour wires of the completed cable connected together.
Temperature correction multiplication factors, $k_t$, for armour resistance, to correct the measured resistance at t °C to 20 °C, are given in Table **E.1**

### E.6 MEASUREMENT OF DIMENSIONS OF ALUMINIUM STRIP ARMOUR

Take at random, from one sample of completed cable, 10 per cent of the total number of strips. Measure the thickness and width of each strip using a dial micrometer or venire calliper.
The average of all the measurements shall be taken as the thickness and width as appropriate.

**TABLE E.1 — TEMPERATURE CORRECTION MULTIPLICATION FACTORS**

| Temperature of armour at time of measurement, t °C | Correction factor $k_t$ | |
|---|---|---|
| | Galvanized steel wire armour | Aluminium wire armour |
| (1) | (2) | (3) |
| 5 | 1.072 | 1.064 |
| 6 | 1.067 | 1.059 |
| 7 | 1.062 | 1.055 |
| 8 | 1.057 | 1.050 |
| 9 | 1.052 | 1.046 |
| 10 | 1.047 | 1.042 |
| 11 | 1.042 | 1.037 |
| 12 | 1.037 | 1.033 |
| 13 | 1.033 | 1.029 |
| 14 | 1.028 | 1.025 |
| 15 | 1.023 | 1.020 |
| 16 | 1.018 | 1.016 |
| 17 | 1.014 | 1.012 |
| 18 | 1.009 | 1.008 |
| 19 | 1.005 | 1.004 |
| 20 | 1.000 | 1.000 |
| 21 | 0.996 | 0.996 |
| 22 | 0.991 | 0.992 |
| 23 | 0.987 | 0.988 |
| 24 | 0.982 | 0.984 |
| 25 | 0.978 | 0.980 |
| 26 | 0.974 | 0.977 |
| 27 | 0.969 | 0.973 |
| 28 | 0.965 | 0.969 |
| 29 | 0.961 | 0.965 |
| 30 | 0.957 | 0.962 |
| 31 | 0.953 | 0.958 |
| 32 | 0.949 | 0.954 |
| 33 | 0.945 | 0.951 |
| 34 | 0.941 | 0.947 |
| 35 | 0.937 | 0.943 |

**NOTE :** *The values of correction factor $k_t$ are based on resistance temperature coefficients at 20 °C of 0.004 5 per K for galvanized steel wire and 0.004 0 per K for aluminium wire.*

## APPENDIX F
## (*Normative)*
## RESISTANCE OF CONDUCTOR AND ARMOUR

Table **F.1**, Table **F.2**, Table **F.3**, Table **F.4** and Table **F.5** give maximum values of the conductor resistance and of the resistance of the aluminium wire, aluminium strip and galvanized steel wire armour for single-core and multicore cables with rated voltage of 600/1 000 V and 1 900/3 300 V as designated in Table **5** to Table **18.**

### TABLE F.1 — Maximum resistance of conductor and armour for single-core cable having aluminium wire armour

| Nominal cross-sectional area of conductor | Maximum resistance per km of cable at 20 °C | | | | | |
|---|---|---|---|---|---|---|
| | Copper conductor | Aluminium conductor | Aluminium wire armour | | | |
| | | | Cables with stranded copper conductor | | Cables with solid aluminium conductor | |
| | | | 600/1 000 V | 1 900/3 300 | 600/1 000 V | 1 900/3 300 |
| mm$^2$ | Ω | Ω | Ω | Ω | Ω | Ω |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 50 | 0.387 | 0.641 | 0.82 | 0.73 | 0.90 | 0.79 |
| 70 | 0.268 | 0.443 | 0.73 | 0.65 | 0.79 | 0.71 |
| 95 | 0.193 | 0.320 | 0.64 | 0.45 | 0.71 | 0.49 |
| 120 | 0.153 | 0.253 | 0.45 | 0.42 | 0.49 | 0.46 |
| 150 | 0.124 | 0.206 | 0.40 | 0.39 | 0.45 | 0.43 |
| 185 | 0.099 1 | 0.164 | 0.37 | 0.36 | 0.41 | 0.40 |
| 240 | 0.075 4 | 0.125 | 0.33 | 0.33 | 0.37 | 0.37 |
| 300 | 0.060 1 | 0.100 | 0.30 | 0.30 | 0.34 | 0.34 |
| 400 | 0.047 0 | 0.077 8 | 0.21 | 0.21 | — | — |
| 500 | 0.036 6 | 0.060 5 | 0.19 | 0.19 | — | — |
| 630 | 0.028 3 | 0.046 9 | 0.18 | 0.18 | — | — |
| 800 | 0.022 1 | 0.036 7 | 0.13 | 0.13 | — | — |
| 1000 | 0.017 6 | 0.029 1 | 0.12 | 0.12 | — | — |
| **Circular sectoral conductors** | | | | | | |
| 380 | — | 0.080 0 | — | — | 0.24 | 0.24 |
| 480 | — | 0.063 3 | — | — | 0.22 | 0.22 |
| 600 | — | 0.051 5 | — | — | 0.20 | 0.20 |
| 740 | — | 0.041 0 | — | | 0.15 | 0.15 |
| 960 | — | 0.031 3 | — | — | 0.13 | 0.13 |
| 1200 | — | 0.025 0 | — | — | 0.12 | 0.12 |

