

CAN/ULC-IEC 60855-1:2016

Live working – Insulating foam-filled tubes and solid rods – Part 1: Tubes and rods of a circular cross-section

**Prepared by :
International Electrotechnical Commission
Commission Électrotechnique Internationale**



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Live working – Insulating foam-filled tubes and solid rods – Part 1: Tubes and rods of a circular cross-section

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Prepared by :
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TABLE OF CONTENTS

ULC STANDARDS COMMITTEE ON LIVE WORKING	..I
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Requirements	2
4.1 Materials and design	2
4.2 Electrical requirements	2
4.3 Mechanical requirements	2
4.4 Diameters of foam-filled tubes and solid rods	2
4.5 Marking	3
4.6 Packaging	3
5 Tests	3
5.1 General	3
5.2 Type test conditions	4
5.2.1 General	4
5.2.2 Groups and test pieces	4
5.3 Visual and dimensional checks	5
5.3.1 General	5
5.3.2 Visual check	5
5.3.3 Dimensional check	5
5.4 Electrical Tests	5
5.4.1 General	5
5.4.2 Dielectric test before and after exposure to humidity	5
5.4.2.1 Type test	5
5.4.2.1.1 General test conditions	5
5.4.2.1.2 Measurements	6
5.4.2.1.3 Tests before exposure to humidity	15
5.4.2.1.4 Tests after exposure to humidity	15
5.4.2.1.5 Test results	15
5.4.2.2 Alternative tests in case of foam-filled tubes and solid rods having completed the production phase	15
5.4.2.2.1 Alternative dry test	15
5.4.2.2.2 Alternative test after exposure to immersion	17
5.4.3 Wet test	17
5.4.3.1 Type test	17
5.4.3.1.1 General test conditions	17
5.4.3.1.2 Precipitation characteristics	18
5.4.3.1.3 Test results	21
5.4.3.2 Alternative means for insulating foam-filled tubes and solid rods having completed the production phase	21
5.5 Mechanical tests	21
5.5.1 Bending test	21
5.5.1.1 Type test	21

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**CAN/ULC-IEC 60855-1:2016
(IEC 60855-1:2016, IDT)**

Live working – Insulating foam-filled tubes and solid rods – Part 1: Tubes and rods of a circular cross-section

ULC STANDARDS PREFACE

This is the First Edition of the Standard CAN/ULC-IEC 60855-1:2016 (IEC 60855-1:2016, IDT), Live working – Insulating foam-filled tubes and solid rods – Part 1: Tubes and rods of a circular cross-section, an adoption of the international standard by International Electrotechnical Commission, IEC 60855-1:2016 (Second Edition 2016-04).

This Edition of the Standard has been formally approved by the ULC Standards Committee on Live Working and has been approved as a National Standard of Canada by the Standards Council of Canada.

This Standard has been developed in compliance with the requirements of SCC for accreditation of a Standards Development Organization.

In Canada there are two official languages, English and French. All safety warnings must be in French and English. Attention is drawn to the possibility that some Canadian authorities may require additional markings and/or installation instructions to be in both official languages.

This First Edition National Standard of Canada is based on, and now supersedes, the Second Edition of CAN/ULC-60855-09.

Attention is drawn to the possibility that some of the elements of this Canadian standard may be the subject of patent rights. ULC Standards shall not be held responsible for identifying any or all such patent rights.

Requests for interpretation of this Standard should be sent to ULC Standards. The requests should be worded in such a manner as to permit a “yes” or “no” answer based on the literal text of the requirement concerned.

The review and action to revise or reaffirm this Standard will not exceed 5 years from the date of publication, unless the Standard is identified as fitting within a stabilized category, whereby the review will commence within the appropriate time frame set out by ULC Standards.

This Standard is intended to be used for conformity assessment.

Major funding in support of the adoption process of this National Standard of Canada was provided by the Canadian Electricity Association (CEA), whose assistance is acknowledged with thanks.

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1 Scope

This part of IEC 60855 is applicable to *insulating foam-filled tubes* and solid rods, of a circular cross-section, made of synthetic materials with reinforced fibreglass and intended to be used in the manufacture and construction of tools, devices and equipment for carrying out live working on electrical systems operating at voltages above 1 kV.

Foam-filled tubes and solid rods of cross-section other than circular and/or made with material other than synthetic materials with reinforced fibreglass are not covered by this part of IEC 60855.

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 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60060-2, *High-voltage test techniques – Part 2: Measuring systems*

IEC 60212:2010, *Standard conditions for use prior to and during the testing of solid electrical insulating materials*

IEC 61318, *Live working – Conformity assessment applicable to tools, devices and equipment*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61318 and the following apply.

