IEC 60455-3-8

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Resin based reactive compounds used for electrical insulation – Part 3: Specifications for individual materials Sheet 8: Resins for cable accessories

Composés réactifs à base de résines utilisés comme isolants électriques – Partie 3: Spécifications pour matériaux particuliers Feuille 8: Résines pour accessoires de câble

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

RESIN BASED REACTIVE COMPOUNDS USED FOR ELECTRICAL INSULATION –

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FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

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International Standard IEC 60455-3-8 has been prepared by IEC technical committee 15: Solid electrical insulating materials, in collaboration with working group 11 of Cenelec technical committee 20.

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

FDIS	Report on voting
15/701/FDIS	15/711/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 60455 series, published under the general title *Resin based reactive compounds used for electrical insulation,* 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 60455-3-8 is one of a series which deals with specifications for reactive compounds and their components for electrical insulation. This series consist of three parts:

Part 1: Definitions and general requirements (IEC 60455-1);

Part 2: Methods of test (IEC 60455-2);

Part 3: Specifications for individual materials (IEC 60455-3)

IEC 60455-3-8 consists of one of the sheets comprising Part 3 as follows:

Sheet 8: Resins for cable accessories

RESIN BASED REACTIVE COMPOUNDS USED FOR ELECTRICAL INSULATION –

Part 3: Specifications for individual materials
Sheet 8: Resins for cable accessories

1 Scope

This sheet 8 of IEC 60455-3 gives the requirements for resins for power cable accessories which conform to this specification and meet established levels of performance. However, the selection of a material by a user for a specific application should be based on the actual requirements necessary for adequate performance in that application and not on this specification alone.

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 60093, *Methods of test for volume resistivity and surface resistivity of solid electrical insulating materials*

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

IEC 60243-1, *Electric strength of insulating materials – Test methods – Part 1: Tests at power frequencies*

IEC 60250, *Recommended methods for the determination of the permittivity and dielectric dissipation factor of electrical insulating materials at power, audio and radio frequencies including metre wavelengths*

IEC 60455-2, *Resin based reactive compounds used for electrical insulation – Part 2: Methods of test* [1]

ISO 179 (all parts), *Plastics – Determination of Charpy impact properties*

ISO 527 (all parts), *Plastics – Determination of tensile properties*

ISO 868, *Plastics and ebonite – Determination of indentation hardness by means of a durometer (Shore hardness)*

ISO 1183-1, *Plastics – Methods for determining the density of non-cellular plastics – Part 1: Immersion method, liquid pyknometer method and titration method*

ISO 2555, *Plastics – Resins in the liquid state or as emulsions or dispersions – Determination of apparent viscosity by the Brookfield Test method*

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[1] Third edition to be published.

ISO 4895, *Plastics – Liquid epoxy resins – Determination of tendency to crystallize*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
tendency to crystallization
measurement of the ability of epoxy base resin not to change from a liquid to a solid state at a certain temperature close to water freezing point for a fixed time

3.2
type tests
tests made on materials or components of a cable accessory in order to demonstrate satisfactory performance characteristics to meet the intended application

3.3
outer protection
cured resinous compound to protect the connections from damage by external mechanical forces

4 Designation

Resins for cable accessories are classified according to their application in categories as follows:

Table 1 – Categories of resins

Voltage Class	Function	Characteristic
Low Voltage (**L**)	Outer Protection (**OP**)	Cures in presence of water [a] (**W**)
Medium Voltage (**M**)	Insulation (**I**)	
[a] Low foaming during curing when in contact with water as described in the subclause dealing with curing under water in IEC 60455-2.		

A resin is identified by a combination of categories.

For example: Low voltage compound for outer protection: **L-OP**;
Low voltage compound for insulation, curing in presence of water: **L-I-W**;
Low voltage compound for insulation and mechanical protection: **L-OP-I**.

Tests for type testing are carried out in accordance with each of the resin categories.

Low voltage: 0,6/1,0 (1,2) kV
Medium voltage: 20,8/36 (42) kV

5 Type testing

5.1 General

Tests shall be carried out based on the category of the resins as defined in Table 1. These tests are of such a nature that, once successfully completed, they need not to be repeated unless changes are made in the material, component formulation or manufacturing process, which might change the performance characteristics.

5.2 Sampling

Samples for type testing shall be taken from material stored under conditions prescribed by the manufacturer. The type testing of resins shall be carried out either:

– as a stand-alone test. Samples used for the type test shall be taken from material available as agreed between supplier and user.

– or in combination with an accessory type test. Samples used for the resins type test shall be taken from the same batch as used in the accessory type test. In the event that no material from the same batch is available, then the samples used for the resins type test shall be taken from material available as agreed between supplier and user.