**TABLE F.2 Maximum resistance of conductor and armour for two-core, three-core, four- core and five-core cables having wire armour**

| Nominal cross-sectional area of conductor | Maximum resistance per km of cable at 20 °C | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Copper conductor[a] | Aluminium conductor | Steel wire armour | | | | | | | |
| | | | Cables with stranded copper conductors | | | | | Cables with solid aluminium conductors | | |
| | | | Two-core | Three- core | | Four-core | Five-core | Two-core | Three-core | Four-core |
| | | | 600/1 000 V | 600/1 000 V | 1 900/3 300 V | 600/1 000 V | 600/1 000 V | 600/1 000 V | 600/1 000 V | 1 900/3 300 V | 600/1 000 V |
| mm² | Ω | Ω | Ω | Ω | Ω | Ω | Ω | Ω | Ω | Ω | Ω |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| 1.5 | 12.1 | - | 10.2 | 9.5 | - | 8.8 | 8.2 | - | - | - | - |
| 2.5 | 7.41 | - | 8.8 | 8.2 | - | 7.7 | 6.8 | - | - | - | - |
| 4 | 4.61 | - | 7.5 | 7.0 | - | 4.6 | 4.1 | - | - | - | - |
| 6 | 3.08 | - | 6.8 | 4.6 | - | 4.1 | 3.8 | - | - | - | - |
| 10 | 1.83 | - | 3.9 | 3.7 | - | 3.4 | 2.3 | - | - | - | - |
| 16 | 1.15 | 1. 91 | 3.4 | 3.1 | 1.9 | 2.2 | 2.0 | 3.7 | 3.4 | 1.9 | 2.4 |
| 25 | 0.727 | 1. 20 | 2.6 | 2.4 | 1.7 | 2.1 | 1.7 | 2.9 | 2.5 | 1.8 | 2.3 |
| 35 | 0.524 | 0.868 | 2.4 | 2.1 | 1.7 | 1.9 | 1.5 | 2.7 | 2.3 | 1.9 | 2.0 |
| 50 | 0.387 | 0.641 | 2.1 | 1.9 | 1.3 | 1.3 | 1.1 | 2.4 | 2.0 | 1.4 | 1.4 |
| 70 | 0.268 | 0.443 | 1.9 | 1.4 | 1.2 | 1.2 | 0.89 | 2.1 | 1.4 | 1.2 | 1.3 |
| 95 | 0.193 | 0.320 | 1.3 | 1.2 | 1.1 | 0.98 | - | 1.5 | 1.3 | 1.1 | 1.1 |
| 120 | 0.153 | 0.253 | 1.2 | 1.1 | 0.74 | 0.71 | - | - | 1.2 | 0.80 | 0.78 |
| 150 | 0.124 | 0.206 | 1.1 | 0.74 | 0.69 | 0.65 | - | - | 0.82 | 0.74 | 0.71 |
| 185 | 0.0991 | 0.164 | 0.78 | 0.68 | 0.64 | 0.59 | - | - | 0.73 | 0.69 | 0.64 |
| 240 | 0.0754 | 0.125 | 0.69 | 0.60 | 0.58 | 0.52 | - | - | 0.65 | 0.63 | 0.57 |
| 300 | 0.0601 | 0.100 | 0.63 | 0.54 | 0.53 | 0.47 | - | - | 0.59 | 0.57 | 0.52 |
| 400 | 0.0470 | - | 0.56 | 0.49 | 0.48 | 0.34 | - | - | - | - | - |

[a] The values given are for plain annealed copper conductors. For tinned conductors reference should be made to **SLS 695**

