SRI LANKA STANDARD 1025 PART 6: 2022
(IEC 60851-6: 2012)

METHODS OF TEST FOR WINDING WIRES
PART 6: THERMAL PROPERTIES
(Second Revision)

SRI LANKA STANDARDS INSTITUTION

Sri Lanka Standard
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SRI LANKA

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

Sri Lanka Standard
METHODS OF TEST FOR WINDING WIRES
PART 6: THERMAL PROPERTIES
(Second Revision)

NATIONAL 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 Sri Lanka Standards Institution on 2022-12-28.

This is the first revision of **SLS 1025 Part 6: 2022** and identical with **IEC 60851: Winding wires - Test methods, Part 6: 2012 Thermal properties, Edition 3.0**, published by the International Electrotechnical Commission (IEC).

TERMINOLOGY AND CONVENTIONS

The text of the International Standard has been accepted as suitable for publication without deviation, as a Sri Lanka Standard However, certain terminology and conventions are not identical with those used in Sri Lanka Standards, attention is therefore drawn to the following:

a) Wherever the words “International Standard” appear referring to this standard they should be interpreted as “Sri Lanka Standard”.

b) Wherever the page numbers are quoted they are the page numbers of IEC standard.

c) The comma has been used as a decimal marker. In Sri Lanka Standards it is the current practice to use a full point on the base line as a decimal marker.

CROSS REFERENCES

International Standards	**Corresponding Sri Lanka Standards**
IEC 60851 Winding wires – Test methods	SLS 1025 Methods of test for winding wires
Part 1: General	Part 1: General
Part 3: Mechanical properties	Part 3: Mechanical properties
Part 5: Electrical properties	Part 5: Electrical properties

No corresponding Sri Lanka Standard, for other International Standard listed under reference is not available

IEC 60851-6

Edition 3.0 2012-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Winding wires – Test methods – Part 6: Thermal properties

Fils de bobinage – Méthodes d'essai – Partie 6: Propriétés thermiques

IEC 60851-6:2012

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WINDING WIRES – TEST METHODS –

Part 6: Thermal properties

FOREWORD

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International Standard IEC 60851-6 has been prepared by IEC technical committee 55: Winding wires.

This third edition cancels and replaces the second edition, published in 1996 and constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

– Deletion of Table 2: Heating period in Test 10: Cut-through
– Revision to Test 15, where the temperature index requirements for all winding wire constructions have a common reference.

The text of this standard is based on the following documents:

FDIS	Report on voting
55/1312/FDIS	55/1330/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all the parts in the IEC 60851 series, published under the general title *Winding wires – Test methods*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

This part of IEC 60851 forms an element of a series of standards which deals with insulated wires used for windings in electrical equipment. The series has three groups describing:

1) winding wires – test methods (IEC 60851);
2) specifications for particular types of winding wires (IEC 60317);
3) packaging of winding wires (IEC 60264).

WINDING WIRES – TEST METHODS –

Part 6: Thermal properties

1 Scope

This part of IEC 60851 specifies the following tests:

– Test 9: Heat shock;
– Test 10: Cut-through;
– Test 15: Temperature index;
– Test 21: Loss of mass.

For definitions, general notes on methods of test and the complete series of methods of test for winding wires, see IEC 60851-1.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60172, *Test procedure for the determination of the temperature index of enamelled winding wires*

IEC 60851-3:2009, *Winding wires – Test methods – Part 3: Mechanical properties*

IEC 60851-5:2008, *Winding wires – Test methods – Part 5: Electrical properties* Amendment 1:2011

3 Test 9: Heat shock (applicable to enamelled and tape wrapped wire)

3.1 General

Heat shock is the potential of the wire to withstand temperature exposure after the wire has been stretched and/or wound or bent around a mandrel.