5.3 Preparation and conditioning

5.3.1 General

For all tests, unless otherwise specified, conditioning shall be made in accordance with IEC 60212 using standard atmosphere B.

5.3.2 Individual components prior to mixing

Components (resin and reactive component) shall be individually prepared, conditioned and tested in accordance with the relevant test method as specified in stage 1 of the sequence of tests given in Table 2. Filler, when supplied as a separate item, shall not be tested as a component.

5.3.3 Resin just after mixing (curing stage)

Compounds shall be prepared and mixed according to supplier's instructions and tested as specified in stage 2 of the sequence of tests specified in Table 2.

5.3.4 Cured resin (original)

Compounds shall be prepared according to supplier's instructions and cured for 24 h at room temperature unless otherwise specified in the test method referred to in stage 3 of the sequence of tests given in Table 2. The specimens shall be post-cured at (80 ± 2) °C for 24 h unless otherwise specified in the test method, and then cooled in a desiccator for 24 h at room temperature.

NOTE If degassing is needed, it will be indicated in the relevant test method and the conditions for the degassing will also be indicated.

5.3.5 Cured resin after thermal ageing (dry and wet)

Cured resin shall be prepared according to supplier's instructions and cured for 24 h at room temperature unless otherwise specified in the test method referred to in stage 4 of the sequence of tests given in Table 2. The specimens shall be post-cured at (80 ± 2) °C for 24 h unless otherwise specified in the test method, and then cooled in a desiccator for 24 h at room temperature.

NOTE If degassing is needed, it will be indicated in the relevant test method and the conditions for the degassing will also be indicated.

5.4 Sequence of tests

Tests shall be carried out on the resin in the following four stages, in accordance with Table 2:

Stage 1: Reactive components prior to mixing;

Stage 2: Resin just after mixing;

Stage 3: Cured resin (original);

Stage 4: Cured resin after heat exposure (dry and wet).

5.5 Test report

The test report shall include the following data:

1) resin category and identification;
2) lot number or identification;
3) marking and labelling to Material safety data sheet (MSDS);
4) test results;
5) major test parameters, including conditioning and calibration, if any;
6) processing conditions used to mix the compound;
7) copy of Technical data sheet (TDS) and MSDS.

6 Test methods

International test methods are specified within this standard where available; for those tests where there is no international test method available or the test method needs some adaptation of conditions, the method or specific conditions are specified in IEC 60455-2.

For special applications, this water temperature in Table 2, 4-2 (Wet heat resistance), may be insufficient to ensure the satisfactory performance of the resinous compound. In such cases, upon agreement between manufacturer and user, the compound shall be tested using an increased temperature of 90 °C. The chosen temperature shall be recorded in the test report.

Compliance at 90 °C also includes compliance at 70 °C.

Table 2 – Type tests: test methods and requirements

Number	Property	Test method	Units	Requirement	Remarks
Stage 1 – Reactive components prior to mixing					
1	Viscosity at 5 °C	ISO 2555	Pas	≤ 50	
2	Tendency to crystallization	ISO 4895	-	No turbidity after 7 days	Epoxy resin part only.
Stage 2 – Resins just after mixing (curing stage)					
3	Pot life (0,3 l at 5 °C) Pot life (0,3 l at 40 °C)	IEC 60455-2	min min	< 75 ≥ 5	
4	Curing in presence of water, gas volume Curing in presence of water, physical structure	IEC 60455-2	ml	< 10 No blisters or cracks, small amount of individual bubbles or inclusions acceptable.	For PUR resin type W only. Include picture of cut resin surface with scale in report.
Stage 3 – Cured resins (original)					
5	Density	ISO 1183-1	g/cm^3	Record value	Density should be > 1,05 g/cm^3
6	Impact strength (without notch)	ISO 179	kJ/m^2	≥ 6	No break is also acceptable.
7	Hardness (Shore)	ISO 868		Record value	
8	Tensile strength	ISO 527	MPa	Record value	
9	Elongation at break	ISO 527	%	Record value	
10	Dissipation factor at room temperature [a]	IEC 60250		MI: dissipation factor ≤ 0,1	Using conductive silver varnish as electrode material Using 500 V/mm at 50 Hz
11	Dielectric constant at room temperature [a]	IEC 60250		MI: relative permittivity ≤ 6	Using conductive silver varnish as electrode material Using 500 V/mm at 50 Hz
12	Volume resistivity at room temperature [a]	IEC 60093	Ω cm	MI: $\geq 1 \times 10^{13}$ LI: $\geq 1 \times 10^{11}$	Using conductive silver varnish as electrode material Using 500 V/mm at 50 Hz

[a] According IEC 60212 atmosphere B.