**TABLE F.3 - Maximum resistance of conductor and armour for 600/1 000 V auxiliary cables with copper conductors having steel wire armour**

| Nominal cross-sectional area of conductor mm$^2$ | Maximum resistance per km of cable at 20 °C | | | | | | |
|---|---|---|---|---|---|---|---|
| | Copper conductor[a] | Steel wire armour : number of cores[b] | | | | | |
| | Ω | 7 Ω | 12 Ω | 19 Ω | 27 Ω | 37 Ω | 48 Ω |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| 1.5 | 12.1 | 7.5 | 4.0 | 3.5 | 2.3 | 2.0 | 1.8 |
| 2.5 | 7.41 | 4.6 | 3.5 | 2.3 | 1.9 | 1.7 | 1.2 |
| 4 | 4.61 | 3.9 | 2.2 | 1.9 | 1.3 | 1.1 | 0.96 |

[a] The values given are for plain annealed copper conductors. For tinned conductors reference should be made to **SLS 695**.
[b] For a non-preferred number of cores, the maximum resistance shall not be greater than that of the next lowest preferred number of cores.

**TABLE F.4 - Maximum resistance of conductor and armour for single-core cables having solid aluminium conductors and aluminium strip armour**

| (1) | (2) | (3) |
|---|---|---|
| Nominal cross-sectional area of conductor mm$^2$ | Maximum resistance per km of cable at 20 °C | |
| | Aluminium conductor Ω | Strip armour Ω |
| **Circular solid conductor (Class 1)** | | |
| 50 | 0.641 | 1.8 |
| 70 | 0.443 | 1.6 |
| 95 | 0.320 | 1.4 |
| 120 | 0.253 | 1.2 |
| 150 | 0.206 | 1.1 |
| 185 | 0.164 | 0.57 |
| 240 | 0.125 | 0.51 |
| 300 | 0.100 | 0.46 |
| **Circular sectoral conductor** | | |
| 380 | 0.080 0 | 0.29 |
| 480 | 0.063 3 | 0.27 |
| 600 | 0.051 5 | 0.24 |
| 740 | 0.041 0 | 0.22 |
| 960 | 0.031 3 | 0.15 |
| 1200 | 0.025 0 | 0.14 |

**TABLE F.5 — Maximum resistance of conductor and armour for two-core, three-core and four-core cables having solid aluminium conductors and aluminium strip armour**

| Nominal cross-sectional area of conductor $mm^2$ | Maximum resistance per km of cable at 20 °C | | | |
|---|---|---|---|---|
| | Aluminium conductor | Strip armour | | |
| | | Two-core | Three-core | Four-core |
| | | 600/1 000 V Ω | 600/1 000 V Ω | 600/1 000 V Ω |
| (1) | (2) | (3) | (4) | (5) |
| 16 | 1.91 | 1.5 | 1.4 | 1.2 |
| 25 | 1.2 | 1.6 | 1.3 | 1.2 |
| 35 | 0.868 | 1.4 | 1.2 | 1.1 |
| 50 | 0.641 | 1.2 | 0.57 | 0.51 |
| 70 | 0.443 | 0.60 | 0.51 | 0.44 |
| 95 | 0.320 | 0.54 | 0.31 | 0.28 |
| 120 | 0.253 | — | 0.29 | 0.25 |
| 150 | 0.206 | — | 0.27 | 0.23 |
| 185 | 0.164 | — | 0.24 | 0.16 |
| 240 | 0.125 | — | 0.16 | 0.14 |
| 300 | 0.100 | — | 0.15 | 0.13 |

## APPENDIX G
*(Normative)*

### VOLTAGE TEST ON COMPLETED CABLES

Apply the test voltage having an r.m.s value in accordance with Table **G.1**, between the conductors and between each conductor and the armour, which shall be earthed. Perform the test at room temperature, increasing the voltage gradually and maintaining it at the full value specified for 5 min.

Alternatively, for 600/1 000 V auxiliary cables, a voltage of 5 kV a.c. may be applied for 1 min. between each conductor and the remaining conductors connected to the armour and earthed.

For three-core 1 900/3 300 V cables, the test shall be made as a three- phase test or as a single-phase test, at the discretion of the manufacturer.

The conductors of multicore auxiliary cables may be suitably connected for successive application of the test voltage to limit the total testing time provided that the sequence of connections ensures that the voltage is applied, for the time given, between each conductor and each other conductor, and between each conductor and the armour, which shall be earthed.