3.1 foam

insulating material composed of closed cells, generally made of polyurethane, used to prevent the ingress and migration of moisture

Note 1 to entry: *Foam* is the inner support to manufacture the *foam-filled tubes* covered by this part of IEC 60855.

[SOURCE: IEC 60050-651:2014, 651-22-03, modified – The note has been changed to refer specifically to the *foam* filled tubes covered by this part of IEC 60855.]

3.2 insulating foam-filled tube

foam-filled tube

tube of uniform circular cross-section supplied in straight lengths, manufactured on a foam and constructed or formed of synthetic insulating rigid material with reinforced fibreglass

3.3 insulating solid rod

solid rod

solid product of uniform circular cross-section supplied in straight lengths, constructed or formed of synthetic insulating rigid reinforced material

[SOURCE: IEC 60050-651:2014, 651-22-04, modified – The term and its definition have been changed to refer specifically to insulating solid rods covered by this part of IEC 60855.]

4 Requirements

4.1 Materials and design

Foam-filled tubes and solid rods shall be made of synthetic insulating material with reinforced fibreglass.

NOTE Yellow, orange and red are the preferred colours to indicate that the material has insulating properties.

If any coating is applied, it may be transparent or coloured.

The *foam* filling shall be bonded to the wall of the insulating tube, and neither the *foam* nor the bond shall be deteriorated during the tests, other than those tests which lead to destruction of the parts. The *foam* filling shall be free of voids, separations, cracks or other defects.

4.2 Electrical requirements

The material and the design of *foam*-filled tubes and solid rods shall have insulating properties.

The external surface of the *foam*-filled tubes and solid rods shall have hydrophobic properties.

4.3 Mechanical requirements

The material and the design of *foam*-filled tubes and solid rods shall have mechanical resistance properties.

4.4 Diameters of foam-filled tubes and solid rods

All measured diameters shall fall within the tolerance limits specified in Table 1.

Table 1 — Specified diameters

Item	External nominal diameter mm	Tolerance on external diameter mm
Solid rod	10	± 1
	15	± 1
Foam-filled tube	32	± 1
	39	$\pm 1,1$
	51	$\pm 1,2$
	64	$\pm 1,3$
	77	$\pm 1,5$

4.5 Marking

Embossed marking is prohibited.

The marking of each *foam*-filled tube and solid rod shall include the following information as a minimum:

- name or trademark of the manufacturer;
- external nominal diameter;
- date of manufacture (month and year) and identification number when available;
- number of the relevant IEC standard (IEC 60855-1).

Other characteristics or information not needed at the work location, like the year of publication of the standard, shall be associated to the product item by other means, such as coded information (bar codes, microchips, etc.) on the product or on its packaging.

The marking shall be clearly legible to a person with normal or corrected vision, without additional magnification. The marking shall be durable and shall not affect the electrical performance of *foam*-filled tubes and solid rods.

4.6 Packaging

The marking of each pack shall include the following information as a minimum:

- name or trademark of the manufacturer;
- external nominal diameter;
- date of manufacture (month and year) and identification number when available;
- number of the relevant IEC standard (IEC 60855-1).

The packaging should reduce abrasive or direct contact with other *foam*-filled tubes or solid rods or any surface that could damage the polished surface.

5 Tests

5.1 General

This part of IEC 60855 provides testing provisions to demonstrate that the *foam*-filled tubes and solid rods comply with the requirements of Clause 4. These testing provisions are primarily intended to be used for type testing for validation of the design input. Where relevant, alternative means (calculation, examination, tests, etc.), are specified within the test subclauses for the purpose of foam-filled tubes and solid rods having completed the production phase (see Annex B).

5.2 Type test conditions

5.2.1 General

To comply with this part of IEC 60855, the design of the product shall fulfil all the type tests listed in Table A.1.

The type tests shall be carried out following the order given in Table A.1.

Each test shall be carried out on each separate test piece in the relevant group.

Any test piece failing to pass any one of the tests mentioned in Annex A shall result in the design being rejected.

For all type tests, environmental conditions in the test room shall comply with the normal atmospheric conditions provided in Table 2 of IEC 60212:2010, at a temperature of between 15 °C and 35 °C, with a relative humidity between 25 % and 75 % (taking into account Note 4 of Table 2 of IEC 60212:2010).

Nevertheless, for the electrical test the atmospheric conditions shall be at temperature between 18 °C and 28 °C, with a relative humidity between 45 % and 75 %.

This part of IEC 60855 covers foam-filled tubes and solid rods for use at temperatures between –25 °C and +55 °C and at a relative humidity between 20 % and 93 %. For foam-filled tubes and solid rods intended to be used in unusual atmospheric conditions (higher or lower temperatures, higher relative humidity), the tests should be more restricting and be carried out in appropriate conditions.

