SLOVENSKI STANDARD
oSIST prEN IEC 62271-208:2024

01-julij-2024

Visokonapetostne stikalne in krmilne naprave - 208. del: Metode za kvantifikacijo elektromagnetnih polj v ustaljenem stanju z močjo in frekvenco, ki jih generirajo visokonapetostne VN omrežne stikalne naprave in VN/NN montažne postaje, tako za nazivno napetost nad 1 kV kot do vključno 52 kV

High-voltage switchgear and controlgear - Part 208: Methods to quantify the steady state, power-frequency electromagnetic fields generated by HV switchgear assemblies and HV/LV prefabricated substations, both for rated voltages above 1 kV and up to and including 52 kV

Appareillage à haute tension - Partie 208: Méthodes de quantification des champs électromagnétiques à fréquence industrielle en régime établi générés par les ensembles d'appareillages ht et les postes préfabriqués ht/BT, à la fois pour les tensions assignées supérieures à 1 kv et inférieures ou égales à 52 kv

Ta slovenski standard je istoveten z: **prEN IEC 62271-208:2024**

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IEC SC 17C : ASSEMBLIES	
SECRETARIAT: Germany	SECRETARY: Mr Mark Kuschel
OF INTEREST TO THE FOLLOWING COMMITTEES: TC 17,SC 17A	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: ☒ EMC ☒ ENVIRONMENT ☒ QUALITY ASSURANCE ☒ SAFETY	
☒ SUBMITTED FOR CENELEC PARALLEL VOTING **Attention IEC-CENELEC parallel voting** The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting. The CENELEC members are invited to vote through the CENELEC online voting system.	☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING

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TITLE:

High-voltage switchgear and controlgear - Part 208: Methods to quantify the steady state, power-frequency electromagnetic fields generated by HV switchgear assemblies and HV/LV prefabricated substations, both for rated voltages above 1 kV and up to and including 52 kV

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NOTE FROM TC/SC OFFICERS:

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 208: Methods to quantify the steady state, power-frequency electromagnetic fields generated by HV switchgear assemblies and HV/LV prefabricated substations, both for rated voltages above 1 kV and up to and including 52 kV

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IEC 62271-208 document has been prepared by subcommittee 17C: High-voltage switchgear and controlgear assemblies, of IEC technical committee 17: Switchgear and controlgear.

151 The text of this document is based on the following documents:

Enquiry draft	Report on voting
17C/450/DTR	17C/462/RVC

152 With respect to previous TR, in the current version of this document the Isoline measurement
153 procedure is introduced and compared to the Hot spot one when it is required a measurement
154 for the characterization of a generated electromagnetic field.

155 Full information on the voting for the approval of this document can be found in the report on
156 voting indicated in the above table.

157 This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

158 A list of all the parts in the IEC 62271 series, under the general title *High-voltage switchgear*
159 *and controlgear*, can be found on the IEC website.

160 The committee has decided that the contents of this publication will remain unchanged until
161 the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in
162 the data related to the specific publication. At this date, the publication will be

163 • reconfirmed,
164 • withdrawn,
165 • replaced by a revised edition, or
166 • amended.

167

INTRODUCTION

Manufacturers of electricity supply equipment may be asked to provide information about the electromagnetic field characteristics to enable the user to

- assess the electromagnetic field conditions to assist with planning, installation, operating instructions and service,
- take measures to meet requirements or regulations on electromagnetic fields,
- compare different products as far as their level of electromagnetic fields is concerned.

The purpose of this document is to describe a methodology for the evaluation (measurement or calculation) of generated electromagnetic fields. In particular, if a measurement is required, Hot spot and Isolines procedures are introduced and described.

The electromagnetic field characteristic of the equipment comprises the values of the electric and the magnetic fields around its accessible surfaces.

The electromagnetic field characteristic defined in this document refers to a single product as defined in the scope. In real installations, several field sources can superimpose, so the resulting electromagnetic fields on site may differ significantly from the single product characteristics.

This document does not define a mandatory test for the products mentioned in the scope.

Neither the establishment of limits for the electromagnetic fields generated by equipment, nor the establishment of assessment methods for the human exposure to electromagnetic fields is within the content or intent of this document.

HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 208: Methods to quantify the steady state, power-frequency electromagnetic fields generated by HV switchgear assemblies and HV/LV prefabricated substations, both for rated voltages above 1 kV and up to and including 52 kV

1 Scope

This part of IEC 62271 gives practical guidance for the evaluation and documentation of the external steady state power-frequency electromagnetic fields which are generated by HV switchgear and controlgear assemblies and prefabricated substations. Basic requirements to measure or calculate the electric and magnetic fields are summarised for assemblies covered by IEC 62271-200 and IEC 62271-201, and for prefabricated substations covered by IEC 62271-202.

NOTE 1 The methods described in this document refer to three-phase equipment. However, the methodology can be used correspondingly for any single- or multi-phase equipment covered by this document.

This document applies to equipment rated for voltages up to and including 52 kV and power-frequencies from 15 Hz to 60 Hz. The electromagnetic fields which are generated by harmonics or transients are not considered in this document. However, the methods described are equally applicable to the harmonic fields of the power-frequency.

Detailed generic information on requirements and measurements of low-frequency electromagnetic fields is given in IEC 61786.

This document covers evaluation under factory or laboratory conditions before installation. The electric and the magnetic fields can be evaluated either by measurements or by calculations.

NOTE 2 Where practicable, the methods described in this document can also be used for installations on site.

It is not within the scope of this document to specify limit values of electromagnetic fields or methods for the assessment of human exposure.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic documents - Immunity for industrial environments*

IEC 61786, *Measurement of low-frequency magnetic and electric fields with regard to exposure of human beings – Special requirements for instruments and guidance for measurements*

IEC 62110, *Electric and magnetic field levels generated by AC power systems – Measurement procedures with regard to public exposure*

IEC 62271-200, *High-voltage switchgear and controlgear – Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*

IEC 62271-201, *High-voltage switchgear and controlgear – Part 201: AC solid-insulation-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*

IEC 62271-202, *High-voltage switchgear and controlgear – Part 202: AC prefabricated substations for rated voltages above 1 kV and up to and including 52 kV*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
EMF
abbreviation for the term “electromagnetic field(s)”

3.2
electric field characteristic
values (RMS) and spatial distribution of the electric field strength (E) expressed in kV/m at rated voltage and frequency around all accessible surfaces of the equipment

Note 1 to entry: The electric field characteristic is the resultant of the RMS values of the three orthogonal vector components.

3.3
magnetic field characteristic
values (RMS) and spatial distribution of the magnetic field strength (H) expressed in A/m or the magnetic flux density (B) expressed in µT, at rated continuous current and frequency around all accessible surfaces of the equipment

Note 1 to entry: The magnetic field characteristic is the resultant of the RMS values of the three orthogonal vector components.

Note 2 to entry: The terms “resultant electric field” and “resultant magnetic field” are defined in IEC 61786.

3.4
accessible surfaces
those parts of the walls and roof of prefabricated substations or HV switchgear and controlgear assemblies that can be touched with all covers and doors in closed position in normal service conditions

3.5
reference surface
RS
virtual envelope containing the equipment for evaluation purposes

3.6
measurement surface
MS
virtual envelope defined outside the reference surface at 20 cm distance for measuring hot spots

3.7
hot spot
centre of an area of a local maximum of the electric or the magnetic field at the measurement surface

3.8
EMF characteristic
spatial distribution of the Electric Field characteristic and of the Magnetic Field strength

Note 1 to entry: The spatial distribution is derived from a measurement or calculation grid.

3.9
measurement volume
MV
virtual space in which the electromagnetic background field does not exceed an appropriate level to permit the uninfluenced measurement of the electric and magnetic fields generated by the high-voltage switchgear and controlgear assembly or the prefabricated substations

3.10 measurement plane
horizontal virtual plane on a specific height above floor level on which the measurement points are taken

3.11
isoline
line of constant electric or magnetic field characteristic on a measurement plane

4 Evaluation requirements

4.1 General

The EMF characteristic of HV switchgear and controlgear assemblies or HV/LV prefabricated substations is the measured or calculated electric field strength and magnetic flux density around all accessible surfaces under the conditions for evaluation described below. These conditions represent the service, where the loading of the switchgear and controlgear assemblies and, in a substation, of the power transformer is at defined values.

As the electric and magnetic fields are dependent on the physical arrangement of incoming and outgoing cables and their loadings, these parameters have to be recorded. The presence of other field sources and shielding or other metallic structures shall be recorded.

The recordings shall be carried out in such a way that the loadings, material characteristics, and geometrical configuration (including metric distances) are clearly indicated.

