IEC 62271-207

Edition 3.0 2023-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

IEC 62271-207:2023-11(en-fr)

IEC Secretariat
3, rue de Varembé
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 It also gives information on projects, replaced and withdrawn publications.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.

IEC 62271-207

Edition 3.0 2023-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

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.