3.2 Specimen

3.2.1 Round wire

A specimen shall be prepared in accordance with:

– 5.1.1.1 of IEC 60851-3:2009 for enamelled wires with a nominal conductor diameter up to and including 1,600 mm;
– 5.2 of IEC 60851-3:2009 for enamelled wires with a nominal conductor diameter over 1,600 mm;
– 5.1.1.4 of IEC 60851-3:2009 for tape wrapped wires with a nominal conductor diameter up to and including 1,600 mm;

– 5.5.4 of IEC 60851-3:2009 for tape wrapped wires with a nominal conductor diameter over 1,600 mm.

3.2.2 Rectangular wire

A specimen shall be prepared in accordance with 5.1.2 of IEC 60851-3:2009, bent however, only flatwise (on the thickness).

3.3 Procedure

The specimen is placed into an oven with forced air circulation for a period of 30 min and at a temperature ± 5 °C specified in the relevant standard. After removal from the oven, the specimen shall be allowed to cool to room temperature and shall then be examined for cracks under a magnification according to Table 1.

Table 1 – Magnification

Wire dimension	Magnification
Round wire of nominal conductor diameter up to and including 0,040 mm	10 to 15 times
Round wire of nominal conductor diameter over 0,040 mm up to and including 0,500 mm	6 to 10 times
Round wire of nominal conductor diameter over 0,500 mm	1 to 6 times
Rectangular wire	6 to 10 times

3.4 Result

Three specimens shall be tested in the case of round wire and two specimens shall be tested in the case of rectangular wire. Any crack detected shall be reported.

4 Test 10: Cut-through (applicable to enamelled round wire with a nominal conductor diameter over 0,100 mm up to and including 1,600 mm and tape wrapped round wire)

4.1 General

Cut-through is expressed as the temperature at which a short circuit occurs between two pieces of wire crossing each other at right angles with a specified load applied to the crossing point.

NOTE In many cases, the cut-through temperature indicates decomposition of the insulation.

4.2 Equipment

The following equipment shall be used:

– metal block of brass or copper provided with means for electrical heating and temperature measurement and control, with two slots for inserting two wire pieces, which cross each other at right angles with the crossing point in the centre of the block, and with a ceramic piston to apply a load on the crossing point, as shown in Figure 1;

– -transformer of at least 100 VA providing an alternating test voltage of (100 ± 10) V, connected to an overcurrent device operating at a current of (5 ± 1) mA, and to a resistor limiting the current to 50 mA maximum.

4.3 Procedure

Two straight pieces of wire shall be inserted into the metal block crossing each other at right angles, with the metal block pre-heated at the temperature specified in the relevant standard.

The temperature shall be measured as close as possible to the crossing point and shall not vary by more than ± 3 °C from the specified value. The crossing point shall lie centrally under the piston. In the case of wire of a nominal conductor diameter of less than 0,200 mm, two straight pieces of wire shall be placed in parallel, side by side, and a third piece shall be placed at right angles across the first two with the crossing points arranged symmetrically to the axis of the piston.

A load as given in Table 2 shall be applied by means of the piston. Immediately thereafter, the test voltage shall be applied between the lower and upper pieces of wire. In the case where two lower pieces are used, they shall be connected. The load and the test voltage shall be applied for 2 min. Three tests shall be made. Any failure shall be reported.

Table 2 – Loads applied to the crossing point

Nominal conductor diameter mm		**Load** N
Over	**Up to and including**	
0,100	0,125	1,25
0,125	0,315	2,20
0,315	0,500	4,50
0,500	0,800	9,00
0,800	1,250	18,00
1,250	1,600	36,00

5 Test 15: Temperature index

The temperature index shall be determined in accordance with IEC 60172 (on unimpregnated specimens).

6 Test 21: Loss of mass (applicable to enamelled round wire)

6.1 General

Loss of mass refers to the wire coating and indicates the degree of curing.