Unless otherwise specified, for all type tests, the tolerance on the dimensions shall be $\pm 0,5$ %.

When a visual check is specified, it shall be understood to be a visual check by a person with normal or corrected vision without additional magnification.

5.2.2 Groups and test pieces

The manufacturer shall supply lengths of foam-filled tubes and solid rods to provide the following groups of test pieces. For each test piece of every group the corresponding length shall be cut at least to 0,1 m from the end of the initial length of solid rod or foam-filled tube provided by the manufacturer.

Group 1: three test pieces of 0,3 m.

Group 2: three test pieces of 1,2 m.

Group 3: three test pieces of 2,5 m in case of foam-filled tube and 2 m in case of solid rod.

Group 4: three test pieces of 1,2 m.

Group 5: (for foam-filled tubes only): three test pieces of length equal to three times the external diameter ± 5 %.

Group 6: three test pieces of 2,5 m.

Group 7: three test pieces of (100 ± 5) mm.

One length of 2 m shall be kept as a reference specimen.

The equipment used to cut the test pieces shall not leave any trace of overheating on the cross-section. The cut shall be clean, showing no signs of tearing of the fibres and shall be made perpendicular to the axis of the foam-filled tube and solid rod.

5.3 Visual and dimensional checks

5.3.1 General

These checks shall be carried out to ensure that the general requirements are fulfilled and that the dimensions comply with the specifications.

5.3.2 Visual check

Initial lengths and test pieces shall be checked visually to verify the elements of marking, the packaging and to detect constructional defects.

There are two levels of inspection to detect constructional defects:

a) A first visual check shall be carried out on each of the initial lengths of foam-filled tube and solid rod provided by the manufacturer before the test pieces are cut from them. This is to detect any surface defects such as obviously faulty bonding between the fibre and the resin, voids underneath the varnish, foreign bodies, protrusions, dirt, bumps or scratches and absence of marks. Any defect shall result in rejection of the initial length.

b) A second visual check shall be carried out on each of the test pieces after they have been cut. This is to detect any internal defects around the visible part of the cross-section, and more particularly, any signs of detachment between the foam and the resin, and foam of poor quality (voids, cracks). Any such defect shall result in rejection of the test piece.

5.3.3 Dimensional check

The purpose of the dimensional check is to verify that diameters comply with the marking, and the tolerances comply with the requirements of 4.4.

The dimensional check shall be carried out on each of the initial lengths, before the test pieces are cut from them, at both ends and in the middle. The difference between any two measured diameters of a given length shall be less than 0,5 mm.

5.4 Electrical Tests

5.4.1 General

Unless otherwise stated, tests shall be carried out using an AC power source at power frequency in accordance with the requirements given in IEC 60060-1. Measuring systems shall comply with IEC 60060-2 unless otherwise specified.

5.4.2 Dielectric test before and after exposure to humidity

5.4.2.1 Type test

5.4.2.1.1 General test conditions

Before the test, each test piece of 300 mm length shall be prepared by cleaning with isopropanol ($\text{CH}_3\text{-CH(OH)-CH}_3$) and then dried in air at room temperature for a period of not less than 15 min.

NOTE It is not the purpose of this part of IEC 60855 to ensure that any relevant legislation and any specific safety instructions regarding the use of isopropanol are fully observed.

The test pieces shall be lightly wiped with a clean dry lint-free cloth and the ends of the test pieces shall be covered with conductive adhesive tape.

Conditioning in a humid atmosphere is carried out in accordance with IEC 60212.

5.4.2.1.2 Measurements

The test assembly shall comply with Figures 1, 2, 3 and 4. The measuring apparatus shall not be less than 2 m from the high voltage source. All measuring leads, the shunt and the optional protective gap shall be shielded and earthed. The test piece shall be mounted at a minimum height of 1 m from the ground on an insulating support. A voltage of 100 kV rms at power frequency shall be applied between the electrodes for 1 min. The AC voltage shall be initially applied at a low value and gradually increased at a constant rate-of-rise of approximately 5 kV/s until the test voltage level is reached. The test period shall be considered to start at the instant the specified voltage is reached.

The current passing through the test piece shall be measured (the guard electrode on the earth side is directly connected to earth). The maximum current recorded during the test is called I .

The phase difference between current and voltage shall be measured as follows:

- current (earth end), by passing it through a known impedance;
- voltage (line end), by means of an appropriate divider.

The minimum phase angle recorded during the test is called ϕ

Before installing the test piece in the test set-up, reference measurements with no test piece present shall be taken and the current and phase angle values recorded. The phase angle value shall be higher than 88°. This blank test will help verify the quality of the test set-up.