SLOVENSKI STANDARD
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Assesment and representative testing of high-voltage machines

Assessment and representative testing of high-voltage machines

Auswahl und repräsentative Prüfung von Hochspannungsmaschinen

Ta slovenski standard je istoveten z: **ENV 50269:1997**

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29.020	Elektrotehnika na splošno	Electrical engineering in general

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English version

Assessment and representation testing of high-voltage machines

This European Prestandard (ENV) was approved by CENELEC on 1996-11-05 as a prospective standard for provisional application. The period of validity of this ENV is limited initially to three years. After two years the members of CENELEC will be requested to submit their comments, particularly on the question whether the ENV can be converted into a European Standard (EN).

CENELEC members are required to announce the existence of this ENV in the same way as for an EN and to make the ENV available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the ENV) until the final decision about the possible conversion of the ENV into an EN is reached.

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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 Prestandard was prepared by Technical Committee CENELEC TC 31, Electrical apparatus for explosive atmospheres: General requirements, Working Group 31-013.

The text of the draft was submitted to voting during the meeting of Technical Committee CENELEC TC 31 held on 5 - 7 November 1996, and was approved by CENELEC as ENV 50269 on 1996-11-05

The following date was fixed:

- latest date by which the existence of the ENV has to be announced at national level (doa) 1997-01-01

Introduction

This prestandard has been prepared to establish additional provisional requirements which are urgently needed for high voltage machines.

Different clauses of this pre-standard apply to different types of protection, maintenance or installation requirements.

At the time of conversion of this ENV into an EN, the contents of this document will be split into parts which will be incorporated into the relevant standards.

1. Scope

This ENV specifies additional assessment and representative testing of certain large electrical machines. It applies to machines having a rated voltage greater than 1kV and, in exceptional circumstances, some of the requirements may be applicable to other large machines.

It is intended to be used in conjunction with the relevant standards (EN50014, EN 50016, EN50019 series and prEN50021 when published) and represents the current developed view of a practical way to assess the risks of ignition from the phenomena, including describing methods for system or representative sample tests, where appropriate.

Clauses 4 and 7 apply to Exp, Exe and Exn machines whereas clauses 5 and 6 apply to Exe and Exn machines only.

2. Normative References

EN50014	Electrical Apparatus for Potentially Explosive Atmospheres. General Requirements
EN50016	Electrical Apparatus for Potentially Explosive Atmospheres. Pressurized Apparatus 'p'
EN50019	Electrical Apparatus for Potentially Explosive Atmospheres. Increased Safety 'e'
prEN50021	Electrical Apparatus for Potentially Explosive Atmospheres. Apparatus type of Protection 'n'

3. General

3.1 Certain phenomena described here relate to starting conditions. These shall always be taken into account for Exe machines and shall be taken into account for Exn machines unless specified otherwise.

3.2 Where testing in an explosive gas mixture is required, the mixture shall comprise 22% $\pm$ 5% hydrogen in air, mixed as evenly as possible. Immediately before the test it shall be verified that the mixture is within the specified range.

3.3 All tests or assessments shall be carried out on machines, components or test models in the 'as new' condition.

4. Bonding of Machine Enclosures

4.1 Bonds shall be fitted across enclosure joints where appropriate. Their efficacy shall be assessed by inspection. Design requirements shall be specified by the machine manufacturer who shall ensure compliance with the design requirements through a recognised QA system.

4.2 According to the design and rating, the machine manufacturer shall specify the cross-sectional area, position and construction of the bonds.

4.3 The bonds shall be protected against corrosion and loosening in accordance with sub-clause 15.5 of EN 50014: 1992

4.4 Bonds shall be designed, selected and installed such that they will only conduct through their designated connection points. Particular care must be taken with bare flexible conductors in this respect.

4.5 Bonds are not required where insulation ensures that circulating currents cannot flow. However, provision shall be made for adequate earthing of isolated exposed conductive parts. The insulation between such parts shall be capable of withstanding a test of 100V rms for 1 min.

5. Stator winding Insulation System

5.1 The necessity for performing system or type tests shall be determined in accordance with Table 1.

5.2 The tests shall be carried out on one:

complete stator, or
stator with motor enclosure, or
motor, or
a partially wound stator, or
a group of coils.