6.2 Specimen

A piece of wire providing not less than 0,5 g of coating shall be cleaned by adequate means without affecting the coating. The specimen shall be heated for 1 h at (130 ± 3) °C in an oven with forced air circulation. After removal from the oven, the specimen shall be placed in a desiccator and allowed to cool to room temperature for at least 30 min. The specimen shall then be weighed to 0,1 mg (M_1).

6.3 Procedure

A crucible shall be conditioned for 2 h at (150 ± 3) °C. The crucible containing the specimen shall then be placed in an oven with forced air circulation for 2 h at a temperature that varies by not more than ± 3 °C from the value specified in the relevant standard. After removal from the oven, the specimen shall be placed in a desiccator and allowed to cool to room temperature for at least 30 min. The specimen shall then be weighed to 0,1 mg (M_2).

The coating shall be removed by suitable chemical means not affecting the conductor and the bare conductor shall be dried for (15 ± 1) min at (150 ± 3) °C, placed in a desiccator and

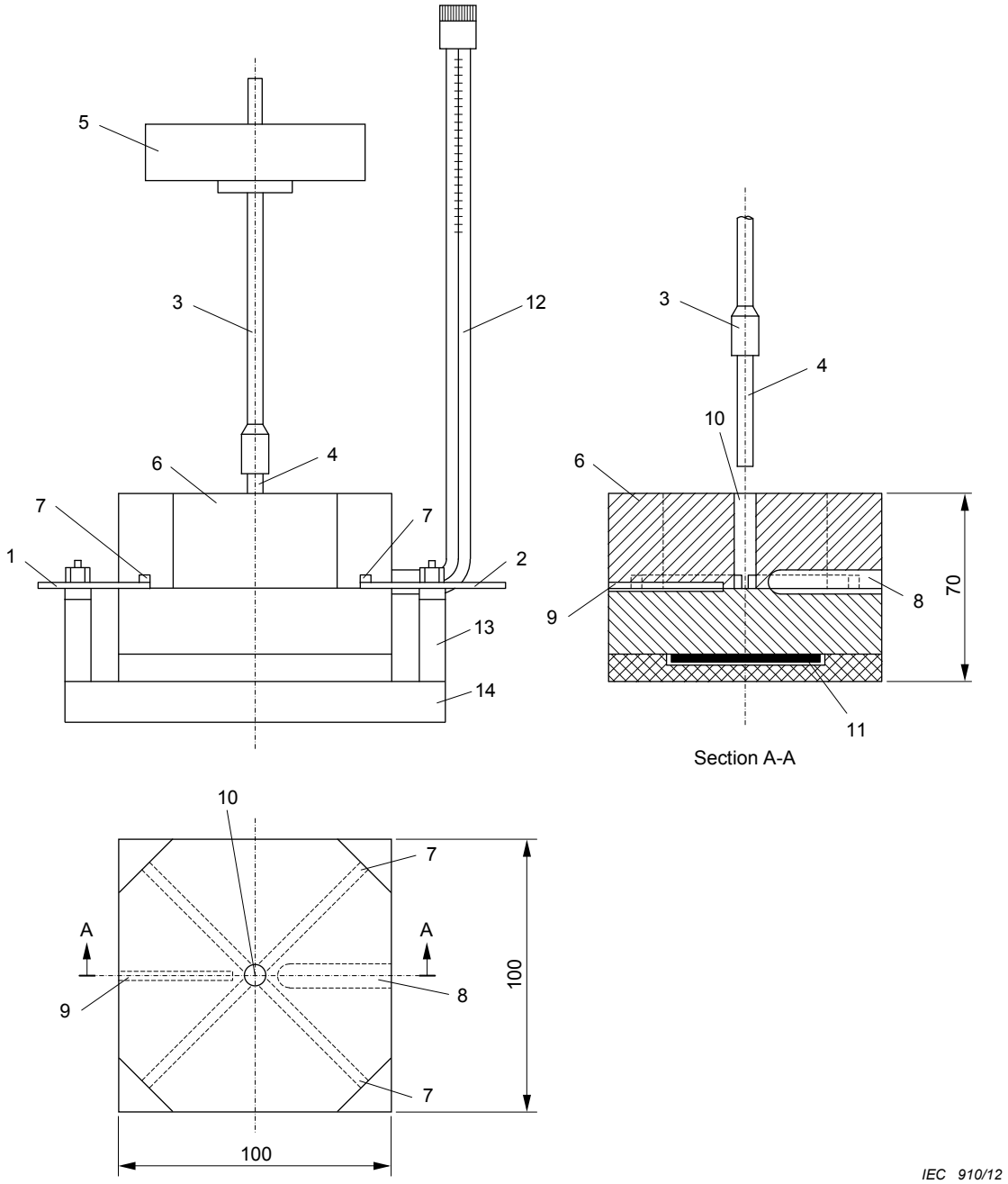
allowed to cool to room temperature for at least 30 min. The bare conductor shall then be weighed to 0,1 mg (M_3).

