

INTERNATIONAL STANDARD

NORME INTERNATIONALE

GROUP SAFETY PUBLICATION
PUBLICATION GROUPEE DE SÉCURITÉ

**Tests on electric and optical fibre cables under fire conditions –
Part 3-22: Test for vertical flame spread of vertically-mounted bunched wires or
cables – Category A**

**Essais des câbles électriques et des câbles à fibres optiques soumis au feu –
Partie 3-22: Essai de propagation verticale de la flamme des fils ou câbles
montés en nappes en position verticale – Catégorie A**

<https://standards.iteh.ai/>



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2009 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 la CEI ou du Comité national de la CEI du pays du demandeur.

Si vous avez des questions sur le copyright de la CEI ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de la CEI de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: 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.

- Catalogue of IEC publications: www.iec.ch/searchpub

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 It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

- Electropedia: www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: csc@iec.ch

Tel.: +41 22 919 02 11

Fax: +41 22 919 03 00

A propos de la CEI

La Commission Electrotechnique internationale (CEI) 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 CEI

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

- Catalogue des publications de la CEI: www.iec.ch/searchpub/cur_fut-f.htm

Le Catalogue en-ligne de la CEI vous permet d'effectuer des recherches en utilisant différents critères (numéro de référence, texte, comité d'études,...). Il donne aussi des informations sur les projets et les publications retirées ou remplacées.

- Just Published CEI: www.iec.ch/online_news/justpub

Restez informé sur les nouvelles publications de la CEI. Just Published détaille deux fois par mois les nouvelles publications parues. Disponible en-ligne et aussi par email.

- Electropedia: www.electropedia.org

Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International en ligne.

- Service Clients: www.iec.ch/webstore/custserv/custserv_entry-f.htm

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions, visitez le FAQ du Service clients ou contactez-nous:

Email: csc@iec.ch

Tél.: +41 22 919 02 11

Fax: +41 22 919 03 00

INTERNATIONAL STANDARD

NORME INTERNATIONALE

GROUP SAFETY PUBLICATION
PUBLICATION GROUPEE DE SÉCURITÉ

**Tests on electric and optical fibre cables under fire conditions –
Part 3-22: Test for vertical flame spread of vertically-mounted bunched wires or
cables – Category A**

**Essais des câbles électriques et des câbles à fibres optiques soumis au feu –
Partie 3-22: Essai de propagation verticale de la flamme des fils ou câbles
montés en nappes en position verticale – Catégorie A**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

CONTENTS

CONTENTS	2
FOREWORD.....	3
1 Scope	6
2 Normative references.....	6
3 Definitions	7
4 Test apparatus	7
4.1 General	7
4.2 Ignition source.....	7
5 Test procedure	7
5.1 Test sample.....	7
5.2 Determination of the number of test pieces	7
5.3 Mounting of the test sample.....	8
5.4 Flame application time.....	9
6 Evaluation of test results.....	9
7 Performance requirements.....	10
8 Retest procedure	10
9 Test report.....	10
Annex A (normative) Guidance on cable selection for type approval testing.....	13
Annex B (informative) Recommended performance requirements	14
Figure 1 – Spaced cables mounted on the front side of the standard ladder	11
Figure 2 – Spaced cables mounted on the front side of the wide ladder.....	11
Figure 3 – Touching cables mounted on front side of the standard ladder (arrays of cables in contact).....	12
Table A.1 – Summary of test conditions.....	13

<https://www.ies-standards.com> <https://www.ies-standards.com/standards/iec-60332-3-22-2000>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**TESTS ON ELECTRIC AND OPTICAL FIBRE CABLES
UNDER FIRE CONDITIONS –****Part 3-22: Test for vertical flame spread of vertically-mounted bunched
wires or cables – Category A**

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 provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 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 60332-3-22 has been prepared by IEC technical committee 20: Electric cables.

It has the status of a group safety publication in accordance with IEC Guide 104.

IEC 60332-3-22 forms one of a series of publications dealing with tests on electric cables under fire conditions; the series supersedes IEC 60332-3 published in 1992. The parts of the series are described in the introduction.

All pre-existing categories of test are retained and updated. A new category (category D) has been added to cater for testing at very low non-metallic volumes.

This consolidated version of IEC 60332-3-22 consists of the first edition (2000) [documents 20/404/FDIS and 20/428/RVD] and its amendment 1 (2008) [documents 20/934/CDV and 20/983A/RVC].

The technical content is therefore identical to the base edition and its amendment and has been prepared for user convenience.