**TABLE G.1 - Test voltage on completed cable**

| Cable voltage designation | Alternating test voltage (r.m.s) | |
|---|---|---|
| V | Between conductors V | Between each conductor and armour V |
| (1) | (2) | (3) |
| 600/1 000 | 3 500 | 3 500 |
| 1 900/ 3 300 | 11 250 | 6 500 |

## APPENDIX H
*(Normative)*

## INSULATION RESISTANCE TEST

After completion of the voltage test given in **12.2.4**, apply a minimum voltage of 500 V d.c. for 1 min and measure the insulation resistance between each conductor and the remaining conductors connected to the armour.

**NOTE :** *For auxiliary cables, the cores may be connected in groups so that the insulation of each conductor is proved with respect to all the others.*

## APPENDIX J
*(Normative)*

## COMPATIBILITY TEST

### J.I GENERAL

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

### J.2 TEST METHOD

Age the sample for 7 days at (80 ± 2) °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 K
*(Informative)*

## GROSS CROSS-SECTIONAL AREA OF ARMOUR

Table **K.1**, Table **K.2**, Table **K.3** and Table **K.4** contain gross cross-sectional areas of armour for use in calculating the maximum fault current permissible for conformity to Chapter 54 of IEE Wiring Regulations **(BS 7671).**

**TABLE K.1 -Gross cross-sectional area of armour wires for single-core 600/1 000 V cables having aluminium wire armour**

| Nominal cross-sectional area of conductor $mm^2$ | Gross cross-sectional area of armour wires | |
|---|---|---|
| | Cables with stranded copper conductors $mm^2$ | Cables with solid aluminium conductors $mm^2$ |
| (1) | (2) | (3) |
| 50 | 39 | 35 |
| 70 | 44 | 40 |
| 95 | 50 | 45 |
| 120 | 72 | 66 |
| 150 | 80 | 72 |
| 185 | 88 | 78 |
| 240 | 98 | 88 |
| 300 | 108 | 96 |
| 400 | 153 | — |
| 500 | 169 | — |
| 630 | 185 | — |
| 800 | 260 | — |
| 1000 | 289 | — |
| **Circular sectoral conductor** | | |
| 380 | — | 138 |
| 480 | — | 150 |
| 600 | — | 163 |
| 740 | — | 225 |
| 960 | — | 255 |
| 1200 | — | 279 |

**TABLE K.2 - Gross cross-sectional area of armour wires for two-core, three-core, four-core- and five-core 600/1 000 V cables having steel wire armour**

| Nominal cross-sectional area of conductor $mm^2$ | Gross cross-sectional area of armour wires | | | | | | |
|---|---|---|---|---|---|---|---|
| | Cables with stranded copper conductors | | | | Cables with solid aluminium | | |
| | Two-core $mm^2$ | Three-core $mm^2$ | Four-core $mm^2$ | Five-core $mm^2$ | Two-core $mm^2$ | Three-core $mm^2$ | Four-core $mm^2$ |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| 1.5 | 15 | 16 | 17 | 19 | — | — | — |
| 2.5 | 17 | 19 | 20 | 22 | — | — | — |
| 4 | 20 | 22 | 34 | 38 | — | — | — |
| 6 | 22 | 34 | 38 | 41 | — | — | — |
| 10 | 40 | 42 | 46 | 68 | — | — | — |
| 16 | 46 | 50 | 72 | 78 | 42 | 46 | 66 |
| 25 | 60 | 66 | 76 | 94 | 54 | 62 | 70 |
| 35 | 66 | 74 | 84 | 106 | 58 | 68 | 78 |
| 50 | 74 | 84 | 122 | 153 | 66 | 78 | 113 |
| 70 | 84 | 119 | 138 | 175 | 74 | 113 | 128 |
| 95 | 122 | 138 | 160 | — | 109 | 128 | 147 |
| 120 | 131 | 150 | 220 | — | — | 138 | 201 |
| 150 | 144 | 211 | 240 | — | — | 191 | 220 |
| 185 | 201 | 230 | 265 | — | — | 215 | 245 |
| 240 | 225 | 260 | 299 | — | — | 240 | 274 |
| 300 | 250 | 289 | 333 | — | — | 265 | 304 |
| 400 | 279 | 319 | 467 | — | — | — | — |

**TABLE K.3 - Gross cross-sectional area of armour wires for 600/1 000 V auxiliary cables with copper conductors having steel wire armour**

| Nominal cross-sectional area of conductor | Gross cross-sectional area of armour wires | | | | | |
|---|---|---|---|---|---|---|
| | Number of cores | | | | | |
| | 7 $mm^2$ | 12 $mm^2$ | 19 $mm^2$ | 27 $mm^2$ | 37 $mm^2$ | 48 $mm^2$ |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 1.5 | 20 | 39 | 45 | 70 | 78 | 90 |
| 2.5 | 34 | 45 | 70 | 84 | 92 | 138 |
| 4 | 40 | 72 | 84 | 128 | 144 | 163 |