The loss of mass shall be determined according to the following equation:

$$\Delta M = \frac{M_1 - M_2}{M_1 - M_3} \times 100\,\%$$

Two tests shall be made. The two single values shall be reported.

Dimenssions in millimetres



Key

1. Specimen
2. Specimen
3. Piston
4. Ceramic piston
5. Load
6. Metal block (copper or brass)
7. Solts for insertion of the specimens
8. Hole for insertion of the temperature controling device
9. Hole for insertion of the thermocouple
10. Hole for insertion of the loaded piston
11. Electrical heating element
12. Temperature controlling device
13. Insulated terminals for connection of the wire specimens
14. Insulated base plate

Figure 1 – Compression device for the cut-through test

Annex A
(informative)

High temperature failure test (applicable to enamelled round wire)

A.1 General

High-temperature failure is expressed by the time to failure of a specimen, which is connected to a test voltage while exposed to elevated temperature.

NOTE This test is intended to indicate the performance of wire at temperatures up to 450 °C where overload conditions under voltage stress are possible. It is not practical to use this test for conditions which produce failures in seconds or in a few minutes because the test duration is substantially longer.

A.2 Equipment

The following equipment is used:

– oven with or without forced air circulation providing a maximum service temperature of 450 °C. The temperature should not vary from the set temperature by more than ± 5 °C. The design of the oven ensures that the specimen reaches the set temperature ± 1 % within 3 min. The oven is equipped with appropriate terminals to apply the test voltage in accordance with Table A.1.

– transformer of at least 100 VA providing an alternating test voltage of 50 Hz or 60 Hz according to Table A.1, connected to an overcurrent device operating at a current of (10 ± 5) mA. To avoid over-voltage surges, a capacitor of 1 μF to 2 μF is connected in parallel with the secondary terminals of the transformer. The overcurrent device indicates failure and disconnects a corresponding timer.

Table A.1 – Test voltage

Increase in diameter due to the insulation mm		**Test voltage (a.c.)** V
Over	**Up to and including**	
0,024	0,035	65
0,035	0,050	85
0,050	0,070	115
0,070	0,090	165
0,090	0,130	200

A.3 Specimen

A specimen is prepared in accordance with 4.4 of IEC 60851-5:2008, Amendment 1:2011. Experience has shown that wire with a nominal conductor diameter of about 1 mm and of grade 2 has been found convenient to handle and to test.

A.4 Procedure

The specimen is connected to the terminals and placed in the oven preheated to the temperature selected for the test. The test voltage is immediately applied and the timer started.

Five specimens are tested. The times to failure are reported. A time to failure below 15 min is disregarded.

Bibliography

IEC 60851-1, *Winding wires – Test methods – Part 1: General*

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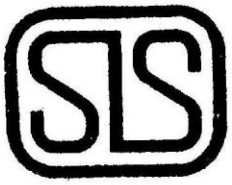

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