It bears the edition number 1.1.

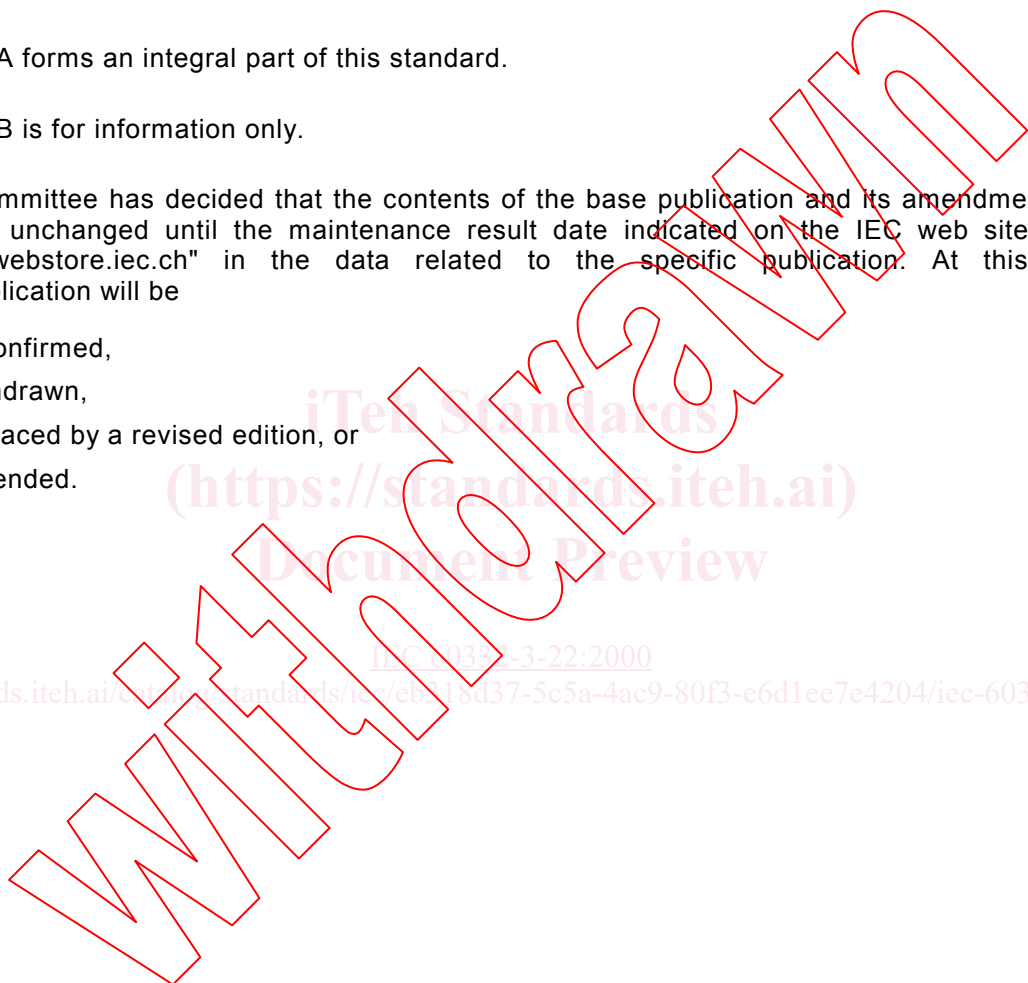
A vertical line in the margin shows where the base publication has been modified by amendment 1.

Annex A forms an integral part of this standard.

Annex B is for information only.

The committee has decided that the contents of the base publication and its amendments will remain unchanged until the maintenance result 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.



ITeH Standards
(<https://standards.iteh.ai>)
Document Preview

[IEC 60332-3-22:2000](https://standards.iteh.ai/standards/iec/eb318d37-5c5a-4ac9-80f3-e6d1ee7e4204/iec-60332-3-22-2000)

<https://standards.iteh.ai/standards/iec/eb318d37-5c5a-4ac9-80f3-e6d1ee7e4204/iec-60332-3-22-2000>

INTRODUCTION

Parts 1 and 2 of IEC 60332 specify methods of test for flame spread characteristics for a single vertical insulated wire or cable. It cannot be assumed that, because a cable or wire meets the requirements of parts 1 and 2, a vertical bunch of similar cables or wires will behave in a similar manner. This is because flame spread along a vertical bunch of cables depends on a number of features, such as

- a) the volume of combustible material exposed to the fire and to any flame which may be produced by the combustion of the cables;
- b) the geometrical configuration of the cables and their relationship to an enclosure;
- c) the temperature at which it is possible to ignite the gases emitted from the cables;
- d) the quantity of combustible gas released from the cables for a given temperature rise;
- e) the volume of air passing through the cable installation;
- f) the construction of the cable, for example armoured or unarmoured, multi- or single-core.

