



SLOVENSKI STANDARD
SIST HD 464 S1:1997/A3:1997
01-oktober-1997

Dry-type power transformers

Dry-type power transformers

Trockentransformatoren

Transformateurs de puissance de type sec

Ta slovenski standard je istoveten z: HD 464 S1:1988/A3:1992

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ICS:

29.180 Transformatorji. Dušilke Transformers. Reactors

SIST HD 464 S1:1997/A3:1997 **en**

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HARMONIZATION DOCUMENT

HD 464 S1/A3

DOCUMENT D'HARMONISATION

HARMONISIERUNGSDOKUMENT

November 1992

UDC 621.314.211.016.2-777.001.2.001.4.12 (083.71)

Descriptors: Dry-type power transformers, requirements, testing,
properties, definitions

ENGLISH VERSION

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This amendment A3 modifies the Harmonization Document HD 464 S1:1988. It was approved by CENELEC on 1992-06-16. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for implementation of this amendment on a national level.

Up-to-date lists and bibliographical references concerning national implementation may be obtained on application to the Central Secretariat or to any CENELEC member.

This amendment exists in three official versions (English, French and German).

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

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

Page 2
HD 464 S1:1988/A3:1992

FOREWORD

During the meeting held in Brussels on 1-2 June 1989, CENELEC Technical Committee TC 14, Power transformers, decided to group possible tests to prove suitability to fire behaviour classes not in HD 464 S1 but in an annex to that document.

The text, prepared by Working Group WG 1 of TC 14, was submitted to the Unique Acceptance Procedure (UAP) as prAC and was approved by CENELEC as amendment A3 to HD 464 S1 on 16 June 1992.

The following dates were fixed:

- latest date of announcement of the amendment at national level (doa) 1993-03-01
- latest date of publication of harmonized national standard (dop) 1993-09-01
- latest date of withdrawal of conflicting national standards (dow) 1993-09-01

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ANNEX ZC

TRIAL USE GUIDE FOR SPECIAL TESTS

TO PROVE SUITABILITY TO FIRE BEHAVIOUR CLASSES

ZC.1 General

The test conditions laid down in the following clauses are meant to be a guide for a learning period to obtain testing experience and to verify the usefulness of this kind of tests by comparison with the behaviour of dry-type transformers in service.

To optimize the fire behaviour of a transformer, it is necessary to minimize its emission of toxic substances and opaque smoke in the event of burning. The use of halogenic materials should be avoided. Moreover, the transformer shall not contribute significantly to the thermal energy of an external fire.

The fire behaviour may be assessed by the following test procedure which consists of two parts (clauses ZC.2 and ZC.3), both applicable to classes F1 and F2.

ZC.2 Checking of corrosive and harmful gas emission

The emission of corrosive and harmful gases shall be checked on small quantities of the combustible materials present in the transformer.

In principle, the tests should be able to detect the presence of components such as hydrogen chloride (HCl), hydrogen cyanide (HCN), hydrogen bromide (HBr), hydrogen fluoride (HF), sulphur dioxide (SO₂), formaldehyde (HCOH).

The details of test procedures and acceptable limits may be agreed between purchaser and manufacturer, unless specified in European or national regulations.

ZC.3 Fire test

The modalities for checking the fire behaviour of a transformer are a matter of agreement between manufacturer and purchaser. The method described in the present HD is recommended.

ZC.3.1 Test object

The test is carried out on one complete phase of a transformer comprising HV and LV coils, core leg and insulation components, without enclosure, if any.

The core leg may be replaced by material of approximately similar dimensions and thermal behaviour as the original core leg. The yoke will not be considered.

The outer coil diameter of the windings to be tested shall be between 400 and 500 mm.

Note: Windings with larger or smaller dimensions as well as coils with non-circular shape may be tested by agreement.

ZC.3.2 Validity of the test

The results of a fire test are valid for all transformers of lower power rating having the same or lower U_m , manufactured with the same materials and based on the same design criteria. The extrapolation of the results to transformers having rated power, U_m , and winding dimension greater than those of the tested one (400 to 500 mm) may be agreed upon between manufacturer and purchaser.

ZC.3.3 Testing installation

SIST HD 464 S1:1997/A3:1997

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a) Test chamber

The proposed test chamber is based on the one described in IEC 332-3 (related to cables) (see fig. 1). The walls are made of heat resisting steel with a thickness of 1,5 to 2,0 mm, thermally insulated, so as to give a heat transfer of approx. $0,7 \text{ W/m}^2 \text{ K}$. A fire resistant window should be fitted if possible. The main dimensions of the test chamber (see fig. 1) are:

- height: 2,5 to 4 m
- width: 1 m
- depth: 2 m

The chamber shall be equipped with a chimney of approx. 0,5 m inner diameter and an air-inlet duct of approx. 0,35 m inner diameter. The difference in level between air inlet into the test-chamber and gas outlet at the chimney shall be approx. 9 m. The air is admitted under the test chamber through a grating (0,40 x 0,80) m^2 and escapes through an opening of approximately 0,3 m^2 into the chimney.

Within the chimney there shall be a measuring section of 0,5 m diameter and a length of at least 0,6 m, the lower end of which is situated 1,5 to 2,0 m above the level of the roof of the test-chamber.

