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Bushings for transformers and reactor cable boxes not exceeding 36 kV

ICS 29.080.20; 29.180

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EUROPEAN STANDARD **EN 50336**

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English version

Bushings for transformers and reactor cable boxes not exceeding 36 kV

Traversées pour boîtes à câbles de transformateurs et d'inductances ne dépassant pas 36 kV

Durchführungen für Kabelanschluss-kästen von Transformatoren und Drosselspulen bis 36 kV

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

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CENELEC

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

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Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 36A, Insulated bushings.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50336 on 2001-12-04.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2002-12-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2004-12-01

Contents

1 Scope

This standard is applicable to insulated bushings for use in air insulated, shroud insulated and fully insulated cable boxes for liquid filled transformers and reactors for rated voltages up to 36 kV, and rated currents up to 4 000 A at frequencies from 15 Hz to 60 Hz.

2 Normative references

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies (including amendments).

EN 60137	1996	Insulated bushings for alternating voltages above 1 kV (IEC 60137:1995)
EN 61099	1992	Specification for unused synthetic organic esters for electrical purposes (IEC 61099:1992)
EN 22768-1	1993	General tolerances - Part 1: Tolerances for linear and angular dimensions without individual tolerance indications
HD 329 S1	1977	Tests on hollow insulators for use in electrical equipment (IEC 60233:1974)
HD 428.2.1 S1	1994	Three-phase oil-immersed distribution transformers 50 Hz, from 50 kVA to 2,5 MVA with highest voltage for equipment not exceeding 36 kV - Part 2: Distribution transformers with cable boxes on the high-voltage and/or low-voltage side - Section 1: General requirements
HD 565 S1	1993	Specifications for silicone liquids for electrical purposes (IEC 60836:1988)
IEC 60296	1992	Specification for unused mineral insulating oils for transformers and switchgear

3 Definitions

For the purposes of this standard the following definitions apply:

3.1
air insulated cable box
a metallic cable box designed to protect the ends of the cables and bushings, providing a weatherproof enclosure with a minimum rating of IP54. An air filled cable box within which the cable cores are electrically terminated by stress control appropriate to the cable design and voltage; air being the sole insulation for the terminal connections

3.2
shroud insulated cable box
an air filled cable box as in 3.1 but within which the cable cores are terminated with local insulation enhancement, e.g. phase barrier, bushing protection or taping

3.3
fully insulated cable box
a cable box where those parts of the termination and bushing within the enclosure including live metal parts and cable cores are insulated by liquid or compound suitable for the appropriate system voltage. The box shall be suitably sealed to contain the liquid or compound and allow for their expansion due to temperature changes

3.4
ceramic, glass or analogous inorganic material bushing
bushing in which the major insulation consists of a ceramic, glass or analogous inorganic material

3.5
cast or moulded resin insulated bushing
bushing in which the major insulation consists of a cast or moulded organic material with or without an inorganic filler.

4 Requirements

Bushings covered by this specification are suitable for operation with one end fully immersed in an insulating liquid and the other end either fully immersed in an insulating liquid; or with shrouded insulation in air; or in air but not exposed to external atmospheric conditions.

All other requirements shall be as specified herein.

4.1 Rating

4.1.1 Standard values of rated voltage (U_r)

The value of U_r of a bushing shall be chosen from the standard values of the highest voltage for transformers and reactors U_m given below in kilovolts:

12 - 24 - 36

NOTE 1 For ceramic bushings

where U_m is 1,1 then U_r 12 is to be used
where U_m is 3,6 then U_r 12 is to be used
where U_m is 7,2 then U_r 12 is to be used
where U_m is 17,5 then U_r 24 is to be used.

NOTE 2 For resin insulated bushings the permitted highest rated voltages U_r are

Liquid / air or air / air 1,1
Liquid / liquid 12.

4.1.2 Standard values of rated current (I_r)

The value I_r of a bushing shall be chosen from the standard values given below in amperes:

250 - 400 - 630 - 800 - 1 250 - 1 600 - 2 000 - 2 500 - 3 150 - 4 000

4.2 Compliance

4.2.1 General - Ceramic bushings

Ceramic bushings shall meet the requirements for both type and routine tests laid out in EN 60137 and in addition the following shall also apply:

Bushings shall be capable of sealing a liquid filled chamber. The design of 24 kV and 36 kV bushings shall be such that free entry of liquid is allowed into the space between the conductor and the ceramic. In such instances the sealing integrity of the bushing shall be maintained.

The conductor size, material and nut and thread dimensions of the bushing terminal for the appropriate current rating shall comply with Table 1.