All of the foregoing assume that the cables are able to be ignited when involved in an external fire.

Part 3 of IEC 60332 gives details of a test where a number of cables are bunched together to form various test sample installations. For easier use and differentiation of the various test categories, the parts are designated as follows:

Part 3-10: Apparatus

Part 3-21: Category A F/R

Part 3-22: Category A

Part 3-23: Category B

Part 3-24: Category C

Part 3-25: Category D

Parts from 3-21 onwards define the various categories and the relevant procedures. The categories are distinguished by test duration, the volume of non-metallic material of the test sample and the method of mounting the sample for the test. In all categories, cables having at least one conductor of cross-sectional area greater than 35 mm² are tested in a spaced configuration, whereas cables of conductor cross-sectional area of 35 mm² or smaller and optical cables are tested in a touching configuration.

The categories are not necessarily related to different safety levels in actual cable installations. The actual installed configuration of the cables may be a major determinant in the level of flame spread occurring in an actual fire.

The method of mounting described as category A F/R (part 3-21) is intended for special cable designs used in particular installations.

Categories A, B, C and D (parts 3-22 to 3-25 respectively) are for general use where different non-metallic volumes are applicable.

TESTS ON ELECTRIC AND OPTICAL FIBRE CABLES UNDER FIRE CONDITIONS –

Part 3-22: Test for vertical flame spread of vertically-mounted bunched wires or cables – Category A

1 Scope

The series of International Standards covered by Parts 3-10, 3-21, 3-22, 3-23, 3-24 and 3-25 of IEC 60332 specifies methods of test for the assessment of vertical flame spread of vertically-mounted bunched wires or cables, electrical or optical, under defined conditions.

NOTE For the purpose of this standard the term "electric wire or cable" covers all insulated metallic conductor cables used for the conveyance of energy or signals.

The test is intended for type approval testing. The requirements for the selection of cables for testing are given in annex A. The flame spread is measured as the extent of damage of the cable sample. This procedure may be used to demonstrate the cable's ability to limit flame spread.

This part of IEC 60332 covers category A and relates to cables installed on the test ladder to achieve a nominal total volume of non-metallic material of 7 l/m of test sample. The flame application time is 40 min. The method of mounting uses the front of the ladder, a standard or wide ladder being used for cables having a conductor cross-section greater than 35 mm² according to the number of test pieces required, and a standard ladder for conductor cross-sections 35 mm² and smaller. The category is intended for general use where high volumes of non-metallic material are required to be evaluated.

A recommended performance requirement is given in annex B.

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 60332-3-10, *Tests on electric cables under fire conditions – Part 3-10: Test for vertical flame spread of vertically-mounted bunched wires or cables – Apparatus*

IEC 60695-4, *Fire hazard testing – Part 4: Terminology concerning fire tests*

IEC 60811-1-3, *Insulating and sheathing materials of electric cables – Common test methods Part 1: General application – Section 3: Methods for determining the density – Water absorption tests – Shrinkage test*

IEC Guide 104, *The preparation of safety publications and the use of basic safety publications and group safety publications*

3 Definitions

For the purpose of this part of IEC 60332 the following definitions apply. The definitions are taken from IEC 60695-4.

3.1

ignition source

source of energy that initiates combustion

3.2

char

carbonaceous residue resulting from pyrolysis or incomplete combustion

3.3

flame spread

propagation of a flame front

4 Test apparatus

4.1 General

The apparatus specified in IEC 60332-3-10 shall be used.

4.2 Ignition source

The ignition source shall be one or two ribbon-type propane gas burners as specified in IEC 60332-3-10.

A single burner shall be used with the standard ladder and two burners with the wide ladder.

5 Test procedure

5.1 Test sample

The test sample shall comprise a number of test pieces of cable from the same production length, each having a minimum length of 3,5 m.

The total number of test pieces in the test sample shall be that number required to provide a nominal total volume of non-metallic material of 7 l/m of test sample.

The test sample shall be chosen within the limitations given in annex A.

The test pieces forming the test sample shall be conditioned at a temperature of (20 ± 10) °C for at least 16 h before commencing the test. The test pieces shall be dry.

