



NSAI
Standards

Irish Standard
I.S. EN 60721-2-9:2014

Classification of environmental conditions -
Part 2-9: Environmental conditions appearing
in nature - Measured shock and vibration
data - Storage, transportation and in-use

I.S. EN 60721-2-9:2014

Incorporating amendments/corrigenda/National Annexes issued since publication:

The National Standards Authority of Ireland (NSAI) produces the following categories of formal documents:

I.S. xxx: Irish Standard — national specification based on the consensus of an expert panel and subject to public consultation.

S.R. xxx: Standard Recommendation — recommendation based on the consensus of an expert panel and subject to public consultation.

SWiFT xxx: A rapidly developed recommendatory document based on the consensus of the participants of an NSAI workshop.

This document replaces/revises/consolidates the NSAI adoption of the document(s) indicated on the CEN/CENELEC cover/Foreword and the following National document(s):

NOTE: The date of any NSAI previous adoption may not match the date of its original CEN/CENELEC document.

This document is based on:

EN 60721-2-9:2014

Published:

2014-05-23

This document was published under the authority of the NSAI and comes into effect on:

2014-06-23

ICS number:

NOTE: If blank see CEN/CENELEC cover page

NSAI
1 Swift Square,
Northwood, Santry
Dublin 9

T +353 1 807 3800
F +353 1 807 3838
E standards@nsai.ie
W NSAI.ie

Sales:
T +353 1 857 6730
F +353 1 857 6729
W standards.ie

Údarás um Chaighdeáin Náisiúnta na hÉireann

EUROPEAN STANDARD

EN 60721-2-9

NORME EUROPÉENNE

EUROPÄISCHE NORM

May 2014

ICS 19.040

English Version

**Classification of environmental conditions - Part 2-9:
Environmental conditions appearing in nature - Measured shock
and vibration data - Storage, transportation and in-use
(IEC 60721-2-9:2014)**

Classification des conditions d'environnement - Partie 2-9:
Conditions d'environnement présentes dans la nature -
Données de chocs et de vibrations mesurées - Stockage,
transport et utilisation
(CEI 60721-2-9:2014)

Klassifizierung von Umgebungsbedingungen - Teil 2-9:
Natürliche Einflüsse - Beschreibung von
Umgebungsbedingungen aus gemessenen Stoß- und
Schwingungsdaten - Lagerung, Transport und Im-Betrieb
(IEC 60721-2-9:2014)

This European Standard was approved by CENELEC on 2014-04-10. 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, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Foreword

The text of document 104/630/FDIS, future edition 1 of IEC 60721-2-9, prepared by IEC TC 104 "Environmental conditions, classification and methods of test" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60721-2-9:2014.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2015-01-10
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2017-04-10

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

Endorsement notice

The text of the International Standard IEC 60721-2-9:2014 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 standards indicated:

IEC 60068-2 (Series)	NOTE	Harmonized as EN 60068-2 (Series).
IEC 60721-3 (Series)	NOTE	Harmonized as EN 60721-3 (Series).
IEC 60068-2-6:2007	NOTE	Harmonized as EN 60068-2-6:2008.
IEC 60721-1	NOTE	Harmonized as EN 60721-1.



IEC 60721-2-9

Edition 1.0 2014-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Classification of environmental conditions –
Part 2-9: Environmental conditions appearing in nature – Measured shock and
vibration data – Storage, transportation and in-use**

**Classification des conditions d'environnement –
Partie 2-9: Conditions d'environnement présentes dans la nature – Données de
chocs et de vibrations mesurées – Stockage, transport et utilisation**





THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2014 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 Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
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 corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

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 also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in 14 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

More than 55 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

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: csc@iec.ch.

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.

Catalogue IEC - webstore.iec.ch/catalogue

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

Recherche de publications IEC - www.iec.ch/searchpub

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 aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 14 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

Plus de 55 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

Service Clients - webstore.iec.ch/csc

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



IEC 60721-2-9

Edition 1.0 2014-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Classification of environmental conditions –
Part 2-9: Environmental conditions appearing in nature – Measured shock and
vibration data – Storage, transportation and in-use**

**Classification des conditions d'environnement –
Partie 2-9: Conditions d'environnement présentes dans la nature – Données de
chocs et de vibrations mesurées – Stockage, transport et utilisation**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX

R

ICS 19.040

ISBN 978-2-8322-1446-6

**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.....	3
INTRODUCTION.....	5
1 Scope and object.....	6
2 Normative references	6
3 General	6
3.1 Introductory remarks	6
3.2 Storage	7
3.3 Transportation	7
3.3.1 Road	7
3.3.2 Rail.....	7
3.3.3 Air	8
3.3.4 Sea.....	8
3.4 In-use	8
4 Shock and vibration data	9
5 Description of the methods	9
5.1 General.....	9
5.2 ASD envelope method	9
5.3 Normal tolerance limit method.....	10
5.4 Product axis.....	11
5.4.1 Known axis	11
5.4.2 Unknown axis	12
5.5 Factoring for variables and unknowns	12
Annex A (informative) Worked example	13
A.1 Envelope curve	13
A.2 NTL curve calculation	13
A.3 Processing of the envelope curve and NTL curve.....	13
Annex B (informative) Method to smooth and envelop an environmental description spectrum.....	15
B.1 Original data	15
B.2 Octave averaging.....	15
B.3 Averaging method.....	15
B.4 Standard slope curves	16
B.5 Comparison of envelope and NTL curves.....	17
Bibliography.....	19
Figure A.1 – Comparison of curves 1 to 5 and the envelope curve 7 and 95/50 NTL curve 6	14
Figure B.1 – 95/50 NTL envelope of data.....	15
Figure B.2 – 95/50 NTL envelope of data.....	16
Figure B.3 – 1/3 octave averaged with standard slopes	17
Figure B.4 – Comparison of curves with increasing normal tolerance factors C	18
Table 1 – Normal tolerance factors, C.....	11
Table A.1 – Example of five hypothetical curves for random vibration	13
Table A.2 – Calculation for the five hypothetical curves	14

INTERNATIONAL ELECTROTECHNICAL COMMISSION

CLASSIFICATION OF ENVIRONMENTAL CONDITIONS –

Part 2-9: Environmental conditions appearing in nature – Measured shock and vibration data – Storage, transportation and in-use

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

International Standard IEC 60721-2-9 has been prepared by IEC technical committee 104: Classification of environmental conditions.

The text of this standard is based on the following documents:

FDIS	Report on voting
104/630/FDIS	104/632/RVD

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

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

A list of all parts in the IEC 60721 series, published under the general title *Classification of environmental conditions*, can be found on the IEC website.

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

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

IMPORTANT – The 'colour inside' logo on the cover page of this publication 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.

INTRODUCTION

This part of IEC 60721 is intended as part of the strategy for defining an environmental description from measured data acquired at multiple locations whilst a product is either in storage, being transported or in-use at weather or non-weather protected locations. This measured data is normally in the form of acceleration versus time records. This, in turn, will then allow appropriate severities to be chosen from the IEC 60068-2 series [1] ¹ of shock and vibration test methods. Environmental levels given in IEC 60721-3 [2] should then be applied, having been updated based upon the strategy described in this standard.

More detailed information may be obtained from specialist documentation, some of which is given in the bibliography.

¹ Numbers in square brackets refer to the Bibliography.

CLASSIFICATION OF ENVIRONMENTAL CONDITIONS –

Part 2-9: Environmental conditions appearing in nature – Measured shock and vibration data – Storage, transportation and in-use

1 Scope and object

This part of IEC 60721 is intended to be used to define the strategy for arriving at an environmental description from measured data when related to a product's life cycle.

Its object is to define fundamental properties and quantities for characterization of storage, transportation and in-use shock and vibration data as background material for the severities to which products are liable to be exposed during those phases of their lifecycle.

2 Normative references

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

None.

3 General

3.1 Introductory remarks

Shock and vibrations measured in storage, transportation platforms and in-use locations can vary considerably from a basic sinusoidal character to pure random, which itself may or may not be normally distributed. If it is the latter, it can be reasonably assumed that the process is a sum of normally distributed random waves of differing amplitudes mixed in a complex manner.

Rarely can a real world environment be classified purely as a sinusoidal vibration and is normally associated with a discrete excitation mechanism such as rotating machinery, aero engines, propellers and is normally mixed with an associated random vibration process. It is then necessary for the specification writer to decide whether to conduct a random vibration test only or to perform one of the mixed mode tests.

Associated with the vibration environment for each life-cycle stage is, potentially, a shock environment which may produce much higher acceleration levels in certain circumstances. Generally speaking, the frequency content for these shocks is contained within the 0 Hz to 200 Hz bandwidth for, say, transportation, assuming that the packaged product is firmly secured to the transport platform base and is not therefore 'bouncing around'. However, much higher frequencies, maybe in the kHz range, may be present in the in-use stage, again dependent upon the real world scenario.

The process described below is for a random vibration environment, since it is probably the most common form of test conducted. Any statement made therefore about the random process should be interpreted as applying to the alternative process. However, it can equally be applied to the shock environment by calculating the shock response spectrum and conducting the same process on this spectrum as for an acceleration spectral density (ASD)

This is a free preview. Purchase the entire publication at the link below:

[Product Page](#)

-
- [Looking for additional Standards? Visit Intertek Inform Infostore](#)
 - [Learn about LexConnect, All Jurisdictions, Standards referenced in Australian legislation](#)
-