The ceramic insulators used shall be to Figures 1 or 2. The ceramic insulator shall be sound, free from defects, thoroughly vitrified and smoothly glazed. The glaze, which shall not be depended upon for insulation, shall, as far as practicable, cover all surfaces except the flat surfaces of the flange and the ends of the ceramic. The preferred glaze colour is a uniform shade of brown. Other glaze colours are acceptable subject to agreement between purchaser and manufacturer.

Tolerances on dimensions for Figures 1 and 2 are as per HD 329 unless otherwise specified.

The prefered value for the mounting hole is a diameter of (D_2 + 3 mm).

Each ceramic insulator shall be legibly and reasonably permanently marked with the name or trade mark of the manufacturer and the month and year of manufacture. These marks shall be printed, clearly legible after glazing and firing and not appear on the flange faces or end surfaces.

All ceramic insulators shall be subjected to tests in accordance with HD 329.

Bushing clamps shall be in accordance with Figure 3 as appropriate, and be fitted to the transformer side of the bushing.

Bushing terminal arrangements for the cable box side are shown in Figures 5 and 6. Terminal arrangements for the transformer side are shown in Figure 7.

Tolerances on dimensions for Figures 3, 5, 6 & 7 are as per EN 22768-1.

Table 1 - Bushing conductor and nut specifications

Current I_r	Conductor			Brass nuts		
	Diameter	Material	Screw thread & pitch	Across flats	Across corners	Thickness
A	mm		mm	mm	mm	mm
250	12	Brass	12 x 1,75	19	21,90	7
400	16	Brass	16 x 2,0	24	27,70	8
630	20	Brass	20 x 2,0	30	34,60	9
800	24	Copper	24 x 2,0	36	41,60	10
1 250	30	Copper	30 x 2,0	46	53,10	12
1 600	36	Copper	36 x 2,0	55	63,50	14
2 000	42	Copper	42 x 3,0	65	75,10	18
2 500	45	Copper	45 x 3,0	70	80,80	18
3 150	48	Copper	48 x 3,0	75	86,60	18

4.2.2 General – Resin insulated bushings

Resin insulated bushings shall meet the requirements for both Type and Routine tests as laid out in EN 60137 and in addition the following shall also apply:

The dimensions, style and arrangement of resin insulated bushings shall be in accordance with Figure 4, and dimensional tolerances according to EN 22768-1.

The preferred conductor material shall be hard drawn high conductivity copper. Other materials may be used by agreement between purchaser and manufacturer.

Resin insulated bushings shall not be adversely affected by continuous immersion in insulating liquids complying with the requirements of IEC 60296, HD 565 and EN 61099 not exceeding 105 °C neither shall they be affected by insulating compounds having a pouring temperature not exceeding 160 °C.

Each resin insulated bushing shall have both ends of each conductor clean and free from resin for the whole of their length from 3 mm clear of the moulding.

Each resin insulated bushing shall be marked in a legible and reasonably permanent manner with the name or trade mark of the manufacturer, a unique identification code to ensure material traceability and numerals and/or letters to indicate the period of manufacture. These marks shall not appear on the flange faces.

4.2.2.1 Temperature cycle type test

A resin insulated bushing of each design shall be subjected to a temperature cycle test. Each cycle shall comprise three stages:

- 10 °C ;
- 105 °C ;
- ambient temperature.

The duration of each stage shall be between 20 min and 30 min. The cycle shall be repeated ten times consecutively. On completion the bushing shall not exhibit signs of cracking and shall withstand the liquid leakage, air leakage and over voltage tests detailed below.

4.2.2.2 Liquid leakage sample test

Each resin insulated bushing selected for sample testing shall be subjected to a liquid leakage test for 6 hours. The liquid shall comply with the requirements of IEC 60296, HD 565 and EN 61099 and shall be maintained at 75 °C with an applied pressure of (1 ± 0,1) bar. The pressure shall be applied to the transformer side of the bushing with the other end exposed to atmosphere. At the conclusion of this test, no leakage or liquid ingress into normally liquid free spaces shall have occurred.

This sample test shall be carried out on at least one assembly from each batch or 2 % of all units manufactured in each batch, whichever is greater.

4.2.2.3 Air leakage routine test

Each resin insulated bushing shall be subjected to an air leakage test for 15 min at a pressure of (1,5 ± 0,1) bar on the transformer side of the bushing with the other side exposed to atmosphere. At the conclusion of this test no leakage of air shall have occurred.

4.2.2.4 Over voltage routine test

Each resin insulated bushing shall withstand a dry power frequency withstand voltage test of 28 kV for 1 min between adjacent conductors and between conductors and earth.

4.2.2.5 Routine partial discharge test

If the resin insulated bushing is to be used at voltages greater than 1,1 kV then each bushing shall be subjected to a partial discharge test in accordance with EN 60137.