The EMF characteristic shall be evaluated for the conditions that would result in the highest levels of electric and magnetic fields in normal, undisturbed service. These conditions include the highest currents and largest loops realistically possible through the assembly working at maximum capacity. EMF caused by switching operations, including interruption of fault currents, or other transient phenomena is deemed to be incidental and shall not be considered.

Electric field strength and magnetic flux density shall be recorded as the resultant of the RMS values of the three orthogonal vector components.

The evaluation shall be carried out at the rated frequency of the equipment.

However, in the frequency range from 15 Hz up to and including 60 Hz the actual value of frequency does not significantly affect the levels of generated E fields for any given values of voltage. Therefore, evaluation at any frequency up to and including 60 Hz is considered valid.

Similarly, the difference in attenuation of B fields by metallic enclosures at 50 Hz and 60 Hz can be ignored for the purpose of this document. Therefore, evaluation at 50 Hz is considered applicable also for 60 Hz and vice versa.

In the power-frequency range covered by this document the electric and magnetic fields may be treated separately. When selecting the conditions to obtain the highest level of electric and magnetic fields as realistically as possible in undisturbed service, the following subclauses should be considered.

4.2 Methods of evaluation

The EMF characteristic may be evaluated by measurement or by calculation.

4.3 Evaluation of electric fields

4.3.1 HV assemblies

The equipment shall be evaluated at the rated voltage of the HV switchgear and controlgear assemblies.

Only if the evaluation cannot be carried out at rated voltage, the results shall be extrapolated to the rated value. Since the electric field strength is a linear function of the voltage, the field strengths for different high voltages may be extrapolated linearly.

4.3.2 HV/LV prefabricated substations

The equipment shall be evaluated at the rated high voltage of the HV/LV power transformer(s).

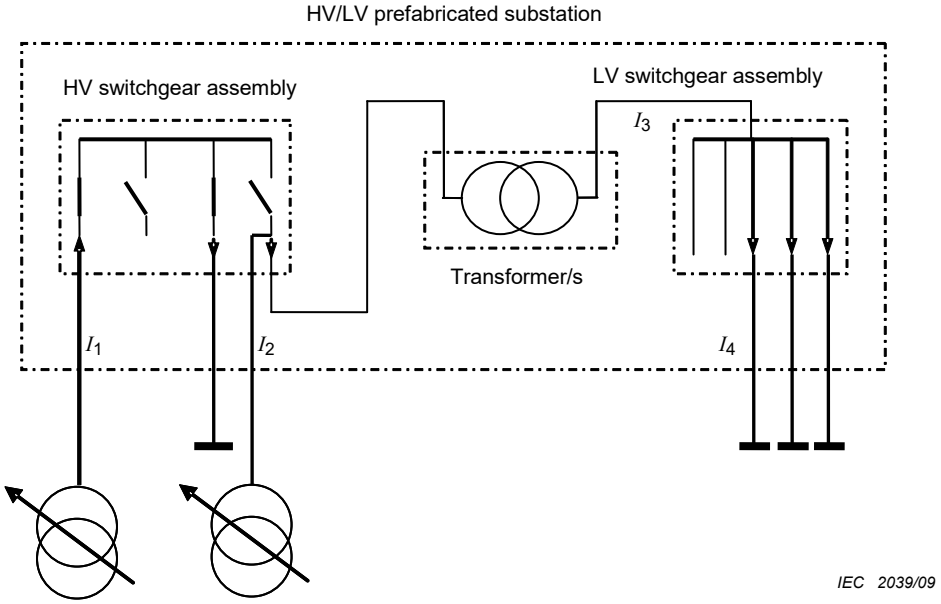
Only if the evaluation cannot be carried out at rated voltage, the results shall be extrapolated to the rated value. Since the electric field strength is a linear function of the voltage, the field strengths for different high voltages may be extrapolated linearly.

4.4 Evaluation of magnetic fields

4.4.1 HV assemblies

To evaluate the HV assembly magnetic field, use the rated continuous current given on the switchgear nameplate. The HV circuit shall be selected to form the widest possible current loop between the incoming and outgoing functional units (panels) of the switchgear and controlgear assemblies to obtain the maximum magnetic field by using the smallest number of circuits, taking into account their rated continuous current. An example is shown in Figure 1.

If the evaluation cannot be carried out at the rated continuous current the results shall be extrapolated to the rated value. Any saturation effect will be less pronounced at lower currents, therefore extrapolation from lower to higher values of current is allowed since it can only result in an overestimate of the B field.