In all cases, the test model shall be representative of a complete stator with, where appropriate, corona shield, stress grading, packing and bracing, impregnation and conductive parts such as the stator core. All exposed conductive parts shall be earthed.

5.3 Typical stator connection cable arrangements shall be tested either on one complete stator or in a representative model. Particular care shall be taken with the spacing of the cables, both from each other and from nearby conductive parts. All such exposed conductive parts shall be earthed.

5.4 Insulation systems and connection cables shall be tested in an explosive gas mixture complying with 3.2 with a sinusoidal voltage of 1.5 times rated rms line voltage for 3 minutes. The maximum rate of voltage rise shall be 0.5 kV/s. The voltage shall be applied between one phase and earth with the other phases earthed.

No explosion shall occur.

5.5 If starting is considered to be a normal operating condition, insulation systems and connecting cables shall be tested in an explosive gas mixture complying with 3.2 and subjected to 10 voltage impulses of 3 times peak phase voltage with a tolerance of $\pm$ 3%, with a voltage rise time between 0.2 µs and 0.5 µs and with a time to half value which is at least 20 µs but normally not exceeding 30 µs.

The impulses shall be applied phase-to-phase and separately phase-to-earth.

Note: This is a non-standard waveform but it is believed that it is necessary to have a short rise time to initiate discharge with a sufficient length to contain enough energy for ignition. This is based on the results of experiments conducted by PTB.

No explosion shall occur.

6. Cage Rotor Construction

6.1 If starting is considered to be a normal operating condition, the rotor construction shall be assessed for possible air gap sparking. The necessity for performing system or type tests shall be determined in accordance with Table 2.

6.2 Tests shall be carried out using a machine which has a stator and rotor that are representative of a finished machine in terms of the stator core and windings, and the rotor core and cage. This shall include ducts, centring rings, rings under the endrings and balance discs, where appropriate.

6.3 The rotor cage shall be subjected to an ageing process comprising a minimum of 5 locked rotor tests. The maximum temperature of the cage shall cycle between the maximum design temperature (Temperature class for Exe machines) and less than 70°C. The applied voltage shall be not less than 50% of the rated voltage.

6.4 After the ageing process of 6.3, the machine shall be filled with, or immersed in, an explosive gas mixture complying with 3.2. Motors shall be subjected to 10 direct-on-line uncoupled starts or locked rotor tests. These tests shall have a duration of at least 1s.

No explosion shall occur.

6.5 During the tests, the terminal voltage shall not fall below 90% of the rated voltage.

Care shall be taken to ensure that temperatures are kept within the maximum limits by means of restricting the length of time of locked rotor tests and allowing sufficient cooling time between tests.

7. Other methods of Assessment

Other equivalent methods of assessing the means of preventing ignition-capable stator winding discharges or air-gap sparking may be acceptable, subject to agreement between the manufacturer, user and certifying authority as appropriate (for example, a monitoring system).

TABLE 1 - Potential Stator Winding Discharge Risk Assessment Ignition Risk Factors

Characteristic	Value	Factor
Rated voltage:	> 11kV	6
	> 6.6 kV to 11 kV	4
	> 3.3 kV to 6.6 kV	2
	> 1 kV to 3.3 kV	1
Starting Frequency in Service	> 1 / hour	3
	> 1 / day	2
	> 1 / week	1
	≤ 1 / week	0
Time between major overhauls	> 10 Years	3
	> 5 to 10 Years	2
	> 2 to 5 Years	1
	≤ 2 Years	0
Degree of Protection (IP Code)	< IP 44	5
	IP 44 and IP 54	2
	IP 55	1
	> IP 55	0
Environmental Conditions (1)	Very dirty or Wet	4
	Intermediate conditions	By engineering judgement
	Clean	0

(1) Examples:

Very Dirty or Wet : Subject to Deluge Systems or open deck, offshore installations

: Clean Indoor installations

If the total sum of the factor is **greater than 6,** it is recommended that:

a) the machine is type tested (representative sample) according to clause 5, or
b) the machine is protected by a purging and pressuring system in accordance with EN 50016; or
c) other equivalent methods according to clause 7 are used.

This assessment system is based on manufacturers' experience and present knowledge and should be used with engineering judgement as otherwise a deceptive impression of accuracy may arise.