**NOTE :** *For a non-preferred number of cores, the gross cross-sectional area of armour will be at least equal to that of the next lowest preferred number of cores.*

**TABLE K.4 — Gross cross-sectional area of aluminium strip armour for single-core, two-core, three-core and four-core 600/1 000 V cables with solid aluminium conductors**

| Nominal cross-sectional area of conductor | Gross cross-sectional area of aluminium strip armour with solid aluminium conductors | | | |
|---|---|---|---|---|
| | Single-core | Two-core | Three-core | Four-core |
| $mm^2$ | $mm^2$ | $mm^2$ | $mm^2$ | $mm^2$ |
| (1) | (2) | (3) | (4) | (5) |
| 16 | — | 23 | 26 | 29 |
| 25 | — | 22 | 27 | 30 |
| 35 | — | 24 | 30 | 34 |
| 50 | 19 | 29 | 60 | 67 |
| 70 | 22 | 56 | 67 | 78 |
| 95 | 26 | 63 | 110 | 123 |
| 120 | 29 | — | 117 | 136 |
| 150 | 31 | — | 130 | 149 |
| 185 | 60 | — | 143 | 214 |
| 240 | 67 | — | 214 | 248 |
| 300 | 74 | — | 237 | 271 |
| **Circular sectoral conductors** | | | | |
| 380 | 117 | — | — | — |
| 480 | 130 | — | — | — |
| 600 | 143 | — | — | — |
| 740 | 156 | — | — | — |
| 960 | 226 | — | — | — |
| 1200 | 248 | — | — | — |

# 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 **L.1**). 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).

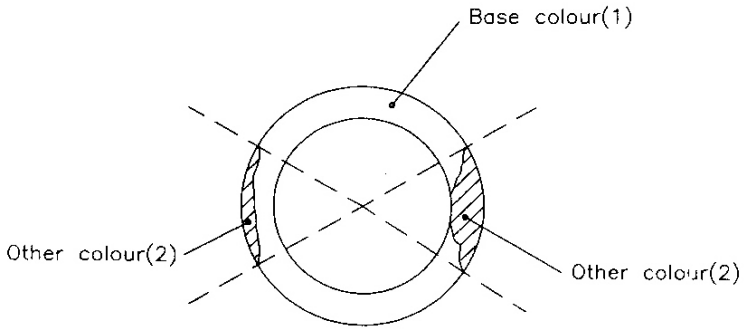


**FIGURE L.1 – Measurement of green and yellow proportion on the insulation of circuit protective conductors**

## 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.

# APPENDIX M
*(Informative)*

# NOTES ON TYPE TESTS

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

## M.2 SAMPLE SELECTION FOR TYPE TESTS

Table **2** 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 (R) tests given in Table **2**.

### M.3 TYPE TESTS

**M.3.1 Compatibility test**
One test should be carried out on each size of cable selected.

### M.4 CHANGE OF MATERIAL

The tests referred to in **M.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

### M.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 N
***(Informative)***

## GUIDE TO USE

### N.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.

### N.2 CABLE SELECTION AND DESIGN

**N.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. **A.2** of Appendix **A** classifies the voltage ratings of cables manufactured to this specification. These ratings should not be exceeded.

**N.2.2** These cables are intended for use within a nominal power frequency of 49 Hz to 51 Hz

**N.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.

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

## N.3 ENVIRONMENT AND APPLICATION

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

**N.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 **BS 6724 :** Electric cables – Thermosetting insulated armoured cables for voltages of 600/1 000 V and 1 900/3 300V, having low emission of smoke and corrosive gases when affected by fire.

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

**N.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).

**N.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;
c) where any exposure to excessive heat is involved;

**N.3.6** If cables in accordance with this specification are exposed to localized heat, solar radiation or high temperature ambient conditions, or there is a possibility of higher soil resistivity, the current carrying capacity will be reduced.

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

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

## N.4 INSTALLATION

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

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

**N.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.

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

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

**N.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.

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

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

## N.5 STORAGE AND HANDLING OF DRUMS

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

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

**N.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.

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

**N.5.5** A detailed guide to the safe handling of cable drums should be available from the cable manufacturers.

## N.6 SCRAP CABLE — INCINERATION

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

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