Within the air-inlet duct there shall be a measuring section of 0,35 m diameter and a length of at least 0,4 m in a distance of at least 1 m to the air inlet into the test chamber and to the air-inlet to the duct.

A throttle valve shall be provided in the chimney and/or in the air inlet unless forced air flow is provided. The test-chamber should be built in such a way that the influence of wind on the amount of entering air be negligible.

b) Ignition sources (see fig. 2)

The main source of heat is ethyl alcohol (caloric value 27 MJ/kg) burning in a container which may be subdivided by concentric rings. The outer diameter of the container ring in use shall be at least 100 mm larger than the external diameter of the outer coil. The inner diameter of the container shall be at least 40 mm smaller than the inner diameter of the inner coil.

The initial level of the alcohol in the container shall be (30 ± 1) mm which corresponds to a burning time of approximately 20 minutes.

A second source of heat is a vertically placed flat radiant electrical panel, approx. 0,8 m in height and 0,5 m in width, made up of heating resistors totalling 24 kW with an adjustable power source to maintain the panel at 750 °C.

A hemicylindrical metal shield, 0,9 m in diameter and 1,2 m in height, shall be placed opposite the panel.

Note: When testing windings with an outer dimension larger than 500 mm, the shield may be omitted.

ZC.3.4 Quantities to be measured and measuring devices

ZC.3.4.1 Temperatures

The following temperatures shall be measured by means of thermocouples or equivalent devices.

- air inlet
- air outlet
- surface of LV-coil at top (optional)
- surface of HV-coil at top (optional)
- core leg or part simulating it, at bottom and top (optional)
- duct between core and LV-coil in the middle (optional)
- duct between LV- and HV-coil in the middle (optional)

Note: The location of the measuring sensors on the test object is indicated in fig. 2.

ZC.3.4.2 Other quantities to be measured

- Transmission of visible light in the measuring section; this measurement shall be carried out along an optical path through the smoke of at least 500 mm.

Note: The measured transmission factor being X and the actual length of the optical path being p (expressed in m), the value of the transmission factor referred to a 1 m path is $\tau = X^{1/p}$.

- Air flow rate in the air inlet
- Gas flow rate in the chimney (optional)

ZC.3.5 Calibration of the test chamber without test object

The chamber shall be calibrated after energizing the radiant panel with 24 kW constant for not less than 40 min. The air-flow-rate shall be adjusted in such a way that in steady state conditions it will be $0,21 \text{ m}^3/\text{s} \pm 30\%$ referred to $20 \text{ }^\circ\text{C}$. When the testing installation is based on natural air-flow the flow-rate may be modified by acting on the throttle valve or equivalent device. In case of testing installations operating with forced air the flow-rate may be adjusted by acting on the fan system.

Note: More adjustments may be needed to obtain the required air-flow-rate in steady-state conditions.

ZC.3.6 Test modality

The test object shall be installed in the test chamber as indicated in fig. 2 respecting the following conditions:

- The distance between the radiant panel and the outer winding surface shall be approx. 175 mm;
- The initial level of alcohol in the container shall be approx. 40 mm under the transformer winding level;

Note: In some cases agreement between purchaser and manufacturer is necessary depending upon the design of the test object.

- The hemicylindrical metal shield shall be opposite to the heating panel and concentric with the test object;
- The temperature in the test chamber and of the test object at the beginning of the test shall be between $15 \text{ }^\circ\text{C}$ and $30 \text{ }^\circ\text{C}$.

The test starts at the moment the alcohol is ignited and the radiant panel (24 kW) switched on. The radiant panel shall be switched off 40 min. later.

The quantities listed in subclauses ZC.3.4.1 and ZC.3.4.2 shall be recorded for at least 60 min. from the beginning of the test, i.e. for the total duration of the test.

The test object shall be weighed before and after the test with an accuracy of $\pm 0,5$ % or better. The material representing the core leg and the coils with insulation parts may be weighed separately.

ZC.3.7 Test report

The test report shall contain the following information:

- 1) Result of the test performed on samples of material (if required by the user).
- 2) Total calculated weight and thermal energy of burnable material, and measured weight of the tested object.
- 3) Transformer surface considered for evaluating the thermal flux during the test shall be calculated as a rectangular box with a distance of 0,3 m from the windings of the complete transformer, neglecting only the bottom of it.
- 4) Result of the test-chamber calibration (air flow-rate, temperature in the measuring sections, adjustment of the throttle valve or gas extraction system, etc.).
- 5) A full description of the method of carrying out the test, including the time periods during which alcohol burns and electrical energy is applied.
- 6) Loss of weight of burnable materials during the test (accuracy of ± 10 %) and calculated heat release (MJ) (if possible).
- 7) Temperatures recorded throughout the test at intervals of 2 min. or less, starting from the beginning of the test (ignition of the alcohol).
- 8) Visible light transmitted in the measuring section continuously recorded throughout the test (in %).
- 9) Inlet air flow rate throughout the test, measured at intervals of 2 min or less in the measuring section (m^3/s), corrected to 20 °C.
- 10) Gas flow rate throughout the test, measured continuously in the measuring section (in m^3/s) (optional)
- 11) Visible fire behaviour of the object under test.