

# SLOVENSKI STANDARD

## SIST HD 307.2 S1:1998

prva izdaja  
oktober 1998

---

---

Specification for solventless polymerisable resinous compounds used for electrical insulation - Part 2: Methods of test (IEC 60455-2:1977 + IEC 60455-2:1977/A1:1982)

### iTeh STANDARD PREVIEW (standards.iteh.ai)

[SIST HD 307.2 S1:1998](https://standards.iteh.ai/catalog/standards/sist/4abb85bd-cf81-4496-932a-195b083914e8/sist-hd-307-2-s1-1998)

<https://standards.iteh.ai/catalog/standards/sist/4abb85bd-cf81-4496-932a-195b083914e8/sist-hd-307-2-s1-1998>

---

ICS 29.035.01

Referenčna številka  
SIST HD 307.2 S1:1998(en)

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

SIST HD 307.2 S1:1998

<https://standards.iteh.ai/catalog/standards/sist/4abb85bd-cf81-4496-932a-195b083914e8/sist-hd-307-2-s1-1998>

UDC: 621.315.616.96/97:678.6/.8.001.2.001.4

KEY WORDS: Electrical insulation; solventless polymerisable resinous compound; method of test

SPECIFICATION FOR SOLVENTLESS POLYMERISABLE  
RESINOUS COMPOUNDS USED FOR ELECTRICAL INSULATION  
PART 2: METHODS OF TEST

Spécification relative aux  
composés résineux polymérisables  
sans solvant utilisés comme  
isolants électriques  
Deuxième partie: Méthodes d'essai

Bestimmungen für  
lösemittelfreie härtbare  
Reaktionsharzmassen für die  
Elektroisolierung  
Teil 2: Prüfverfahren

BODY OF THE HD

The Harmonization Document consists of:

- IEC 455-2 (1977) ed 1 + Amdt 1 (1982); IEC/SC 15C, not appended

This Harmonization Document was approved by CENELEC on 26 June 1986.

The English and French versions of this Harmonization Document are provided by the text of the IEC publication and the German version is the official translation of the IEC text.

According to the CENELEC Internal Regulations the CENELEC member National Committees are bound:

to announce the existence of this Harmonization Document at national level by or before 1987-01-01

to publish their new harmonized national standard by or before 1987-07-01

to withdraw all conflicting national standards by or before 1987-07-01.

Harmonized national standards are listed on the HD information sheet, which is available from the CENELEC National Committees or from the CENELEC Central Secretariat.

The CENELEC National Committees are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxemburg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

© Copyright reserved to all CENELEC members

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

SIST HD 307.2 S1:1998

<https://standards.iteh.ai/catalog/standards/sist/4abb85bd-cf81-4496-932a-195b083914e8/sist-hd-307-2-s1-1998>

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE  
NORME DE LA CEI

INTERNATIONAL ELECTROTECHNICAL COMMISSION  
IEC STANDARD

Publication 455-2  
Première édition — First edition  
1977

---

Spécification relative aux composés résineux polymérisables sans solvant  
utilisés comme isolants électriques

Deuxième partie: Méthodes d'essai

**ITeH STANDARD PREVIEW**

**(standards.iteh.ai)**

Specification for solventless polymerisable resinous compounds

used for electrical insulation

<https://standards.iteh.ai/catalog/standards/sist/81-4496-932a-195b083914e8/sist-hd-307-2-s1-1998>

Part 2: Methods of test

---



Droits de reproduction réservés — Copyright - all rights reserved

Aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'éditeur.