Key

I_1 = HV assembly highest loop current
I_2 = HV/LV loop (HV side) current
I_3 = HV/LV loop (LV side) highest current
I_4 = HV/LV (LV outgoing) highest current

Figure 1 – Example of test circuits configuration to obtain the maximum external magnetic field of a HV assembly and/or a prefabricated substation

4.4.2 HV/LV prefabricated substations

For the HV assembly, 4.4.1 applies.

The LV switchgear and controlgear assembly and the power transformer shall be loaded with the highest continuous current derived from the rated power of the prefabricated substation and the highest LV rated current of the corresponding power transformer for a given LV level. The circuit shall be configured to form the highest concentration of currents to obtain the maximum magnetic field. This can be achieved by using the smallest number of circuits, choosing those located closest to the enclosure of the prefabricated substation and taking into account their rated continuous currents. An example is shown in Figure 1.

NOTE: See 5.5 of IEC 62271-202:2022 for further information about the different rated currents

If the evaluation cannot be carried out at the rated power for a given LV level, the results shall be extrapolated to the rated value. Any saturation effect will be less pronounced at lower currents, therefore extrapolation from lower to higher values of current is allowed since it can only result in an overestimate of the B field.

The extrapolation of magnetic field values is not permitted if the currents on the HV and LV sides of the prefabricated substation vary independently.

5 Measurements

5.1 General

At power-frequency the electric and magnetic field are independent from each other. Hence, magnetic flux density and electric field strength characteristic need not be recorded simultaneously.

The electric field characteristic of the equipment is independent of the load current.

The magnetic field characteristic of the equipment is independent of the voltage.

NOTE General guidance on measurement procedures for electric and magnetic fields can also be found in IEC 62110 and IEC 61786.

5.2 Measuring instruments

Instruments for measuring electric and magnetic fields shall meet the requirements of specification and calibration given by IEC 61786. The calibration report shall be traceable to national or International Standards. These instruments should be used in appropriate conditions, in particular with regard to

- electromagnetic immunity according to IEC 61000-6-2,
- immunity of power-frequency electric field on magnetic field measurement,
- temperature and humidity ranges as recommended by the instrument manufacturer.

A three-axis instrument measures RMS values of resultant field F_r. A single-axis instrument may be used to obtain F_r by measuring F_x, F_y, and F_z, using Equation (1), where F_x, F_y and F_z are RMS values of the orthogonal three-axis components of electric or magnetic field.

$$F_r = \sqrt{F_x^2 + F_y^2 + F_z^2} \quad (1)$$

The use of a three-axis instrument with three concentric sensors is preferred. However, if a single-axis instrument is used, special attention should be paid to the orientation of the sensor along three orthogonal directions. The orientation of the sensor shall be changed without moving the position of its centre.

In the case of non-concentric sensors, the locations and orientations of the sensors that are contained within the housings of field meters shall be clearly indicated on the instrument or in the instruction manual.

During the evaluation of the magnetic field generated by HV assemblies and HV/LV prefabricated substations, the distance between the field source and the measuring instrument is relatively short (in comparison to other AC power equipment like overhead lines). In general, the measurements will be carried out in non-uniform fields. In case of the magnetic field measurement, it is necessary to consider the ratio of distance (d_{sc}) from the field source and sensor radius (a). For measurements with a three-axis instrument, a minimum ratio of 4 is considered suitable.

For example, when using a probe with radius 5 cm the minimum distance to the field source would be 20 cm considering a ratio of 4. More information about this topic can be found in IEC 61786.

5.3 Measurement procedures

If measurement procedures are used, one of the following methods shall be used: a) Hot spot measurement procedure b) Isoline measurement procedure.

5.3.1 General

To consider equipment of all kinds of shape, a virtual envelope containing the equipment is defined as the reference surface (RS); see Figure 2. The purpose of the RS is to integrate irregularities and to eliminate abrupt changes in the measurement surface (MS). The MS is defined outside the RS at 20 cm distance.

NOTE A measurement distance between 0,10 m and 0,20 m corresponds to the distance from the centre of a person's body to an accessible surface when a person is leaning against it. Taking into account the practical sizes of field probes and the necessary clearance to avoid direct contact of the probe with the accessible surface, 0,20 m IS considered the minimum measurement distance. Some national regulations as well as IEC 62110 take this distance as their basis.