

High-voltage switchgear and controlgear - Part 207:
Seismic qualification for gas-insulated switchgear
assemblies, metal enclosed and solid-insulation
enclosed switchgear for rated voltages above 1 kV

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

<p>See Eesti standard EVS-EN IEC 62271-207:2023 sisaldab Euroopa standardi EN IEC 62271-207:2023 ingliskeelset teksti.</p> <p>Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.</p> <p>Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 15.12.2023.</p> <p>Standard on kättesaadav Eesti Standardimis- ja Akrediteerimiskeskusest.</p>	<p>This Estonian standard EVS-EN IEC 62271-207:2023 consists of the English text of the European standard EN IEC 62271-207:2023.</p> <p>This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation and Accreditation.</p> <p>Date of Availability of the European standard is 15.12.2023.</p> <p>The standard is available from the Estonian Centre for Standardisation and Accreditation.</p>
--	---

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

ICS 29.130.10

Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardimis- ja Akrediteerimiskeskusele. Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardimis- ja Akrediteerimiskeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardimis- ja Akrediteerimiskeskusega: Koduleht www.evs.ee; telefon 605 5050; e-post info@evs.ee

The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation and Accreditation. No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation and Accreditation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation and Accreditation: Homepage www.evs.ee; phone +372 605 5050; e-mail info@evs.ee

English Version

High-voltage switchgear and controlgear - Part 207: Seismic qualification for gas-insulated switchgear assemblies, metal enclosed and solid-insulation enclosed switchgear for rated voltages above 1 kV
(IEC 62271-207:2023)

Appareillage à haute tension - Partie 207: Qualification sismique des ensembles d'appareillages à isolation gazeuse et des appareillages sous enveloppe métallique et sous enveloppe isolante solide pour des tensions assignées supérieures à 1 kV
(IEC 62271-207:2023)

Hochspannungs-Schaltgeräte und -Schaltanlagen - Teil 207: Erdbebenqualifikation für gasisolierte Schaltgerätekombinationen, metallgekapselte und isolierstoffgekapselte Schaltanlagen mit Bemessungsspannungen über 1 kV
(IEC 62271-207:2023)

This European Standard was approved by CENELEC on 2023-12-14. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.



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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 17C/902/FDIS, future edition 3 of IEC 62271-207, prepared by SC 17C "Assemblies" of IEC/TC 17 "High-voltage switchgear and controlgear" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 62271-207:2023.

The following dates are fixed:

- latest date by which the document has to be implemented at national (dop) 2024-09-14 level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting with the (dow) 2026-12-14 document have to be withdrawn

This document supersedes EN 62271-207:2012 and all of its amendments and corrigenda (if any).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website.

Endorsement notice

The text of the International Standard IEC 62271-207:2023 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standard indicated:

IEC 62271-207:2012	NOTE	Approved as EN 62271-207:2012 (not modified)
IEC 62155	NOTE	Approved as EN 62155
IEC 62231	NOTE	Approved as EN 62231
IEC 61462	NOTE	Approved as EN IEC 61462

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**High-voltage switchgear and controlgear –
Part 207: Seismic qualification for gas-insulated switchgear assemblies, metal
enclosed and solid-insulation enclosed switchgear for rated voltages above 1 kV**

**Appareillage à haute tension –
Partie 207: Qualification sismique des ensembles d'appareillages à isolation
gazeuse et des appareillages sous enveloppe métallique et sous enveloppe
isolante solide pour des tensions assignées supérieures à 1 kV**



THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2023 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Secretariat
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC -

webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, ...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 300 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 19 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**High-voltage switchgear and controlgear –
Part 207: Seismic qualification for gas-insulated switchgear assemblies, metal
enclosed and solid-insulation enclosed switchgear for rated voltages above 1 kV**

**Appareillage à haute tension –
Partie 207: Qualification sismique des ensembles d'appareillages à isolation
gazeuse et des appareillages sous enveloppe métallique et sous enveloppe
isolante solide pour des tensions assignées supérieures à 1 kV**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 29.130.10