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

Bureau Central de la Commission Electrotechnique Internationale

1-3, rue de Varembe  
Genève, Suisse

Prix  
Price Fr.s. 50.—

## CONTENTS

	Page
FOREWORD . . . . .	5
PREFACE . . . . .	5
INTRODUCTION . . . . .	7
Clause	
1. Scope . . . . .	7
2. General notes on tests . . . . .	7
SECTION ONE — TESTS FOR MATERIALS BEFORE CURE	
3. Density . . . . .	7
4. Viscosity . . . . .	9
5. Needle penetration with respect to time . . . . .	9
6. Softening temperature . . . . .	11
7. Ash content . . . . .	13
8. Filler content . . . . .	15
9. Acid-value of polyester resins . . . . .	15
10. Hydroxyl content of polyester resins . . . . .	17
11. Determination of volatile content at elevated temperatures . . . . .	17
12. Epoxy content of epoxy resins . . . . .	17
13. Halogen content . . . . .	19
14. Shelf-life . . . . .	19
15. Pot-life . . . . .	19
16. Gel-time . . . . .	19
17. Exothermic temperature peak . . . . .	21
18. Curing in thick layers . . . . .	21
19. Curing in thin layers . . . . .	23
20. Total shrinkage . . . . .	25
21. Special tests for solventless varnishes . . . . .	25
SECTION TWO — TESTS FOR MATERIALS IN THE CURED FORM	
22. General notes on test pieces . . . . .	25
23. Density . . . . .	27
24. Flexural strength . . . . .	27
25. Tensile strength and elongation at break . . . . .	27
26. Impact strength . . . . .	27
27. Bond strength . . . . .	29
28. Hardness . . . . .	29
29. Coefficient of linear thermal expansion . . . . .	29
30. Thermal conductivity . . . . .	31
31. Thermal shock . . . . .	31
32. Temperature of deflection under load . . . . .	33
33. Flammability . . . . .	35
34. Water absorption . . . . .	35
35. Water vapour permeability . . . . .	35
36. Surface resistivity and volume resistivity . . . . .	35
37. Dissipation factor and permittivity . . . . .	35
38. Electric strength . . . . .	35
39. Electrolytic corrosion . . . . .	37
40. Tracking resistance . . . . .	37
41. Discharge resistance . . . . .	37
42. Thermal endurance . . . . .	37
FIGURES . . . . .	38

STANDARD PREVIEW  
(standards.iteh.ai)

SIST HD 307.2 S1:1998  
<https://standards.iteh.ai/catalog/standards/sist/4db655c8-1086-932a-195b083914e8/sist-hd-307-2-s1-1998>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SPECIFICATION FOR SOLVENTLESS POLYMERISABLE RESINOUS  
COMPOUNDS USED FOR ELECTRICAL INSULATION

Part 2: Methods of test

FOREWORD

- 1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.
- 2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.
- 3) In order to promote international unification, the IEC expresses the wish that all National Committees should adopt the text of the IEC recommendation for their national rules in so far as national conditions will permit. Any divergence between the IEC recommendation and the corresponding national rules should, as far as possible, be clearly indicated in the latter.

PREFACE

This standard has been prepared by Sub-Committee 15C, Specifications, of IEC Technical Committee No. 15, Insulating Materials.

A first draft was discussed at the meeting held in Zurich in 1973. As a result of this meeting, the draft, Document 15C(Central Office)43, was submitted to the National Committees for approval under the Six Months' Rule in March 1975.

The following countries voted explicitly in favour of publication:

Argentina	Finland	South Africa (Republic of)
Australia	France	Spain
Austria	Israel	Sweden
Belgium	Italy	Switzerland
Bulgaria	Japan	Turkey
Canada	Netherlands	United Kingdom
China	Poland	United States of America
Czechoslovakia	Romania	Yugoslavia
Denmark		

Other IEC publications quoted in this standard:

Publications Nos.	93:	Recommended Methods of Test for Volume and Surface Resistivities of Electrical Insulating Materials.
	112:	Recommended Method for Determining the Comparative Tracking Index of Solid Insulating Materials under Moist Conditions.
	216-1:	Guide for the Determination of Thermal Endurance Properties of Electrical Insulating Materials, Part 1: General Procedures for the Determination of Thermal Endurance Properties, Temperature Indices and Thermal Endurance Profiles.
	216-2:	Part 2: List of Materials and Available Tests.
	243:	Recommended Methods of Tests for Electric Strength of Solid Insulating Materials at Power Frequencies.
	249-3:	Metal-clad Base Materials for Printed Circuits, Part 3: Special Materials Used in Connection with Printed Circuits.
	250:	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.
	343:	Recommended Test Methods for Determining the Relative Resistance of Insulating Materials to Breakdown by Surface Discharges.
	426:	Test Methods for Determining Electrolytic Corrosion with Insulating Materials.
	464-2:	Specification for Insulating Varnishes Containing Solvent, Part 2: Test Methods.

# SPECIFICATION FOR SOLVENTLESS POLYMERISABLE RESINOUS COMPOUNDS USED FOR ELECTRICAL INSULATION

## Part 2: Methods of test

### INTRODUCTION

This standard is one of the series which deals with solventless polymerisable resinous compounds used for electrical insulation. The series will have the following three parts:

Part 1: Definitions and general requirements.

Part 2: Methods of test.

Part 3: Specifications for individual materials (under consideration).