5.2 Determination of the number of test pieces

In order to calculate the appropriate number of test pieces, it is necessary to determine the volume per metre of non-metallic material of one test piece.

A length of cable which shall be not less than 0,3 m long is carefully cut to ensure that the surfaces are at right angles to the cable axis, thus enabling precise measurements of its length.

The density of each non-metallic component (including cellular material) shall be measured in an appropriate way, for example clause 8 of IEC 60811-1-3, in order to obtain values expressed to the second decimal place.

Each non-metallic material C_i shall be removed from the test piece and weighed. Any non-metallic material making up less than 5 % of the total non-metallic mass of the test piece shall be assumed to have a density of 1,0 kg/dm³.

Where semi-conducting screens cannot be removed from the insulating material, the components may be considered as one for the purpose of measuring their mass and density.

The volume V_i (litres per metre of cable) of each non-metallic material C_i is calculated as follows:

$$V_i = \frac{M_i}{\rho_i \times l}$$

where

M_i is the mass of the component C_i (kg);

ρ_i is the density of the component C_i (kg/dm³);

l is the length of the test piece of cable (m).

The total volume, V , of the non-metallic materials contained in 1 m of cable is equal to the sum of the individual volumes V_1, V_2 , etc.

The closest integer (0,5 and above corresponding to 1) of the number of test pieces to be mounted is obtained by dividing the volume per metre specified in 5.1 by the total volume, V , of non-metallic material per metre of cable.

5.3 Mounting of the test sample

5.3.1 Cables having at least one conductor above 35 mm²

For cables having at least one conductor with a cross-section exceeding 35 mm², each test piece shall be attached individually to each rung of the ladder by means of metal wire (steel or copper). For cables up to and including 50 mm diameter, use wire between 0,5 mm and 1,0 mm in diameter. For cables above 50 mm diameter, use wire between 1,0 mm and 1,5 mm in diameter.

Test pieces shall be attached to the front of the ladder in a single layer with a space between each test piece of 0,5 times the cable diameter but not exceeding 20 mm. The ladder may be either standard or wide depending on whichever is necessary to ensure that there shall be a minimum distance of 50 mm between the edge of the test sample and the inside of the ladder uprights.

The maximum width of the test sample for the standard ladder shall be 300 mm and for the wide ladder 600 mm (see figures 1 and 2).

When mounting the test pieces, the first test piece shall be positioned approximately in the centre of the ladder and further test pieces added on either side so that the whole array of test pieces is approximately centred on the ladder.

5.3.2 Cables having conductors 35 mm² and below and optical cables

For cables having all conductors with cross-sections of 35 mm² or smaller and optical cables, each test piece shall be attached, either individually or as part of an array, to each rung of the ladder by means of metal wire (steel or copper) between 0,5 mm and 1,0 mm in diameter.

Test pieces shall be attached to the front of the standard ladder in touching formation in one or more layers up to a maximum total width of 300 mm. There shall be a minimum distance of 50 mm between the edge of the test sample and the inside of the ladder uprights.

When mounting the test pieces, the first test piece or array of test pieces shall be positioned approximately in the centre of the ladder and further test pieces or arrays added on either side so that the test sample is approximately centred on the ladder.

If a second (or more) layer of test pieces is required after the full width of the ladder has been utilized for the first (or following) layer, then the first test piece or array of test pieces in the second (or following) layer shall be positioned approximately in the centre of the ladder and further test pieces or arrays added on either side so that the second (or following) layer is approximately centred on the ladder.

If a large number of test pieces is required to make up a test sample, the test pieces may be attached to each rung of the ladder in flat arrays of cables of a maximum width of five test pieces using the specified metal wire. For consistency, it is recommended that adjacent arrays of cables are secured together at every rung to ensure that they are in touching formation (see figure 3).

5.4 Flame application time

The test flame shall be applied for 40 min, after which it shall be extinguished. The air flow rate through the test chamber shall be maintained until cable burning or glowing has ceased, or until a maximum duration of 1 h, after which any remaining cable burning or glowing shall be extinguished.

6 Evaluation of test results

After all cable burning or glowing has ceased or been extinguished, the test sample shall be wiped clean.

All soot is to be ignored if, when wiped off, the original surface is undamaged. Softening or any deformation of the non-metallic material is also to be ignored. The flame spread shall be measured as the extent of the damage. It shall be measured in metres to two decimal places from the bottom edge of the burner to the onset of char. The onset of char is determined as follows:

press against the cable surface with a sharp object, for example a knife blade. Where the surface changes from a resilient to a brittle (crumbling) surface, this indicates the onset of char.