



SLOVENSKI STANDARD
SIST EN 60465:2002

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Specification for unused insulating mineral oils for cables with oil ducts (IEC 60465:1988)

Specification for unused insulating mineral oils for cables with oil ducts

Anforderungen an ungebrauchte Isolieröle auf Mineralölbasis für Kabel mit Ölkanälen

Spécification pour huiles minérales isolantes neuves pour câbles à circulation d'huile

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EUROPEAN STANDARD
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EN 60465

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Specification for unused insulating mineral oils for cables with oil ducts

(IEC 465:1988)

Spécification pour huiles minérales isolantes
neuves pour câbles à circulation d'huile
(CEI 465:1988)

Anforderungen an ungebrauchte Isolieröle auf
Mineralölbasis für Kabel mit Ölkanälen
(IEC 465:1988)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Foreword

The CENELEC questionnaire procedure, performed for finding out whether or not the International Standard IEC 465:1988 could be accepted without textual changes, has shown that no CENELEC common modifications were necessary for the acceptance as European Standard. The reference document was submitted to the CENELEC members for formal vote and was approved by CENELEC as EN 60465 on 1 May 1990 with exception of Austria and Switzerland.

The following dates were fixed:

- latest date of announcement of the EN at national level (doa) 1990-12-15
- latest date of publication of an identical national standard (dop) 1991-06-15
- latest date of withdrawal of conflicting national standards (dow) 1991-06-15

Endorsement Notice

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Section 1. General

1 Scope

1.1 This standard covers specifications and test methods for unused mineral insulating oils, as delivered, intended for use in cables with oil ducts. These include hollow core cables, pipe type cables and any others in which provision is made for the oil to flow. Oils concerned are obtained by distillation and refining of petroleum. Oils with and without additives are within the scope of this standard.

1.2 This standard does not apply to mineral insulating oils used in transformers, switchgear, capacitors and similar equipment or to hydrocarbon insulating liquids obtained by synthesis.

1.3 For the purposes of this standard three grades of oil are considered: class I, class II and class III, based on the values of certain physical properties namely: viscosity, flash-point and pour-point.

2 Definition

2.1 additive

a suitable substance, which is deliberately added to an insulating liquid in small proportion in order to improve certain characteristics

3 Identification and general delivery requirements

3.1 Oil is normally delivered in road tankers or rail tank-cars or in drums, which shall be specially cleaned for this purpose.

3.2 The drums and containers of oil samples shipped by the oil supplier shall carry at least the following markings:

- number of this standard;
- supplier's designation;
- class of oil.

3.3 Each oil delivery shall be accompanied by a document from the supplier specifying at least: supplier's designation, oil class and the nature of any additive present.

If an anti-oxidant additive or a pour-point depressant is included in an oil formulation this shall be done by agreement between purchaser and supplier; in this case the nature of both additives shall be made known to the purchaser.

NOTE The purchaser may require that no major changes in crude oil type or refining process may be made without the purchaser being informed.

4 Sampling

Sampling shall be carried out in accordance with the procedure described in IEC Publication 475.

Section 2. Test methods

5 Test methods

5.1 Appearance

Appearance shall be evaluated by examining a representative sample of the liquid in transmitted light under a thickness of approximately 10 cm, at ambient temperature.

5.2 Density

Any recognized test method may be used. The method to be used in case of dispute shall be that given in ISO Standard 3675.

Density shall be measured at 20 °C or converted to 20 °C by the formula:

$$\rho_{20} = \rho_t [1 + X(t - 20)]$$

where:

ρ_{20} is the density at 20 °C

t is the temperature in degrees Celsius

ρ_t is the density measured at temperature t

X is a correction factor: 65×10^{-5} (approximate value) For greater accuracy the correction factor listed in ISO Recommendation R/91-1 should be used.

5.3 Kinematic viscosity

Kinematic viscosity shall be measured by the method given in ISO Standard 3104.

5.4 Flash-point

Flash-point shall be determined either with a closed cup or with an open cup.

5.4.1 Closed cup method

Flash-point shall be determined according to ISO Standard 2719.

5.4.2 Open cup method

Flash-point shall be determined according to ISO Standard 2592.

5.5 Pour-point

Pour-point shall be determined according to ISO Standard 3016.

5.6 Cloud-point

Cloud-point shall be determined according to ISO Standard 3015.

5.7 Neutralization value

5.7.1 Reagents

- a) Standard alcoholic potassium hydroxide (KOH) solution 0,1 mol/l.
- b) Toluene, sulphur-free.
- c) Azeotropic ethanol (boiling-point 78,2 °C).
- d) Standard hydrochloric acid solution (HCl) 0,1 mol/l.

e) Alkali blue indicator solution: 2 g of alkali blue 6 B are dissolved in 100 ml of azeotropic ethanol containing 1 ml hydrochloric acid 0,1 mol/l. After 24 h, titrate to check whether the indicator has been sufficiently sensitized. The indicator is satisfactory if the colour changes distinctly from blue to red, comparable to that of 10 % solution of cobalt nitrate $[\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}]$.