### 1. Scope

This Part 2 of the standard contains the test methods to be used in testing solventless polymerisable resinous compounds used for electrical insulation to meet the requirements prescribed in the specification sheets of Part 3.

iteh STANDARD PREVIEW  
(standards.iteh.ai)

### 2. General notes on tests

- Unless otherwise specified, the number of tests shall be two.
- When performing tests according to Clauses 3, 4, 5, 6, 7 and 8, it shall be specified clearly whether the measurement is carried out on a resinous compound or on a mixture prepared for use. When mixtures prepared for use are tested, it should be borne in mind that these may have a short pot-life and precautions should be taken to maintain the mixture at the right temperature and to terminate the determination within a certain time.

## SECTION ONE — TESTS FOR MATERIALS BEFORE CURE

### 3. Density

#### *Pyknometer method*

The density of a liquid resin can be determined by weighing a sample of the resin in a wide-mouth, 25 cm<sup>3</sup> minimum-capacity pyknometer at 23 ± 2 °C to the nearest 5 mg and dividing the mass of the resin by the mass of an equal volume of distilled water at the same temperature.

Report the result in g/cm<sup>3</sup>.

For higher viscosity resins, other methods may be more convenient.

Notes 1. — A more detailed description of the pyknometer method is to be found in ISO Standard 1675.

2. — Instead of the pyknometer method, a displacement-of-liquid method may also be used.



#### 4. Viscosity

The viscosity shall be determined with a suitable viscometer at  $23 \pm 0.5$  °C. When specified in Part 3, other temperatures and other tolerances on the temperatures may be used. The viscometer shall be kept calibrated over the range of viscosity of the liquid resins to be tested by means of oils verified as to absolute viscosity at 23 °C.

A calibration curve showing the relation between viscosity in absolute units and corresponding instrument reading shall be used.

Examples of viscometers that can be used are rotating viscometers and efflux type viscometers.

##### 4.1 Rotating type viscometer

A description of the determination of viscosity by means of the Brookfield viscometer is given in ISO Standard 2555. This method is also applicable for non-newtonian liquids.

##### 4.2 Efflux type viscometer

When flow cups are used, the type and the method of test shall be as specified in ISO Standard 2431.

All disputes shall be resolved using calibrated viscometers to measure the viscosity in centipoises.

#### 5. Needle penetration with respect to time

**ITeH STANDARD PREVIEW**  
**(standards.iteh.ai)**

##### 5.1 Test apparatus

###### 5.1.1 Penetration needle

[SIST HD 307.2 S1:1998](https://standards.iteh.ai/catalog/standards/sist/4abb85bd-cf81-4496-932a-8391552e381d/sist/307.2:1998)

<https://standards.iteh.ai/catalog/standards/sist/4abb85bd-cf81-4496-932a-8391552e381d/sist/307.2:1998>

A steel needle, as shown in Figure 1, page 38, complying with the following requirements: the diameter shall be 1.00 mm to 1.20 mm and the needle shall be symmetrically tapered at one end to a cone approximately 6.35 mm in height and of which the angle of inclination shall be within the range of  $8^{\circ} 40'$  to  $9^{\circ} 40'$ . After tapering, the needle shall be "blunted" by grinding to form a truncated cone, the smaller base of which shall be from 0.14 mm to 0.16 mm in diameter. The length of the frustrum shall be 5.0 mm to 5.8 mm. The finished needle shall be hardened and highly polished; it shall be mounted coaxially and centrally in a brass shank approximately 3.0 mm in diameter.

###### 5.1.2 Penetrometer

Any suitable penetrometer which permits the needle holder to move vertically in the guide without appreciable friction, and which is capable of indicating the depth of penetration to the nearest 0.1 mm. The sides of the guide shall be vertical. The total moving mass (needle, needle-holder and superimposed mass) shall be  $100 \pm 0.25$  g.

###### 5.1.3 Sample containers

Flat-bottomed, having a capacity of 20 cm<sup>3</sup>, a base of 25 mm diameter, a top of 37 mm diameter and a depth of 32 mm.

###### 5.1.4 Timing device

An audible second-counter is required for use with a hand-operated penetrometer. The timing device shall be used in such a way that the time of penetration is  $5.0 \pm 0.2$  s.

## 5.2 Test procedure

Take a sufficient amount of each resinous compound so that, when used in the proportions recommended by the supplier, the mixture is sufficient to fill the container. Allow each part to stand at  $23 \pm 5$  °C for one hour. Note the time and mix the two parts thoroughly, with gloved hands, according to the directions of the supplier. Press the mixture into one of the containers, care being taken to ensure that the mass of resinous compound is void-free and that the top surface is level.