ISBN 978-2-8322-7776-8

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	4
1 Scope.....	6
2 Normative references	6
3 Terms and definitions	7
4 Seismic qualification requirements.....	11
4.1 Seismic qualification objective	11
4.2 Qualification levels.....	11
4.3 Selection of seismic qualification level	14
4.3.1 General	14
4.3.2 Estimation of site-specific seismic hazard level.....	14
4.3.3 Effect of building response and elevation.....	15
4.3.4 Soil-structure interaction.....	15
5 Qualification by test.....	15
5.1 General.....	15
5.2 Mounting.....	16
5.3 Test parameters.....	16
5.3.1 Measurements	16
5.3.2 Frequency range	16
5.3.3 Parameters for resonant frequency search	17
5.3.4 Parameters for time history test (seismic load test).....	17
5.4 Testing procedure.....	17
5.4.1 General	17
5.4.2 Inspection and functional checks	17
5.4.3 Resonant frequency search	18
5.4.4 Time history test (seismic load test).....	18
6 Qualification by combined test and numerical analysis	19
6.1 General.....	19
6.2 Dynamic and functional data	19
6.3 Numerical analysis.....	20
6.3.1 General	20
6.3.2 Analytical earthquake component combination techniques.....	20
6.3.3 Static analysis for rigid equipment	21
6.3.4 Static coefficient analysis	21
6.3.5 Dynamic response spectrum analysis	21
6.3.6 Time history analysis	22
6.4 Analysis by experience or similarity	22
7 Evaluation of the seismic qualification	23
7.1 Combination of loads and stresses.....	23
7.2 Validity criteria for the seismic waveform and the seismic test	24
7.3 Structural and functional evaluation of the test results	24
7.3.1 Common criteria for HV switchgear and MV switchgear	24
7.3.2 HV switchgear	24
7.3.3 MV switchgear.....	25
7.4 Allowable stresses	25
7.5 Criteria of model acceptance.....	25
7.6 Acceptance criteria of the analysis results by similarity	25

8	Documentation	26
8.1	Test report	26
8.2	Analysis report	26
8.3	Analysis report when analysis is performed by similarity	28
Annex A	(normative) Characterisation of the test-set	29
A.1	Low-level excitation	29
A.1.1	General	29
A.1.2	Test method	29
A.1.3	Analysis	29
A.2	Determination of the damping ratio by testing	29
A.2.1	General	29
A.2.2	Determination of the damping ratio by free oscillation test	29
A.2.3	Determination of the damping ratio by measuring the half-power bandwidth	31
A.2.4	Determination of the damping ratio by curve fitting to frequency response methods	31
A.2.5	Determination of the damping ratio by time domain curve fitting	31
Annex B	(informative) Criteria for seismic adequacy of enclosed switchgear and controlgear assemblies	32
B.1	General	32
B.2	Foundations	32
B.3	Methods for anchoring equipment to foundations	32
B.4	Interconnection to adjacent equipment	33
B.5	Use of bracings on switchgear structure	33
Annex C	(informative) Qualification process flowchart	34
Bibliography	35
Figure 1	– Required response spectrum (RRS) for qualification level AG2.5 (ZPA = 0,25 g)	13
Figure 2	– Required response spectrum (RRS) for qualification level AG5 (ZPA = 0,50 g)	13
Figure 3	– Required response spectrum (RRS) for qualification level AG10 (ZPA = 1,00 g)	14
Figure A.1	– Monogram for the determination of equivalent damping ratio	30
Figure C.1	– Qualification process flowchart	34
Table 1	– Seismic qualification levels for switchgear and controlgear assemblies – Horizontal severities	11
Table 2	– Comparison of qualification levels between various standards	12
Table 3	– Summary of maximum stresses, loads etc.	27
Table 4	– Example of summary of maximum stresses, loads etc.	28

INTERNATIONAL ELECTROTECHNICAL COMMISSION

HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –**Part 207: Seismic qualification for gas-insulated switchgear assemblies,
metal-enclosed and solid-insulation enclosed switchgear
for rated voltages above 1 kV**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 62271-207 has been prepared by subcommittee 17C: Assemblies, of IEC technical committee 17: High-voltage switchgear and controlgear. It is an International Standard.

This third edition cancels and replaces the second edition published in 2012. This edition constitutes a technical revision. It also cancels and replaces, through merging, the first edition of IEC TS 62271-210 published in 2013.