Should sensitization be insufficient, repeat the addition of 0,1 mol/l HCl and check again after 24 h. Continue until sensitization is satisfactory. Filter and store in a brown bottle in the dark.

5.7.2 Procedure

Weigh 20 g of the sample to the nearest 0,05 g into a 250 ml stoppered conical flask.

To a mixture of 60 ml of toluene and 40 ml of ethanol in a second conical flask add 2 ml of indicator solution. Neutralize the solution with 0,1 mol/l KOH alcoholic solution until a red colour comparable to that of a solution of 10 % cobalt nitrate $[\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}]$ is obtained and persists for at least 15 s.

Add this solution to the sample, swirl and immediately titrate at a temperature not above 25 °C with 0,1 mol/l KOH solution to the above end-point.

The neutralization value is calculated from the expression:

$$\text{Neutralization value (mg KOH/g)} = \frac{V \times N \times 56,1}{P}$$

where:

- V = is the number of millilitres of 0,1 mol/l KOH used in the titration
- N = is the concentration of the KOH solution in mol/l
- P = is the mass of the oil sample in grams

5.8 Water content

Water content shall be determined according to IEC Publication 814 or IEC Publication 733.

5.9 Corrosive sulphur

Corrosive sulphur shall be determined according to ISO Standard 5662.

5.10 Anti-oxidant additives

Methods for the detection and quantitative determination of specified anti-oxidant additives are described in IEC Publication 666.

5.11 Breakdown voltage

5.11.1 Breakdown voltage shall be determined according to IEC Publication 156.

5.11.2 When breakdown voltage is to be determined on a treated oil sample the following procedure shall be used to remove moisture and particulate contaminants present in the original sample.

A sufficient oil volume is heated to approximately 60 °C, then filtered hot under a vacuum of about 2,5 kPa through a sintered glass filter of grade 10 porosity (ISO Standard 4793). The filtrate is cooled in a desiccator and used immediately to determine breakdown voltage.

NOTE Filtration can be done equally well at ambient temperature, but under lower pressure (e.g. 0,5 kPa).

5.12 Dielectric dissipation factor

Dielectric dissipation factor shall be determined at 90 °C according to IEC Publication 247.

NOTE When oil as delivered shows a dielectric dissipation factor exceeding the limits specified in Sheet 1, a repeat measurement made on a sample treated as indicated in Sub-clause 5.11.2 will show if contaminants are removed by a relatively mild treatment.

5.13 Stability under electrical stress and ionization (gassing)

The gassing shall be determined by Method A of IEC Publication 628.

Section 3. Individual specifications

6 General remark

Precision data given in the specified methods in this standard are to be used solely as a guide to the expected agreement between duplicate measurements of the property and are not to be regarded as tolerances applicable to the limits specified in Sheet 1.

7 Sheet 1: Specifications for unused insulating mineral oils for cables with oil ducts

Mineral insulating oils for cables with oil ducts complying with this standard shall meet the limiting values specified in Sheet 1 when tested in accordance with the methods specified in Clause 5. These limiting values apply only to unused oil, as delivered, prior to its introduction into cable.

Sheet 1: Specifications for unused insulating mineral oils for cables with oil ducts

Property	Test method (sub-clause)	Permissible value		
		Class I	Class II	Class III
<u>Physical</u>				
— Appearance	5.1	Clear, no suspended matter or sediment		
— Density at 20 °C (kg/dm ³)	5.2		Max. 0,900	
— Kinematic viscosity at 40 °C (mm ² /s)	5.3	Min. 13	Min. 6,5 – Max. 13	Max. 6,5
— Flash-point: ^a				
— closed cup (°C)	5.4.1	Min. 140	Min. 125	Min. 100
— open cup (°C)	5.4.2	Min. 150	Min. 135	Min. 110
— Pour-point (°C)	5.5	Max. – 30	Max. – 30	Max. – 40
— Cloud-point (°C) ^b	5.6		Max. 20	
<u>Chemicals</u>				
— Neutralization value (mg KOH/g)	5.7		Max. 0,03	
— Water content (mg/kg)	5.8		^c	
— Corrosive sulphur	5.9		Non-corrosive	
— Anti-oxidant additives (% by mass)	5.10		^d	
<u>Electrical</u>				
— Breakdown voltage (kV)	5.11		Min. 40 ^e	
— Dielectric dissipation factor			Max. 0,002	
tg _δ at 90 °C and 50 Hz or 60 Hz	5.12			
— Stability under electrical stress and ionization	5.13			
Gassing tendency, absorption (mm ³ /min)	Method A		Min. 2	
^a Only one method need be used. ^b Only a slight opalescence, no separation of solid products. ^c No requirement for water content on delivery is included as it is usual in most applications to process the oil before use. However, in some countries, it is usual for standards to specify maximum water content on delivery; in this case the water content should be less than 30 mg/kg for bulk delivery and less than 40 mg/kg for drum delivery. ^d See Sub-clause 3.3. ^e Required value for mineral oil delivered in bulk. For delivery in drums the following value may be accepted: breakdown voltage, kV: min. 30.				