Measure the penetration 5 min after beginning the mixing operation and at intervals until the penetration is only 0.5 mm, making each determination at least 4 mm from the edge of the container and at least 4 mm from any previously-made hole.

To measure the penetration, load the needle-holder with the mass required to make a total moving mass of  $100 \pm 0.25$  g.

Lower the needle slowly until the tip just makes contact with the surface of the sample; note the penetrometer dial reading or bring the pointer to zero (depending on the type of penetrometer used). Quickly release the needle-holder and leave free for  $5 \pm 0.2$  s. Read and record the depth of penetration in tenths of a mm from the scale reading. Observe the container as the needle is applied: if any movement of the container is noted, ignore the determination.

Repeat the procedure on two further freshly mixed samples.

## 5.3 Result

Plot a graph of penetration against time for each sample.

**iTeh STANDARD PREVIEW**  
(standards.iteh.ai)

[SIST HD 307.2 S1:1998](https://standards.iteh.ai/catalog/standards/sist/4abb85bd-cf81-4496-932a-195b083914e8/sist-hd-307-2-s1-1998)

<https://standards.iteh.ai/catalog/standards/sist/4abb85bd-cf81-4496-932a-195b083914e8/sist-hd-307-2-s1-1998>

## 6. Softening temperature

### 6.1 Method using a heating plate

#### 6.1.1 Test apparatus

Heating plate according to Kofler (see Figure 3, page 39). The plate is heated in such a way that there is a temperature gradient from one side to the other, generally from room-temperature up to  $250$  °C —  $300$  °C. A temperature scale is placed along the heated plate; this temperature scale shall be calibrated by means of materials having known melting-points. Corrections for variations in room-temperature can be made by means of an adjustment knob. A draught screen shall be used.

#### 6.1.2 Test specimen

Small amount of the material to be tested in powder form.

#### 6.1.3 Test procedure

Switch on the heating for a period of 40 min to allow the apparatus to reach temperature equilibrium. Check the temperature indication of the apparatus by means of the materials with known melting-points, choosing one having a melting-point close to that of the material under test.

Readjust the temperature indicator of the test apparatus.

Spread a small amount of material on the heated plate of the test apparatus in such a way that a small and thin ribbon of powder covers a temperature range of about 20 °C, the expected melting-point to be approximately in the middle of that range. After approximately 1 min, brush the powder off the heated strip towards the low-temperature end, for example, to the right. Brushing towards the higher temperature (to the left) will cause smudging of the hot strip. The pointer is set against the position which still shows traces of baked-on powder. This is the softening point.

Three determinations shall be made.

#### 6.1.4 Result

The result is the central value of the three determinations. The other values are also reported.

#### 6.2 Other methods

Alternatively, the ring-and-ball method as described in an ISO Standard (under consideration).

*Note.* — Alternative methods are under consideration.

### 7. Ash content

## iTeh STANDARD PREVIEW (standards.iteh.ai)

#### 7.1 Test apparatus

Crucibles, muffle furnace, analytical balance, drying chamber (any typical glass desiccator containing dry CaCl<sub>2</sub>), crucible tongs. [SIST HD 307.2 S1:1998](https://standards.iteh.ai/catalog/standards/sist/4abb85bd-cf81-4496-932a-195b083914e8/sist-hd-307-2-s1-1998)

<https://standards.iteh.ai/catalog/standards/sist/4abb85bd-cf81-4496-932a-195b083914e8/sist-hd-307-2-s1-1998>

#### 7.2 Test specimens

Three specimens of approximately 10 g.

#### 7.3 Test method

Three numbered crucibles of sufficient size for 10 g of specimen are heated in a muffle furnace for 1 h at  $900 \pm 25$  °C. They are removed from the furnace by means of crucible tongs and placed immediately in a drying chamber until cooled to ambient temperature.

After removal from the drying chamber, they are immediately weighed on an analytical balance. Their mass is recorded to the nearest milligram. Approximately 10 g of specimen material is weighed into each of them and the exact mass is recorded. The crucibles are covered and placed in the muffle furnace previously heated up to 220 °C-250 °C. The temperature is raised progressively to  $900 \pm 25$  °C and kept at this value for 2 h. If necessary, the lid of the crucible may be removed during the heating and replaced before the end of the heating period. At the end of the two-hour period, the crucibles are removed and placed in the drying chamber until they are cooled to room-temperature. They are then immediately weighed to the nearest milligram.

Alternatively, other quantities, other times and other temperatures will be specified in Part 3, for example, 5 g, 30 min at 600 °C.