This edition includes the following significant technical changes with respect to the previous edition:

- a) modification of the minimum voltage rating from 52 kV to above 1 kV in order to include medium voltage equipment previously being within IEC TS 62271-210 scope;

- b) further harmonisation of qualification procedures with the revised IEEE Std 693-2018 [1]¹, Annex A and Annex P, including
- 1) matching this document's required response spectra with IEEE Std 693-2018 performance level spectra and IEC TS 62271-210 spectra,
 - 2) addition of a step-by-step procedure assisting the user of this document to select an appropriate seismic qualification level combining seismic integrity with cost-effective design,
 - 3) addition of analytical earthquake component combination techniques, and
 - 4) reference to publicly available accelerograms specially developed to match the IEEE Std 693-2018 spectra for testing and analysis purposes, since this document and IEC TS 62271-210 spectra are identical in shape with IEEE Std 693 spectra.
- c) various enhancements of test procedures;
- d) addition of minimum contents for seismic qualification reports;
- e) scope extended to cover DC GIS including and above 100 kV.

The text of this International Standard is based on the following documents:

Draft	Report on voting
17C/902/FDIS	17C/916/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

¹ Numbers in square brackets refer to the Bibliography.

HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 207: Seismic qualification for gas-insulated switchgear assemblies, metal-enclosed and solid-insulation enclosed switchgear for rated voltages above 1 kV

1 Scope

This part of IEC 62271 applies to

- gas-insulated switchgear (GIS) assemblies
 - for alternating current of rated voltages above 52 kV complying with IEC 62271-203, and
 - for direct current of rated voltages including and above 100 kV,
 - for indoor and outdoor installations, including their supporting structures,
- AC metal-enclosed switchgear and controlgear assemblies for rated voltages above 1 kV and up to and including 52 kV complying with IEC 62271-200, ground or floor mounted, intended to be used under seismic conditions, and
- AC solid-insulation enclosed switchgear and controlgear assemblies for rated voltages above 1 kV and up to and including 52 kV complying with IEC 62271-201, ground or floor mounted, intended to be used under seismic conditions.

The seismic qualification of the switchgear and controlgear assemblies takes into account testing of typical switchgear and controlgear assemblies combined with methods of analysis. Mutual interaction between directly mounted auxiliary and control equipment and switchgear assemblies is considered.

Seismic qualification philosophy includes selection of seismic qualification level (Clause 4), methodologies for qualification by testing (Clause 5) and by combined testing and analysis (Clause 6), acceptance criteria (Clause 7) and seismic qualification documentation (Clause 8).

Recommendations on increasing the seismic adequacy of switchgear and controlgear assemblies are provided in Annex B. A flowchart of the seismic qualification process is included in Annex C.

The seismic qualification of switchgear and controlgear assemblies by the manufacturer is performed usually if needed.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60068-2-47, *Environmental testing – Part 2-47: Tests – Mounting of specimens for vibration, impact and similar dynamic tests*

IEC 60068-2-57:2013, *Environmental testing – Part 2-57: Tests – Test Ff: Vibration – Time-history and sine-beat method*

IEC 60068-3-3:2019, *Environmental testing – Part 3-3: Supporting documentation and guidance – Seismic test methods for equipment*

IEC 60099-4:2014, *Surge arresters – Part 4: Metal-oxide surge arresters without gaps for a.c. systems*

IEC 62271-1:2017, *High-voltage switchgear and controlgear – Part 1: Common specifications for alternating current switchgear and controlgear*

IEC 62271-200:2021, *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 62271-201:2014, *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 62271-203:2022, *High-voltage switchgear and controlgear – Part 203: AC gas-insulated metal-enclosed switchgear for rated voltages above 52 kV*

ISO 2041, *Mechanical vibration, shock and condition monitoring – Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60068-3-3, IEC 62271-1, IEC 62271-200, IEC 62271-201, IEC 62271-203, ISO 2041 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

switchgear and controlgear

switching devices and their combination with associated control, measuring, protective and regulating equipment, including assemblies of such devices and equipment with associated interconnections, accessories, enclosures and supporting structures

[SOURCE: IEC 60050-441:1984, 441-11-01]

3.2

metal-enclosed switchgear and controlgear

switchgear and controlgear assemblies with an external metal enclosure intended to be earthed, and complete except for external connections

[SOURCE: IEC 60050-441:1984, 441-12-04, modified – Note deleted.]

3.3

gas-insulated metal-enclosed switchgear

GIS

metal-enclosed switchgear in which the insulation is obtained, at least partly, by an insulating gas or gas mixture other than air at atmospheric pressure

[SOURCE: IEC 60050-441:1984, 441-12-05, modified – Abbreviated term "GIS" added. Words "or gas mixture" added to the definition, and note deleted.]